

ADVANCE SOCIAL SCIENCE ARCHIVE JOURNAL

Available Online: <https://assajournal.com>

Vol. 04 No. 02. October-December 2025. Page# 4787-4820

Print ISSN: [3006-2497](#) Online ISSN: [3006-2500](#)Platform & Workflow by: [Open Journal Systems](#)**Financial Feasibility of Date-Seed Coffee in Pakistan
From Processing Residue to Premium Beverage****Omama Khan**

Mohammad Ali Jinnah University

omamakhani173@gmail.com**Muskan Naz**

Mohammad Ali Jinnah University

naz853417@gmail.com**Rameen Nazar**

Mohammad Ali Jinnah University

khrameen123@gmail.com**Mirza Muhib Baig**

Mohammad Ali Jinnah University

mrzmuhib@gmail.com**Abstract**

Pakistan ranks among the world's five largest date producers, yet date seeds — which constitute 10–15 per cent of fruit mass — are routinely discarded or diverted to low-value animal feed. Roasted date seeds yield a caffeine-free, polyphenol-rich beverage with a documented consumption history and a favourable toxicological profile, creating the conditions for a circular-economy venture. This study asks two questions. Substantively: is a premium date-seed coffee brand financially feasible in Pakistan? Methodologically: do promoter-prepared feasibility studies produce appraisal metrics that survive independent restatement? We appraise the venture using secondary market data, a published process route and a discounted-cash-flow model over a five-year explicit horizon, discounted at 26 per cent — a rate built up from Pakistani sovereign yields, a country equity premium and an early-stage premium. We first audit an antecedent promoter appraisal reporting an internal rate of return of 378 per cent and a payback period of 0.28 years. The audit identifies four material defects: an arithmetic error of PKR 20,000 in the stated investment total; the same net present value reported in rupees in one section and dollars in another; an investment base excluding equipment, working capital and pre-launch marketing entirely; and a reported triple of metrics that cannot be reconciled to any single constant cash-flow stream at the stated discount rate and horizon. Restating the investment base at PKR 2.10 million — twenty-five times the reported figure — yields a net present value of PKR 5.58 million (USD 20,054), an internal rate of return of 78.6 per cent, a discounted payback of 2.64 years, and a break-even volume of 4,230 units against a Year-1 plan of 5,400, implying a margin of safety of 21.7 per cent. Monte Carlo simulation across 10,000 trials returns a median net present value of PKR 4.48 million alongside a 19.3 per cent probability of value destruction. The venture is feasible, but not on the terms originally claimed, and the divergence between the two appraisals is traceable almost entirely to capitalisation understatement rather than to any disagreement about market demand. We argue that

feasibility studies of early-stage ventures should report a probability of loss alongside point estimates, and that an internal rate of return computed on a materially incomplete investment base is not merely imprecise but structurally uninformative.

Keywords: *agri-food valorisation; circular economy; date seed coffee; feasibility analysis; Monte Carlo simulation; optimism bias; Pakistan; venture appraisal*

JEL classification: *G31; L66; O13; Q13*

1. Introduction

1.1 Background

The global date sector produces on the order of ten million tonnes of fruit annually, and the seed — a hard, lignified kernel making up between a tenth and a sixth of the fruit by weight — is a near-universal by-product of every pitting, pasting and packing operation in the chain (Kiesler et al., 2024). Most of it is discarded, composted, or sold into animal feed at nominal prices. Recent forecasting work using six decades of FAOSTAT data places Pakistan fifth among producing nations, accounting for roughly a tenth of world output, behind Egypt, Saudi Arabia, Algeria and Iran (Sezer & Engindeniz, 2025). On any plausible pitting ratio, this implies a domestic seed stream measured in tens of thousands of tonnes per year that currently earns close to nothing.

What makes that stream commercially interesting rather than merely large is what can be done with it. Roasted and milled date seeds brew into a beverage that resembles coffee in colour, body and preparation, but contains no caffeine whatsoever — a point confirmed repeatedly across analytical studies using HPLC and comparable methods (Kiesler et al., 2024; Ghnimi & Almansoori, 2015). The product is not a novelty. German trade and analytical records describe date-seed coffee from the 1880s onward, its use expanded markedly as a coffee surrogate during the First World War, and traditional preparation persists in the Gulf, where a boiled, spiced form is served as qahwa (Kiesler et al., 2024). Contemporary interest has reframed it: less a wartime substitute than a functional beverage, sold in Europe and North America at premium price points on the strength of its caffeine-free status and phenolic content.

Pakistan's beverage market is meanwhile undergoing a shift that would have seemed implausible two decades ago. Coffee, long marginal in a country where tea consumption is close to universal, is growing at rates between 7 and 11 per cent annually depending on the source and segment definition, concentrated among urban consumers under thirty-five and driven substantially by café culture rather than at-home preparation (StrategyHelix, 2025; 6Wresearch, 2025). A caffeine-free, locally sourced, agriculturally circular beverage aimed at that same demographic sits at the intersection of two independently favourable trends.

1.2 Problem statement

The strategic logic is therefore attractive, and attractive strategic logic is precisely the condition under which financial appraisal is most likely to go wrong. Feasibility studies for early-stage ventures are typically prepared by, or on behalf of, the people proposing the venture. Kahneman and Lovallo (1993) characterised the resulting bias as a preference for the inside view — a forecast constructed from the specifics of the case at hand, which systematically ignores the base rate of outcomes for comparable cases. Lovallo and Kahneman (2003) subsequently documented how this operates in capital allocation, and Flyvbjerg (2008) showed that in large infrastructure the resulting error is not random noise but a directional overstatement of benefit and understatement of cost that persists across decades and jurisdictions.

In venture-scale appraisal the mechanism has a characteristic signature. The error rarely appears as an implausible revenue forecast, which reviewers scrutinise. It appears in the denominator: the investment

base is drawn narrowly, omitting equipment, working capital, and the pre-launch expenditure needed to make the revenue forecast achievable in the first place. Because the internal rate of return and the payback period are both ratios of cash flow to invested capital, an understated denominator inflates both without touching a single revenue assumption. The resulting figures — returns in the hundreds of per cent, paybacks measured in weeks — carry an air of arithmetic authority while resting on a definitional choice that is nowhere stated.

1.3 Research gap

Two literatures bear on this venture and neither closes the question. The food-science literature on date seeds is substantial and technically mature: composition, roasting kinetics, phenolic profiles, sensory acceptance and toxicology are all reasonably well characterised (Besbes et al., 2004; Rahman et al., 2007; Ghnimi & Almansoori, 2015; Kiesler et al., 2024). It establishes that the product can be made safely and acceptably. It says nothing about whether it can be made profitably, in any particular market, at any particular scale. The entrepreneurship and development literature on agri-food valorisation, conversely, argues persuasively for the systemic benefits of converting residues into products (Teigiserova et al., 2020; Kirchherr et al., 2017) but rarely descends to the level of a costed, risk-adjusted appraisal of a specific venture in a specific economy.

The intersection is close to empty. We are not aware of a published, transparently parameterised financial feasibility assessment of a date-seed beverage venture in any South Asian market, and certainly not one that reports a probability distribution over outcomes rather than a point estimate. That absence matters more than it might in a better-studied category, because the product has no domestic price precedent: there is no existing Pakistani date-seed coffee market from which to infer willingness to pay.

1.4 Objectives and research questions

This study pursues four objectives: to characterise the demand and supply conditions bearing on a premium date-seed coffee venture in Pakistan; to audit an existing promoter-prepared appraisal of that venture against internal-consistency criteria; to restate the appraisal on a defensible investment base and risk-adjusted discount rate; and to characterise the residual uncertainty stochastically rather than describing it in prose. Four research questions follow:

- **RQ1.** Do the demand-side and supply-side conditions in Pakistan support a premium, caffeine-free, date-seed-based beverage?
- **RQ2.** Are the investment-appraisal metrics reported in the antecedent promoter study internally consistent and reproducible?
- **RQ3.** Under a restated investment base and a risk-adjusted discount rate, does the venture create value, and how quickly is capital recovered?
- **RQ4.** What is the probability that the venture destroys value, and which parameters drive that probability?

1.5 Contribution and structure

The contribution is threefold. Empirically, we provide the first transparently parameterised financial appraisal of a date-seed beverage venture in Pakistan, with the full assumption schedule disclosed so that any reader may rederive our results or substitute their own priors. Methodologically, we demonstrate a reproducible audit protocol for promoter-prepared feasibility studies — testing whether a reported set of appraisal metrics can be reconciled to any single cash-flow stream — which detects a class of error that inspection of individual assumptions does not. Practically, we show that the venture's viability depends far

more on margin defence than on volume growth, a finding that inverts the strategic emphasis of the antecedent study and carries direct implications for how such a business should be launched.

The remainder of the paper is organised as follows. Section 2 reviews the relevant literatures and develops the conceptual framework. Section 3 sets out the research design, data sources, valuation model and risk-analysis procedures. Section 4 presents the market and industry context. Section 5 reports results, beginning with the audit of the antecedent appraisal and proceeding through the restated model to the stochastic analysis. Section 6 discusses implications, and Section 7 concludes with limitations and a research agenda.

2. Literature Review and Conceptual Framework

2.1 Valorising agri-food processing residues

Circular-economy scholarship has converged on a hierarchy in which retaining material at the highest possible value is preferred to recovery, and recovery to disposal. Kirchherr et al. (2017), synthesising 114 definitions, found the concept coherent in principle but frequently operationalised as little more than recycling, with the higher-value loops — reuse, repurposing, and upcycling into new product categories — comparatively neglected. Geissdoerfer et al. (2017) drew a related distinction between circularity as a resource-management technique and circularity as a business-model innovation, noting that the latter is where economic value is actually captured.

Teigiserova et al. (2020) applied this to food specifically, arguing that surplus, waste and loss occupy different positions in the hierarchy and warrant different interventions: material that has never entered the consumer chain and is uncontaminated — precisely the position of a date seed separated during industrial pitting — is the most straightforward candidate for upcycling into food. The date-specific literature bears this out. Najjar et al. (2020) catalogue a wide set of food applications for date by-products, and Mrabet et al. (2020) document the functional properties of date seed oil. What distinguishes the beverage route from these is that it requires no extraction, no fractionation and no reformulation into a host product: the residue becomes the product almost directly, which keeps both capital intensity and processing loss low.

2.2 Date seeds as a beverage substrate

Date seeds are compositionally dominated by carbohydrate, most of it insoluble fibre — cellulose and hemicellulose — with protein around 5–6 per cent, fat between 5 and 13 per cent depending on cultivar, and ash near 1 per cent (Besbes et al., 2004; Rahman et al., 2007; Kiesler et al., 2024). The fat fraction is high in oleic acid with oxidative stability comparable to olive oil (Mrabet et al., 2020), which matters commercially because it bears on shelf life. Phenolic content is high, and the seed exhibits the greatest antioxidant activity of any part of the date fruit (Kiesler et al., 2024).

Processing parallels coffee closely enough that conventional roasting equipment can be used without modification (Kiesler et al., 2024). Seeds are separated from pulp, washed, dried, roasted, milled and brewed. Roasting conditions materially affect the outcome: the consensus range is 180–220 °C for approximately twenty minutes, with sensory panels favouring the upper end and phenolic retention favouring the lower. Shi et al. (2025), examining eight cultivars across three roasting intensities, found total phenolic content falling monotonically from light roast (4.98–14.09 mg GAE/g) through medium (3.66–8.65) to dark (1.66–6.33), and antioxidant capacity following the same gradient. The commercial implication is a genuine trade-off between the flavour intensity that drives repeat purchase and the functional-ingredient claim that supports premium pricing — a formulation decision, not merely a technical one.

On safety, the evidence is reassuring but incomplete. Kiesler et al. (2024) conducted a full toxicological review and found no adverse effects in subchronic animal studies, acute LD50 values roughly twice those of

Coffea arabica, no cytotoxicity across three cell lines, and acrylamide levels below those of conventional coffee. Genotoxicity testing meeting OECD criteria has not been performed, which they flag as the principal outstanding data requirement. Mycotoxin risk is the operative commercial concern: *Aspergillus* contamination of date fruit is common, seeds are less affected than pulp but not free of it, and in the absence of a seed-specific standard the authors propose applying the ochratoxin A limit set for coffee beans. For a Pakistani venture this converts directly into a quality-assurance obligation at intake.

2.3 Beverage-category transition in tea-dominant markets

Pakistan's coffee growth is best understood as a category transition rather than incremental share-taking. Consumption is concentrated among consumers under thirty-five, weighted towards out-of-home occasions, and organised around café experience as much as around the beverage itself (StrategyHelix, 2025). Sources agree on direction while differing on magnitude — roughly 7 per cent annually on narrower roasted-coffee definitions (6Wresearch, 2025) against 10.8 per cent on broader ones (StrategyHelix, 2025) — a divergence attributable to segment boundaries rather than to genuine disagreement.

Two features of this transition bear directly on a date-seed product. First, the out-of-home skew indicates that coffee is being adopted as a social and identity practice, which favours products with a narratable origin story and disfavors undifferentiated commodities. Second, price sensitivity is acute: rupee depreciation and inflation have compressed real discretionary spending, and premium beverage consumption is materially exposed to it. A product priced at PKR 2,000 per unit is a discretionary purchase for a narrow segment, and the size of that segment — not the size of the coffee market — is the binding demand constraint.

2.4 Financial appraisal of early-stage ventures

Discounted cash flow remains the standard apparatus for investment appraisal, and its properties are not in dispute. Net present value is additive and consistent with value maximisation; the internal rate of return is a summary statistic that coincides with NPV rankings only under restrictive conditions, and is undefined where cash flows do not change sign; payback ignores everything beyond the recovery point (Brealey et al., 2020). For early-stage ventures the difficulty is not the machinery but its inputs — specifically, the discount rate and the definition of the investment base.

On the discount rate, applying a rate appropriate to an established firm to a pre-revenue venture in a frontier market understates risk on at least three dimensions simultaneously: sovereign and currency risk, sector risk, and the idiosyncratic risk of an unproven business with no operating history. Damodaran (2012) sets out the standard build-up — a local risk-free rate, a country-adjusted equity risk premium, a sector beta, and an explicit small-company or early-stage premium — and we adopt it in Section 3.4.

On the investment base, the literature is thinner, largely because the omission is a definitional rather than an estimation error and therefore falls outside the usual sensitivity apparatus. Yet its consequences are severe. Where invested capital is understated by a factor of k , both IRR and payback are distorted by approximately the same factor, while NPV is affected only by the absolute omission. The three metrics consequently drift apart, and their mutual inconsistency becomes a detectable signature — a property we exploit in Section 3.7.

2.5 Optimism bias in promoter-prepared appraisals

Kahneman and Lovallo (1993) distinguished the inside view, which builds a forecast from the details of the specific case, from the outside view, which situates the case within the distribution of comparable cases. Forecasters overwhelmingly adopt the former and consequently produce estimates that are both too

optimistic and too narrow. Lovallo and Kahneman (2003) traced the consequences in corporate investment decisions; Flyvbjerg (2008) proposed reference-class forecasting as a corrective and documented systematic, directional error in large infrastructure appraisal.

The remedy most directly available to feasibility analysis is stochastic simulation. Hertz (1964) proposed exactly this in what remains the foundational statement: rather than computing a return from a single set of bestguess inputs, assign each uncertain input a distribution, sample repeatedly, and report the distribution of outcomes. Savage (2009) later gave the underlying error a memorable name — the *flaw of averages* — namely that a function of expected inputs is not generally the expected value of the function, so that a model built entirely from central estimates does not describe the central outcome. For a venture whose downside includes outright failure, this distinction is not academic: the mean and the median of the outcome distribution can differ substantially, and neither conveys the probability of loss, which is the quantity an investor most needs.

2.6 Conceptual framework

Figure 1 sets out the framework. Three premises establish the venture's rationale: an agri-food residue available at negligible cost, a conversion route that upgrades it into a consumer product, and a demand-side pull from consumers seeking caffeine-free or wellness-positioned beverages. These are screened against six feasibility dimensions — technical, economic, legal, operational, scheduling and social — following the structure common in systems and project appraisal (Whitten & Bentley, 2007). The economic dimension is then developed in depth: a deterministic valuation establishes the central estimate and the break-even volume, and a risk characterisation using one-way sensitivity, discrete scenarios and Monte Carlo simulation establishes the distribution around it. The verdict is expressed with explicit confidence bounds rather than as a binary recommendation.

The framework's distinctive feature is the feedback path from risk characterisation back to the venture premises. Where simulation reveals that a premise is load-bearing — that the venture's viability depends on it within narrow tolerances — that premise requires validation before commitment rather than after. Section 5 identifies which premises meet this description.

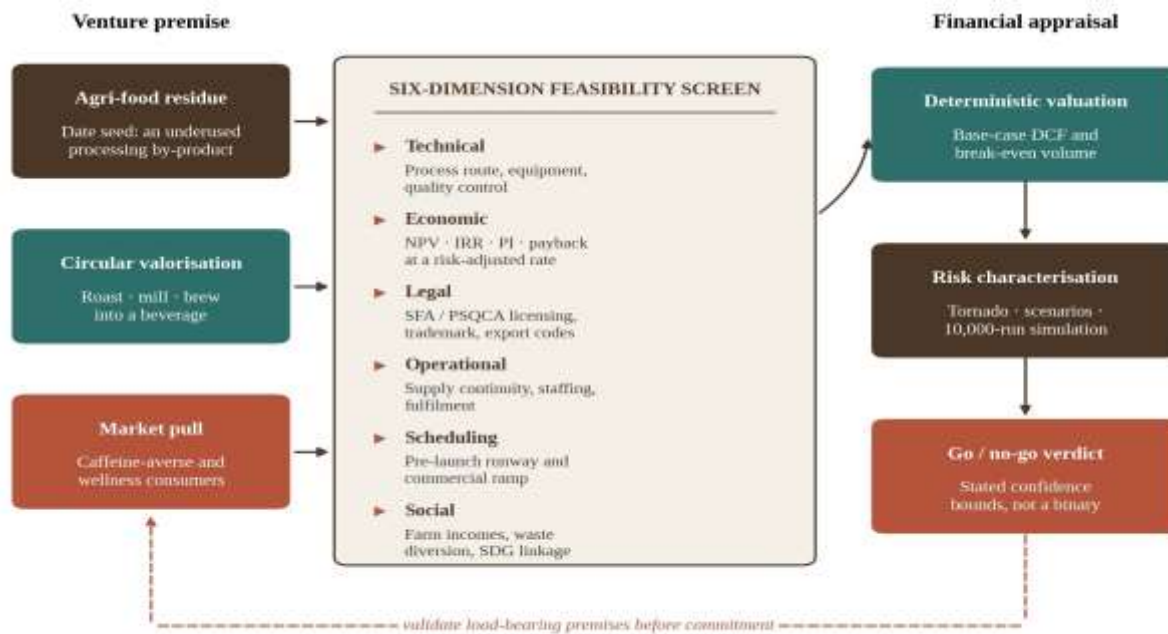


Figure 1. Analytical framework. Venture premises are screened against six feasibility dimensions; the economic dimension is developed through deterministic valuation and stochastic risk characterisation. The feedback path indicates premises that simulation identifies as load-bearing and therefore requiring validation before commitment.

3. Methodology

3.1 Research design

The study uses a quantitative, desk-based research design combining secondary-data market analysis with deterministic and stochastic financial modelling. This design is appropriate because the research questions concern the *ex ante* viability of a venture that does not yet exist: there is no operating history to observe, no customer base to survey about a product they have not encountered, and no comparable domestic firm whose financials could be benchmarked. Under these conditions the object of study is a model, and the relevant standard of rigour is transparency of assumptions and completeness of sensitivity testing rather than sample size.

Three deliberate design choices follow. First, every parameter is disclosed in a single assumption schedule (Table 2) with its basis stated, so that readers may substitute their own priors and re-derive our results. Second, the appraisal horizon is limited to five explicit years with no terminal value in the headline metrics; terminal value is reported separately as a disclosure. This is deliberately conservative — including a perpetuity term would raise the reported NPV substantially — and it avoids resting a feasibility verdict on cash flows beyond any reasonable forecasting horizon for an unproven category. Third, uncertainty is reported as a distribution rather than as prose caveats.

3.2 Data sources

Market and industry parameters are drawn from published secondary sources: coffee market size and growth from commercial market-research publications (StrategyHelix, 2025; 6Wresearch, 2025); date

production and area from FAOSTAT-derived analyses and Trade Development Authority of Pakistan reporting (Sezer & Engindeniz, 2025); regulatory fee schedules from the Sindh Food Authority. Technical process parameters — roasting temperature and duration, seed-to-fruit mass ratio, moisture targets, contamination controls — are taken from the peer-reviewed food-science literature (Ghnimi & Almansoori, 2015; Kiesler et al., 2024; Shi et al., 2025) rather than assumed.

Price and variable cost per unit are inherited from the antecedent promoter study, at PKR 2,000 and PKR 1,046 respectively. We retain these deliberately. Our purpose is to isolate the effect of restating the investment base and discount rate, and importing our own revenue assumptions would confound that comparison. Both parameters are subsequently stress-tested across wide ranges in Sections 5.6 to 5.9, where they emerge as the dominant value drivers.

Investment-base and fixed-cost parameters are constructed by the authors, since these are precisely the items the antecedent study omits. They are built from equipment specifications for small-batch roasting operations, prevailing Karachi commercial rents and salary levels, and the published Sindh Food Authority fee schedule. Table 7 states the basis for each.

3.3 The appraisal model

Free cash flow in each year t is constructed conventionally. Revenue is the product of unit volume and unit price, both escalating annually; variable cost scales with volume at a separately escalating unit rate; marketing is modelled as a constant proportion of revenue, reflecting the continuing consumer-education requirement of a category that does not yet exist; remaining operating costs are fixed in real terms and escalate with inflation. Depreciation is straight-line over five years on the equipment component of the investment base only. Tax is applied at the small-company rate of 20 per cent to positive operating profit, with no loss carry-forward modelled. Net working capital is held at 10 per cent of revenue, so that growth absorbs cash — an effect that matters materially in Year 1 and is invisible in models built on accounting profit.

Formally, free cash flow is given by $FCF_t = (EBITDA_t - D)(1 - \tau) + D - \Delta WC_t$, where $EBITDA_t = Q_t \cdot P_t - Q_t \cdot V_t - F_t - m \cdot Q_t \cdot P_t$, and net present value by the sum of discounted free cash flows less initial investment. Full expressions appear in Appendix A. The internal rate of return is obtained by root-finding on the discount rate; where cash flows do not change sign it is reported as undefined rather than approximated, since an IRR does not exist in that case.

3.4 Discount rate construction

The antecedent study applies an 11 per cent discount rate. This approximates the Pakistani policy rate over the relevant period and would be a defensible cost of debt for an established borrower, but it is not a defensible cost of equity for a pre-revenue venture in a food category with no domestic precedent. We construct the rate by build-up, following Damodaran (2012).

Component	Rate	Basis
Risk-free rate	12.0%	Long-dated Pakistan Investment Bond yield, mid-2025
Equity risk premium (country-adjusted)	8.5%	Mature-market premium plus Pakistan country risk premium
Levered beta, food & beverage	0.95	Sector average, adjusted for an all-equity capital structure

Beta-weighted equity premium	8.1%	$0.95 \times 8.5\%$
Early-stage and illiquidity premium	6.0%	Pre-revenue venture, no operating history, unlisted
Cost of equity	26.1%	Sum of the above
Weighted average cost of capital (applied)	26.0%	All-equity funding assumed; no debt modelled

Table 1. Discount rate build-up. The venture is modelled as entirely equity-funded, so the weighted average cost of capital equals the cost of equity. The rate is varied between 19.5 and 32.5 per cent in sensitivity analysis (Section 5.6) and drawn from a triangular distribution over 20–34 per cent in simulation (Section 5.9).

The resulting 26 per cent is materially higher than the antecedent study's 11 per cent, and the gap accounts for part — though, as Section 5 shows, a distinctly minor part — of the difference between the two appraisals. We stress that a higher discount rate is not a pessimistic assumption but a correctly specified one: it is the return an investor could obtain elsewhere at comparable risk, and a venture that cannot clear it is not creating value however large its accounting profit.

3.5 Assumption schedule

Table 2 states every parameter entering the base-case model. Parameters marked as inherited are taken unchanged from the antecedent study; those marked as constructed are established by the present authors.

Parameter	Value	Source
Retail price, 250 g unit (Year 1)	PKR 2,000	Inherited
Variable cost per unit (Year 1)	PKR 1,046	Inherited
Contribution margin per unit	PKR 954 (47.7%)	Derived
Year-1 unit volume	5,400	Constructed — 450/month across three metropolitan markets
Volume growth, Years 2–5	50% · 38% · 30% · 24%	Constructed — decaying ramp
Price escalation	9.0% p.a.	Constructed — below headline inflation
Variable cost escalation	11.0% p.a.	Constructed — above price, margin compression
Salaries (Year 1)	PKR 1,800,000	Constructed — founder plus two staff
Rent (Year 1)	PKR 600,000	Constructed — shared production unit, Karachi
Utilities (Year 1)	PKR 240,000	Constructed

Administrative and regulatory renewals	PKR 180,000	Constructed — SFA schedule plus general administration
Fixed cost escalation	10.0% p.a.	Constructed
Marketing intensity	12% of revenue	Constructed — category education requirement
Corporate tax rate	20%	Small-company rate, Pakistan
Net working capital	10% of revenue	Constructed
Depreciation	Straight line, 5 years	Equipment component only
Discount rate	26.0%	Table 1
Explicit forecast horizon	5 years	No terminal value in headline metrics
Exchange rate	PKR 278 = USD 1	Mid-2025

Table 2. Base-case assumption schedule. Inherited parameters are retained unchanged from the antecedent promoter study so that the effect of restating the investment base and discount rate can be isolated.

3.6 Risk analysis procedures

Three complementary procedures characterise uncertainty. One-way sensitivity analysis varies each parameter individually across a plausible range while holding all others at base-case values, and reports the resulting NPV span; ranking parameters by span produces the tornado diagram of Section 5.6. This isolates influence but cannot capture interaction, so a two-way analysis follows, computing NPV across a grid of price and volume combinations and locating the zero-NPV frontier.

Scenario analysis then constructs three internally coherent states of the world. Coherence is the operative constraint: a genuine downside is not the base case with one parameter reduced, but a correlated deterioration in which weak volume, price concession, cost inflation and a higher required return occur together, as they would in an actual adverse environment. The pessimistic scenario accordingly assumes a scaled-back fixed-cost base, reflecting the operational response a founder would in fact make.

Finally, Monte Carlo simulation samples 10,000 draws from distributions over six inputs (Table 11), recomputing the full model each time. Triangular distributions are used where a minimum, mode and maximum can be defended but the shape cannot; a normal distribution is used for unit variable cost, where variation reflects the accumulation of many small independent cost components. Volume growth in Years 2 to 5 is scaled proportionally to the sampled Year-1 growth rate, since these are strongly dependent in reality and treating them independently would understate variance. The simulation uses a fixed random seed and the code is available from the authors, so results are exactly reproducible.

3.7 Audit protocol for the antecedent appraisal

The audit applies four tests, each independent of any view about whether the venture's assumptions are reasonable. The arithmetic test re-adds the stated cost line items and compares the result to the stated total. The currency test checks that quantities carrying monetary units are expressed consistently across the document and that stated conversions match a plausible exchange rate. The completeness test asks whether

the investment base contains every category of expenditure logically required to generate the forecast revenue — equipment, inventory, working capital and pre-launch marketing in particular.

The fourth is the reconciliation test, and it is the most informative. Given a reported net present value, internal rate of return and payback period, we ask what constant annual cash flow each metric independently implies, at the discount rate and horizon the study itself states. For a coherent underlying model these three implied cash flows must coincide. Where they diverge materially, the reported metrics cannot all have been generated by the same cash-flow stream, and at least one is in error — a conclusion that follows without needing to know which assumptions were used. To our knowledge this test is not standard in the appraisal literature, and we suggest it deserves to be, because it detects a class of error that assumption-by-assumption review does not.

3.8 Reliability, validity and ethics

Reliability rests on reproducibility: the model is deterministic given its inputs, all inputs are disclosed in Tables 1 and 2, the simulation seed is fixed, and every reported figure derives from a single computational pipeline rather than from separate spreadsheets. Internal validity is supported by the sensitivity apparatus, which establishes how conclusions respond to each assumption and therefore how much weight any single assumption bears.

External validity is more constrained and we state the limits plainly. Price and volume are not observed but assumed, since the product has no domestic market from which they could be estimated; equipment and rent figures are indicative rather than quoted; the model describes a venture at a specific scale in a specific city, and does not generalise to substantially different configurations without re-parameterisation. The study involved no human participants and required no ethical approval. The authors have no financial interest in the venture appraised.

4. Market and Industry Context

4.1 Coffee demand in Pakistan

Pakistan's coffee market is small in absolute terms and growing quickly. Total revenue is estimated at USD 29.26 million for 2025, split between at-home consumption of USD 11.78 million and cafés and food service of USD 17.48 million. Extending the reported 7.2 per cent annual growth rate through 2029 yields the trajectory in Table 3 and Figure 2, reaching USD 38.64 million by the end of the period.

Year	Total revenue (USD m)	At-home (USD m)	Cafés & food service (USD m)	Growth (%)
2025	29.26	11.78	17.48	—
2026 ^p	31.36	12.63	18.73	7.2
2027 ^p	33.62	13.54	20.08	7.2
2028 ^p	36.04	14.52	21.52	7.2
2029 ^p	38.64	15.56	23.07	7.2

Table 3. Pakistan coffee market revenue and projections. Superscript p denotes projected values, computed by compounding the reported 7.2 per cent annual growth rate from the 2025 base. Source: derived from StrategyHelix (2025) and 6Wresearch (2025).

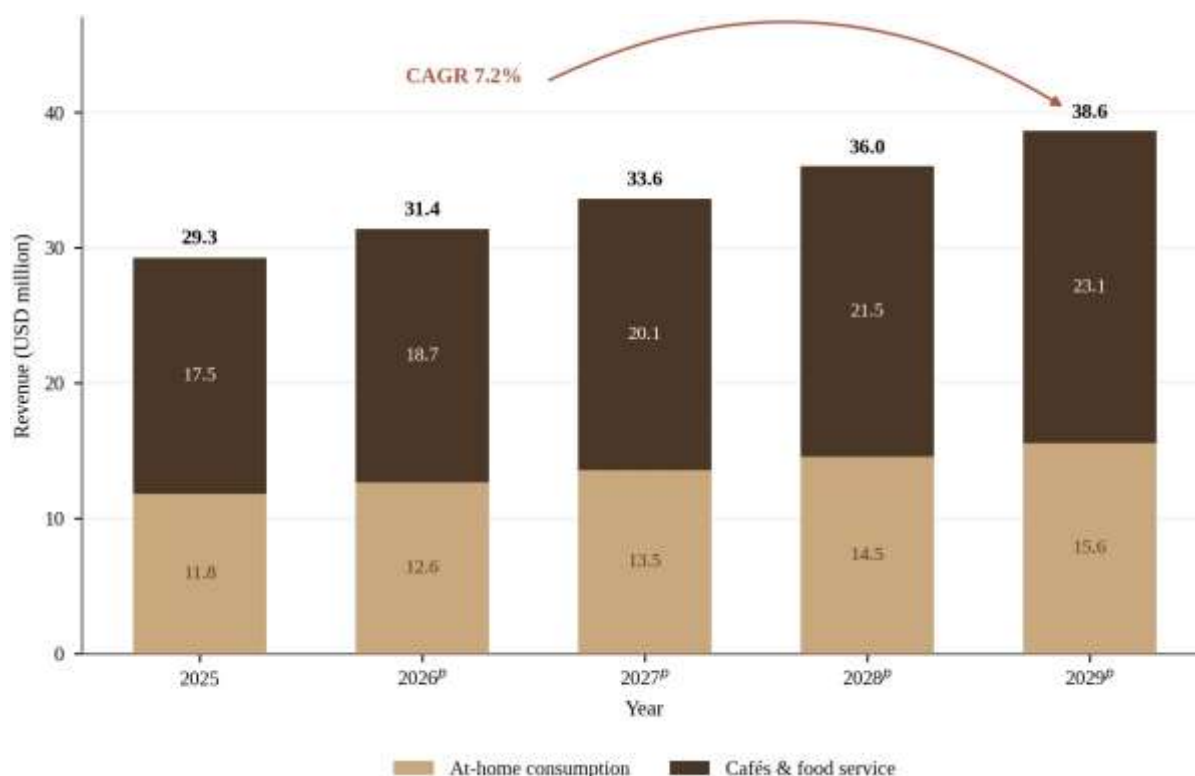


Figure 2. Pakistan coffee market revenue by consumption channel, 2025–2029. The persistent majority share held by cafés and food service is the market’s defining structural feature and indicates that coffee is being adopted as a social practice rather than a household staple.

The channel split is the more informative figure. Out-of-home consumption accounts for roughly sixty per cent of revenue throughout, and the proportion is stable. This has a direct bearing on the venture. A market where the majority of coffee revenue is generated in cafés is one where the beverage functions as social currency, and where trial is mediated by venue rather than by shelf. It follows that a new at-home product entering such a market faces a distribution problem that is not primarily about retail listings: consumers form their preferences elsewhere. The implication — that café placement may be a more efficient route to trial than retail distribution, notwithstanding a direct-to-consumer sales model — is one the antecedent study does not draw.

Estimates of growth vary with segment definition. StrategyHelix (2025) projects a compound annual rate of 10.8 per cent to 2030, implying an increase of USD 73.8 million; 6Wresearch (2025) reports 7.3 per cent for roasted coffee specifically over 2025–2031. The divergence reflects category boundaries, not disagreement about direction. We adopt the more conservative figure throughout, rounded to 7.2 per cent for the projection in Table 3.

4.2 Competitive structure

The market is sharply bifurcated. Nestlé’s Nescafé brand dominates the instant segment with a share variously reported between 55 and 98 per cent depending on measurement basis and date — a range wide enough that the figures should be treated as indicative of dominance rather than as precise estimates. Multinational entrants including Lavazza, Jacobs, Kenco and Moccona occupy the mid-market. Against this, a specialty tier has emerged since roughly 2020: local roasters and third-wave cafés sourcing green beans

from Latin America, roasting in small batches, and competing on provenance, freshness and preparation method rather than on price.

The venture's competitive position depends entirely on which of these it is understood to join. Framed as a coffee substitute, it competes with a near-monopolist on convenience and price and loses. Framed as a specialty functional beverage — caffeine-free, locally sourced, agriculturally circular — it competes in the tier where consumers already accept premium pricing for narrative and provenance, and where no incumbent offers anything comparable. The strategic requirement is therefore that the product be positioned as a category of its own rather than as a cheaper or healthier version of an existing one. This is a marketing constraint with direct financial consequences, since the entire appraisal rests on a PKR 2,000 price point that only the second framing can sustain.

4.3 The date supply base

Pakistan produces between 500,000 and 600,000 tonnes of dates annually across roughly 95,000 to 99,000 hectares. Forecasting work using FAOSTAT data through 2022 places the country fifth globally with approximately 10.4 per cent of world output (Sezer & Engindeniz, 2025). Table 4 and Figure 3 present provincial production over four crop years.

Crop year	Punjab	Sindh	Balochistan	KPK	Total	Area ('000 ha)
2016–17	43.6	202.3	180.8	n.r.	426.7	97.100
2017–18	37.8	309.7	180.8	12.4	540.7	97.800
2018–19	37.7	186.4	181.5	14.6	420.2	98.302
2019–20	37.7	215.8	293.8	17.6	564.9	99.034

Table 4. Pakistan date production by province ('000 tonnes) and total harvested area. "n.r." indicates not reported. Source: FAOSTAT and Trade Development Authority of Pakistan data as compiled in the antecedent study; totals computed by the present authors.

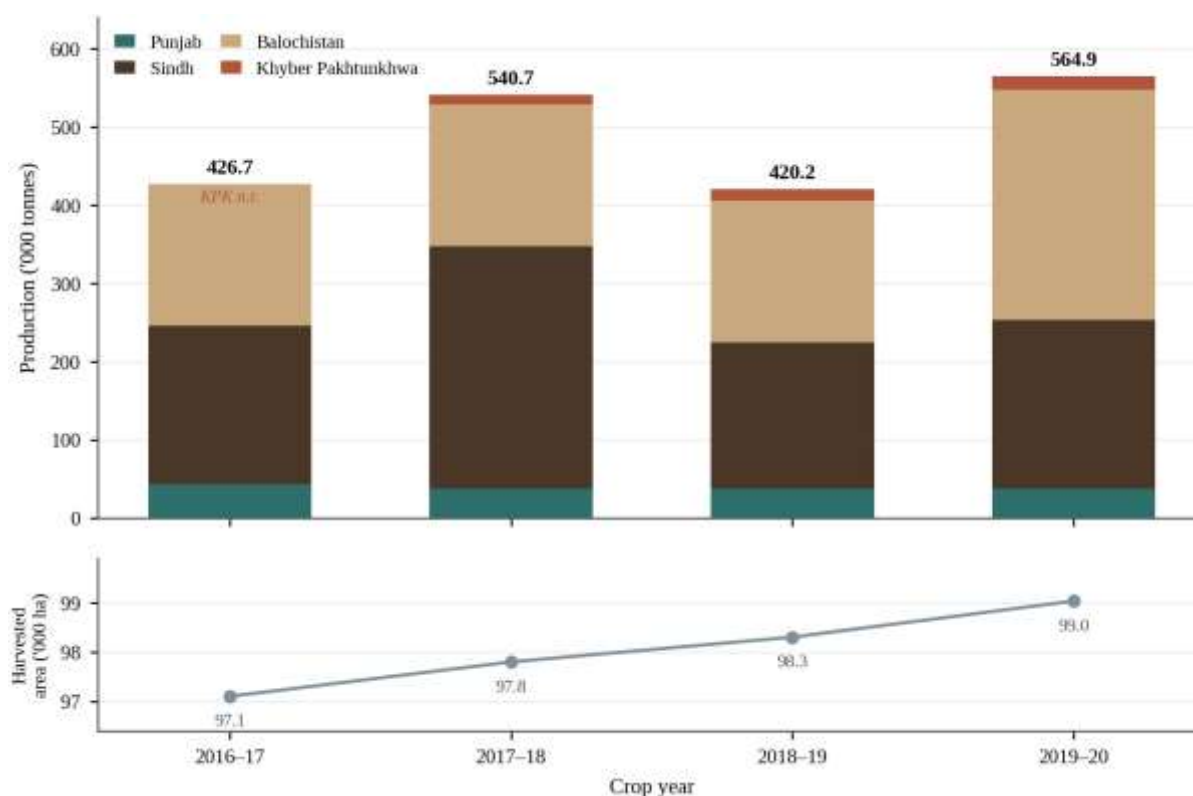


Figure 3. Provincial date production and harvested area, 2016–17 to 2019–20. Total output fluctuates by more than a third between adjacent years (upper panel) while harvested area rises smoothly and by less than two per cent across the whole period (lower panel), indicating that variation is driven by yield rather than by planting decisions. The two series are plotted on separate panels because their scales are unrelated. Khyber Pakhtunkhwa output was not reported for 2016–17.

Two features of these data warrant comment, and both bear on supply risk. First, output swings sharply — from 540.7 thousand tonnes in 2017–18 to 420.2 in 2018–19 and back to 564.9 in 2019–20 — while harvested area rises monotonically and by less than two per cent across the whole period. Variation is therefore a yield phenomenon, driven by weather and by harvest-period rainfall in particular, and is not smoothed by area adjustment. Second, provincial shares are unstable: Sindh leads in three of four years, Balochistan in the fourth by a wide margin. Published claims that Sindh accounts for roughly half of national output and that three Balochistan districts account for seventy per cent cannot both hold, and the antecedent study reproduces both without reconciling them.

For the venture the practical consequence is that single-region sourcing carries real supply risk even though the aggregate resource is abundant. A seed stream is a derivative of a fruit harvest that varies by a third year to year, and a processor dependent on one district inherits that variance directly. Dual-province sourcing — Sindh and Balochistan — is not a hedge against scarcity, which is not the risk, but against the correlated regional yield failures that the data show do occur.

On volume, the arithmetic is comfortable. At the 10–15 per cent seed-to-fruit mass ratio reported by Kiesler et al. (2024), annual national production of roughly 540,000 tonnes implies a seed stream of 54,000 to 81,000 tonnes. The venture's Year-5 requirement, at approximately 18,000 units of 250 g, is on the order of 4.5 tonnes of finished product. Raw material availability is not a constraint at any scale contemplated here, and

will not become one; the constraint is the organised collection of a residue that is currently dispersed across pitting operations with no aggregation infrastructure.

4.4 Process route and quality control

Figure 4 sets out the conversion route, with parameters drawn from the food-science literature rather than assumed. Seeds recovered during pitting are washed to remove adhering pulp, dried to below 8 per cent moisture, roasted between 180 and 220 °C for approximately twenty minutes, milled to a target particle grade, and filled into 250 g containers.

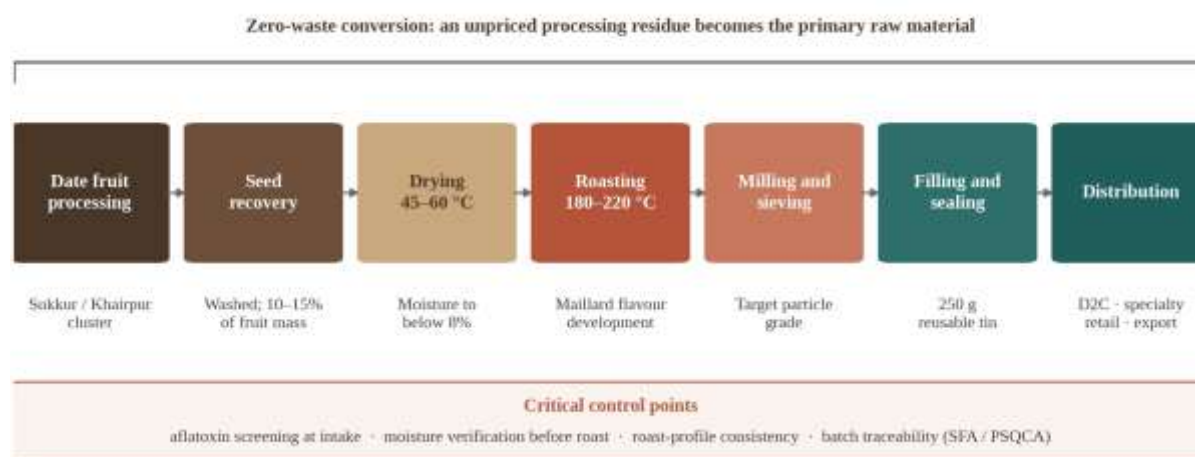


Figure 4. Date-seed valorisation route from processing residue to packaged product, with critical control points. Process parameters follow Ghnmi and Almansoori (2015), Kiesler et al. (2024) and Shi et al. (2025); the route requires no equipment beyond conventional coffee roasting and milling machinery.

Three features of this route matter financially. It requires no specialised equipment: conventional coffee roasters handle date seeds without modification (Kiesler et al., 2024), which holds capital intensity low and is why the equipment line in Table 7 is modest. It involves no extraction or fractionation, so processing loss is limited to moisture and roasting weight loss. And the roast profile is a genuine strategic variable rather than a technical detail, since Shi et al. (2025) show phenolic content falling by roughly two-thirds from light to dark roast while sensory preference moves the other way — meaning the venture must choose between the flavour intensity that drives repeat purchase and the antioxidant claim that supports the price.

The critical control points are aflatoxin and ochratoxin screening at intake, moisture verification before roasting, roast-profile consistency, and batch traceability. The first is the material one. *Aspergillus* contamination of Pakistani dates is well documented, seeds are less affected than pulp but not exempt, and no seed-specific regulatory limit exists — Kiesler et al. (2024) recommend applying the coffee-bean ochratoxin A standard as a reference. Since the venture's entire premium rests on a health positioning, a contamination incident would be existential rather than merely costly, and intake screening should be treated as a fixed cost of doing business rather than a variable to be optimised.

4.5 Regulatory environment

Domestic sale requires registration with the Sindh Food Authority under a fee schedule graduated by facility size and category. Export additionally requires certification from the Pakistan Standards and Quality Control Authority. Trademark registration protects the brand name.

Category	Size band	Base fee	Additional	Total	Floor area
Food manufacturing (C)	Small	20,000	2,600	22,600	Up to 2,000 sq ft
	Medium	30,000	3,900	33,900	2,001–5,000 sq ft
	Large	50,000	6,500	56,500	Over 5,000 sq ft
Food-grade packaging (C-III)	Small	10,000	1,300	11,300	Up to 1,000 sq ft
	Medium	20,000	2,600	22,600	1,001–2,000 sq ft

Table 5. Sindh Food Authority annual licensing fees (PKR). The venture is modelled at the medium manufacturing band, PKR 33,900. Source: Sindh Food Authority fee schedule.

The regulatory burden is modest in absolute terms — under PKR 80,000 annually in licence and renewal fees, within the PKR 180,000 administrative line of Table 2, which also carries general administration — and presents no barrier to entry. It is worth noting, however, that this is exactly the kind of cost that is easy to include and easy to feel diligent about including, which may explain why it appears in the antecedent study's investment schedule while equipment, inventory and working capital do not. Visibility and materiality are not the same thing.

5. Results

5.1 Audit of the antecedent appraisal

The antecedent promoter study reports a total pre-operating investment of PKR 83,900, a net present value of approximately PKR 1,905,569, an internal rate of return of about 378 per cent, and a payback period of approximately 0.28 years, concluding that the project is “extremely low-risk.” Applying the four tests of Section 3.7 produces the findings in Table 6.

Test	Finding	Effect
Arithmetic	The four stated line items — PKR 5,000, 5,000, 33,900 and 20,000 — sum to PKR 63,900, not the stated PKR 83,900.	Either a line item of PKR 20,000 is undisclosed, or the total is overstated by that amount.
Currency	The same quantity, 1,905,569, is reported as PKR in §3.6 and as USD in §4.5. Separately, PKR 83,900 is converted to “approximately USD 839,” implying a rate of PKR 100 = USD 1.	At the prevailing rate of roughly PKR 278 = USD 1, the correct conversion is USD 302. The NPV inconsistency spans a factor of 278.

Completeness	The investment base comprises logo design, packaging design, licensing and lab testing, and website development. It contains no roasting or milling equipment, no filling or sealing capability, no opening inventory, no working capital and no pre-launch marketing.	The base excludes every asset required to manufacture the product whose sale generates the forecast revenue.
Reconciliation	At the stated 11 per cent discount rate over a fiveyear horizon, the reported NPV implies a constant annual cash flow of PKR 538,291; the reported IRR implies PKR 317,269; the reported payback implies PKR 299,643.	The three metrics cannot have been generated by one cash-flow stream. The NPV implies a cash flow 70 per cent above that implied by the IRR.

Table 6. Audit of the antecedent appraisal against the four tests of Section 3.7. Each test is independent of any judgement about whether the study's underlying assumptions are reasonable.

The reconciliation result deserves elaboration because it is the least obvious and the most diagnostic. If a single stream of constant annual cash flows underlies all three reported metrics, then each metric independently determines that cash flow, and the three determinations must agree. They do not: the spread between the highest and lowest implied cash flow is 80 per cent. Extending the horizon to ten years narrows the spread considerably — to PKR 337,815, 317,142 and 299,643 respectively — which suggests the NPV may have been computed over a longer horizon than the five years the study's own framing implies. But the study nowhere states a horizon, and a reader cannot reconstruct the model from what is disclosed. The metrics are, in the strict sense, unreproducible.

We emphasise that these are not judgements about optimism. An analyst may reasonably assume aggressive volume growth or a low discount rate, and a reader may reasonably disagree. Arithmetic, currency consistency and mutual reconcilability are different in kind: they are properties a set of appraisal metrics either has or lacks. This appraisal lacks all three.

5.2 The restated investment base

Table 7 and Figure 5 set out the restated pre-operating investment. The largest single item is roasting and grinding equipment at PKR 850,000, which the antecedent study omits entirely despite the venture being defined by its ability to roast and grind. Opening inventory and working capital at PKR 400,000 and pre-launch consumer education at PKR 250,000 are similarly absent — the latter a striking omission in a study that elsewhere identifies consumer unfamiliarity as the venture's principal risk.

Item	Amount (PKR)	Rationale
Roasting and grinding equipment	850,000	Small-batch roaster and mill; conventional coffee equipment is suitable without modification

Opening inventory and working capital	400,000	Raw material, packaging stock and receivables cover to first cash cycle
Pre-launch market education campaign	250,000	Trial generation in a category with no domestic precedent
Filling, sealing and weighing station	150,000	Packing line for 250 g format
E-commerce platform and digital build	120,000	Direct-to-consumer channel and payment integration
Brand identity, packaging design and artwork	60,000	Design and production artwork
PSQCA certification and trademark registration	45,000	Export readiness and brand protection
SFA licence (medium unit) and laboratory testing	33,900	Table 5
Subtotal	1,908,900	
Contingency at 10%	190,890	Standard allowance for pre-operating cost variance
Total restated investment	2,099,790	USD 7,553 at PKR 278 = USD 1

Table 7. Restated pre-operating investment schedule. Items are ordered by magnitude. The three largest — equipment, working capital and pre-launch marketing, together PKR 1.50 million or 71 per cent of the base — are absent from the antecedent study.

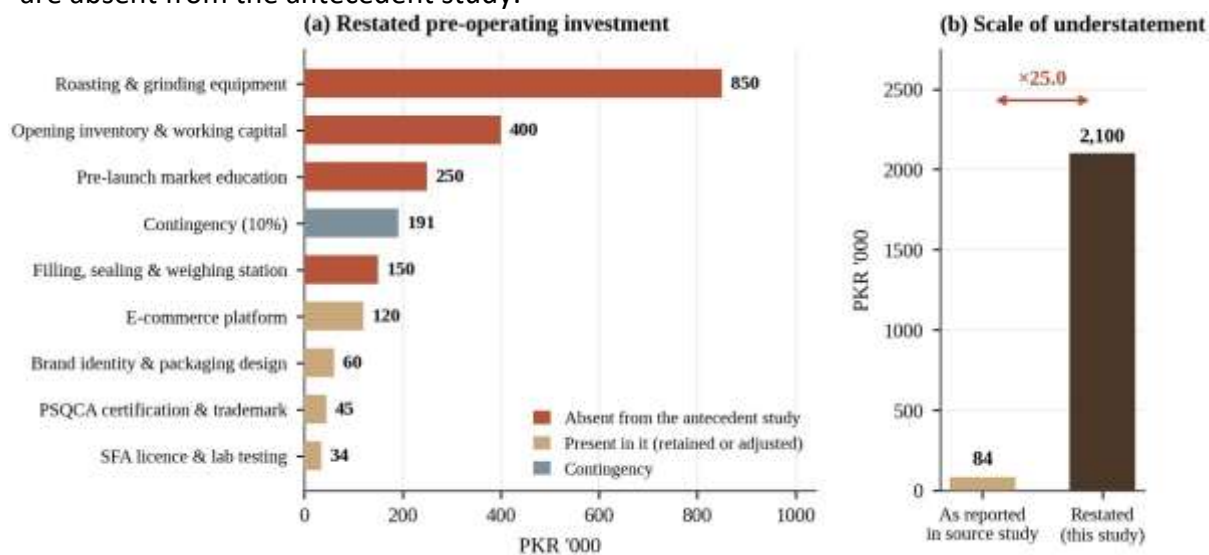


Figure 5. Restated pre-operating investment. Panel (a) shows the composition of the restated base, with items shaded according to whether they appear in the antecedent study; panel (b) compares the total with the antecedent study.

the figure reported there. The restatement is a factor of twenty-five, and is driven almost entirely by categories the antecedent study omits rather than by disagreement about the cost of items it includes.

The restated total of PKR 2,099,790 is twenty-five times the reported figure. We note that this is not a disagreement about prices: we accept the antecedent study's licensing figure unchanged and adjust its design and website estimates only modestly. The gap is almost entirely a matter of categories included versus excluded. Even so, PKR 2.1 million — roughly USD 7,550 — remains a genuinely modest capital requirement for a manufacturing venture, and the finding is emphatically not that the project is unaffordable. It is that a return computed against PKR 83,900 describes a different project from the one the study proposes to operate.

5.3 Unit economics and break-even

At a retail price of PKR 2,000 and a variable cost of PKR 1,046, contribution is PKR 954 per unit, a margin of 47.7 per cent. This is a strong gross structure and it is what makes the venture viable at modest volume. Once marketing at 12 per cent of revenue is deducted, effective contribution falls to PKR 714 per unit, and after allocating Year-1 fixed costs of PKR 3,020,000 across the planned 5,400 units, the operating margin is PKR 155 per unit. Figure 6(a) traces this cascade.

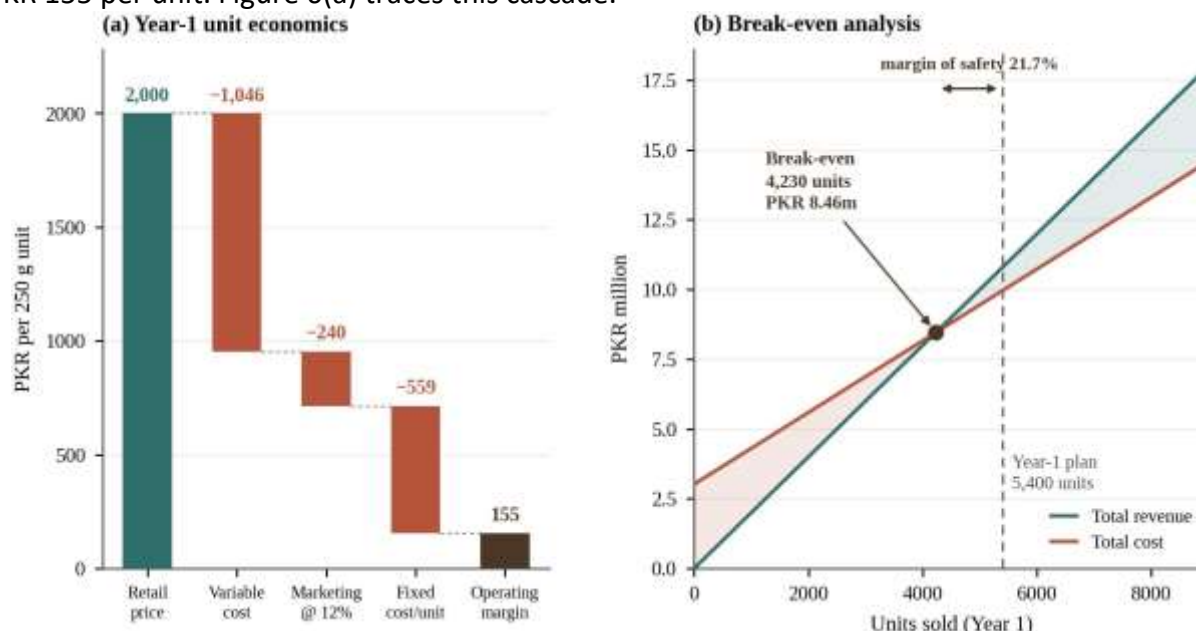


Figure 6. Unit economics and break-even. Panel (a) traces the Year-1 cascade from retail price to operating margin per unit. Panel (b) locates the break-even volume at 4,230 units against a Year-1 plan of 5,400, a margin of safety of 21.7 per cent.

Break-even follows directly: dividing Year-1 fixed costs by effective unit contribution gives 4,230 units, or PKR 8.46 million in revenue. Against a plan of 5,400 units this is a margin of safety of 21.7 per cent — the venture may miss its first-year volume target by a fifth and still cover its costs, but not by a third. Figure 6(b) shows the relationship.

This is the single most important operational finding in the study, and it inverts the antecedent study's characterisation of the venture as low-risk. A margin of safety of 21.7 per cent in the first year of an unproven category is thin. Year-1 volume is not a forecast in the ordinary sense — it is a hypothesis about a product

no Pakistani consumer has encountered, and hypotheses of that kind are routinely wrong by more than a fifth. The venture is not low-risk; it is viable within a band that first-year execution must actually hit.

5.4 Base-case projections

Table 8 presents the five-year projection. Revenue rises from PKR 10.8 million to PKR 50.9 million as volume grows from 5,400 to 18,019 units, with the combined effect of a 9 per cent annual price increase and a decaying volume ramp.

	Year 1	Year 2	Year 3	Year 4	Year 5
Units sold	5,400	8,100	11,178	14,531	18,019
Price per unit (PKR)	2,000	2,180	2,376	2,590	2,823
Revenue	10,800,000	17,658,000	26,561,164	37,637,169	50,870,397
Variable cost	(5,648,400)	(9,404,586)	(14,405,945)	(20,787,778)	(28,612,298)
Gross contribution	5,151,600	8,253,414	12,155,219	16,849,390	22,258,099
Fixed operating cost	(2,820,000)	(3,102,000)	(3,412,200)	(3,753,420)	(4,128,762)
Marketing	(1,296,000)	(2,118,960)	(3,187,340)	(4,516,460)	(6,104,448)
EBITDA	1,035,600	3,032,454	5,555,679	8,579,510	12,024,890
Depreciation	(200,000)	(200,000)	(200,000)	(200,000)	(200,000)
Operating profit	835,600	2,832,454	5,355,679	8,379,510	11,824,890
Tax at 20%	(167,120)	(566,491)	(1,071,136)	(1,675,902)	(2,364,978)
Net operating profit after tax	668,480	2,265,963	4,284,543	6,703,608	9,459,912
Add back depreciation	200,000	200,000	200,000	200,000	200,000
Change in working capital	(1,080,000)	(685,800)	(890,316)	(1,107,601)	(1,323,323)
Free cash flow	(211,520)	1,780,163	3,594,227	5,796,008	8,336,589

Table 8. Five-year projected income statement and free cash flow (PKR). Figures in parentheses are deductions. Free cash flow is negative in Year 1 because working capital absorbs PKR 1.08 million against EBITDA of PKR 1.04 million.

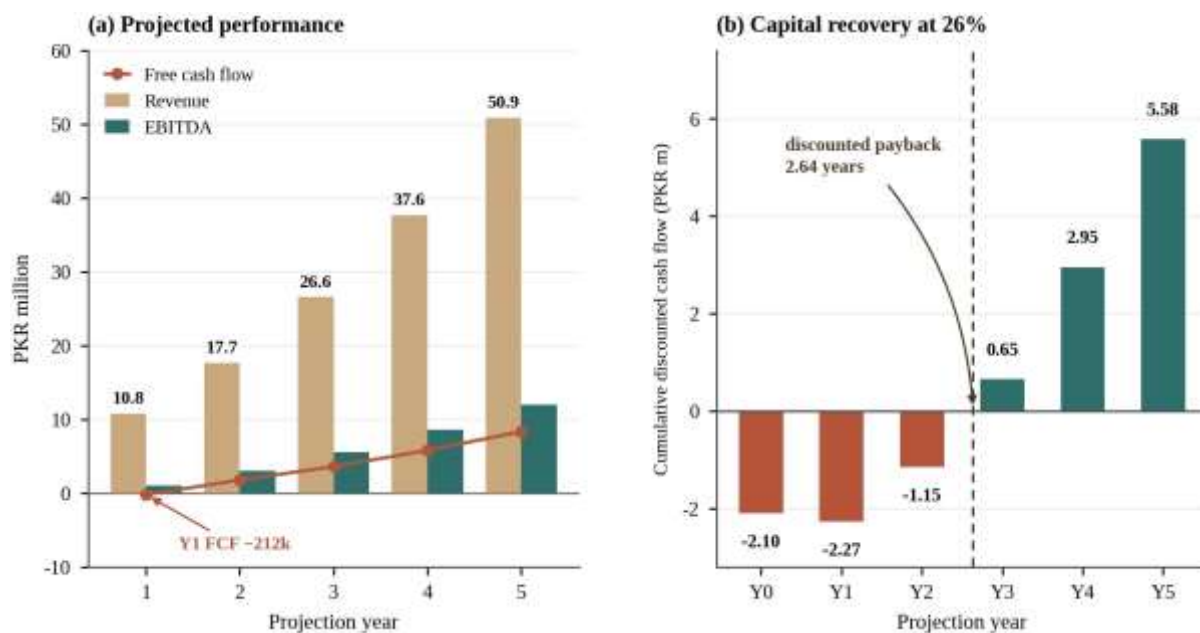


Figure 7. Projected performance and capital recovery. Panel (a) shows revenue, EBITDA and free cash flow across the explicit forecast horizon. Panel (b) shows cumulative discounted cash flow at 26 per cent, with the discounted payback point at 2.64 years.

The Year-1 free cash flow of negative PKR 211,520 deserves attention because it is invisible in any statement of accounting profit. The year is profitable at every line — EBITDA of PKR 1.04 million, operating profit of PKR 836,000, post-tax profit of PKR 668,000 — and yet consumes cash, because working capital absorbs PKR 1.08 million as the business builds inventory and receivables from a standing start. The practical implication is that the PKR 2.1 million investment base is not sufficient on its own: the venture requires a further buffer of roughly PKR 250,000 to survive its first year without additional funding, or an operating discipline that keeps inventory tighter than the model assumes. A founder working from the antecedent study's PKR 83,900 figure would discover this in month four.

5.5 Investment appraisal metrics

Table 9 compares the restated metrics with those reported in the antecedent study.

Metric	As reported	Restated	Basis of difference
Investment base	PKR 83,900	PKR 2,099,790	Equipment, working capital and pre-launch marketing included
Discount rate	11.0%	26.0%	Risk-adjusted build-up (Table 1)
Net present value	PKR/USD 1,905,569	PKR 5,575,014 (USD 20,054)	Restated cash flows, five-year explicit horizon, no terminal value
Internal rate of return	≈378%	78.6%	Computed on the full investment base
Payback period	≈0.28 years	2.64 years (discounted)	Discounted, on full investment base

Profitability index	Not reported	3.66	NPV plus investment, divided by investment
Break-even volume	Not reported	4,230 units	Year-1 fixed cost ÷ effective unit contribution
Probability of negative NPV	Not reported	19.3%	Monte Carlo, 10,000 trials

Table 9. Investment appraisal metrics, as reported and restated. Including a terminal value at 3 per cent perpetual growth would raise the restated NPV to PKR 17.33 million and the IRR to 110.2 per cent; these figures are disclosed for completeness but are excluded from the headline metrics as insufficiently conservative for an unproven category.

The restated venture creates value. A net present value of PKR 5.58 million against an investment of PKR 2.10 million, an IRR of 78.6 per cent against a hurdle of 26 per cent, and a profitability index of 3.66 all point the same way, and the margin over the hurdle rate is wide enough to absorb considerable error. Discounted payback at 2.64 years is unremarkable for a manufacturing venture and bears no resemblance to the fourteen weeks originally claimed.

It is worth being precise about what drives the difference between the two appraisals, because the intuitive answer is wrong. Raising the discount rate from 11 to 26 per cent is the more visible change, but restating the investment base is the more consequential one: it is what moves the IRR from the hundreds of per cent to double digits, and it does so without altering a single revenue assumption. The antecedent study's headline finding was not optimistic about the market. It was arithmetically detached from the project's capital requirement.

5.6 One-way sensitivity

Figure 8 ranks the six principal parameters by the NPV span each generates when varied individually.

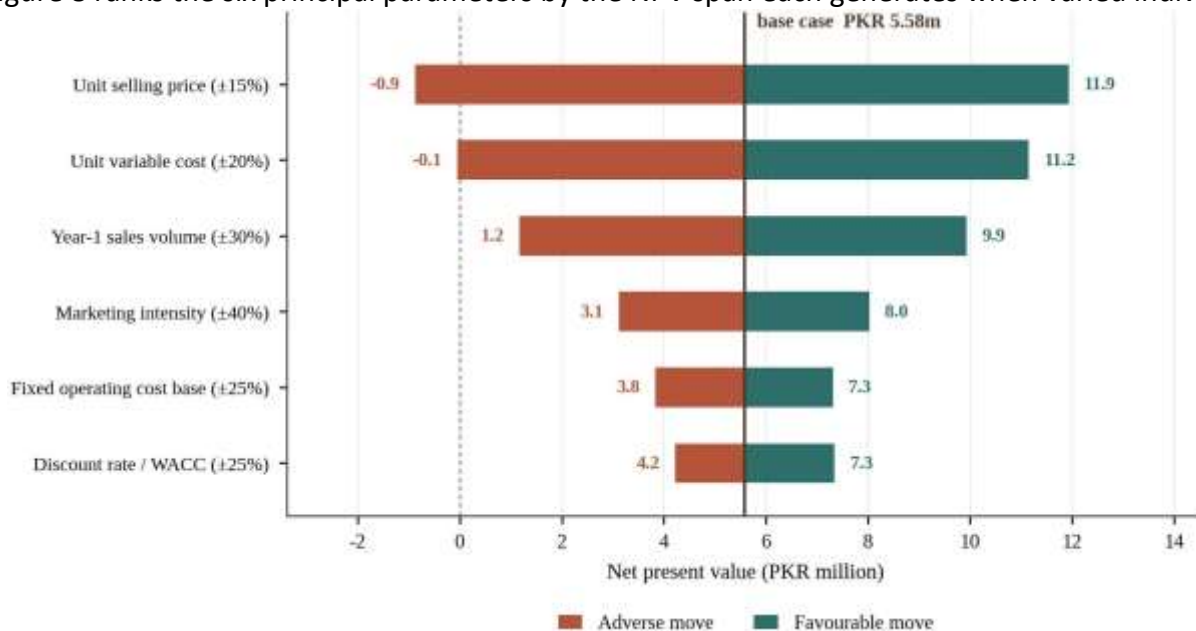


Figure 8. One-way sensitivity of net present value. Bars show the NPV range as each parameter is varied individually across the stated range, holding all others at base-case values. Parameters are ordered by span. Unit selling price dominates, generating a span of PKR 12.8 million across a ± 15 per cent variation — and, critically, a 15 per cent price concession alone drives NPV to negative PKR 0.88 million. Unit variable cost follows closely at PKR 11.2 million across ± 20 per cent, with a 20 per cent cost overrun taking NPV to approximately zero. Year-1 volume ranks third at PKR 8.76 million across ± 30 per cent, despite the wider variation applied. Marketing intensity, the fixed cost base and the discount rate follow at PKR 4.91, 3.47 and 3.12 million respectively.

The ordering is the finding. Price and cost — the two components of unit margin — together account for far more NPV variation than volume does, even though volume is tested across twice the range. A 15 per cent price cut destroys more value than a 30 per cent volume shortfall. That the discount rate ranks last, despite our having raised it by fifteen percentage points relative to the antecedent study, confirms the point made in Section 5.5: the appraisal's conclusions are robust to the choice of hurdle rate and fragile to the choice of price.

5.7 Two-way sensitivity

Because price and volume are the two parameters over which management has most direct influence and which interact most strongly, Figure 9 computes NPV across a grid of both.

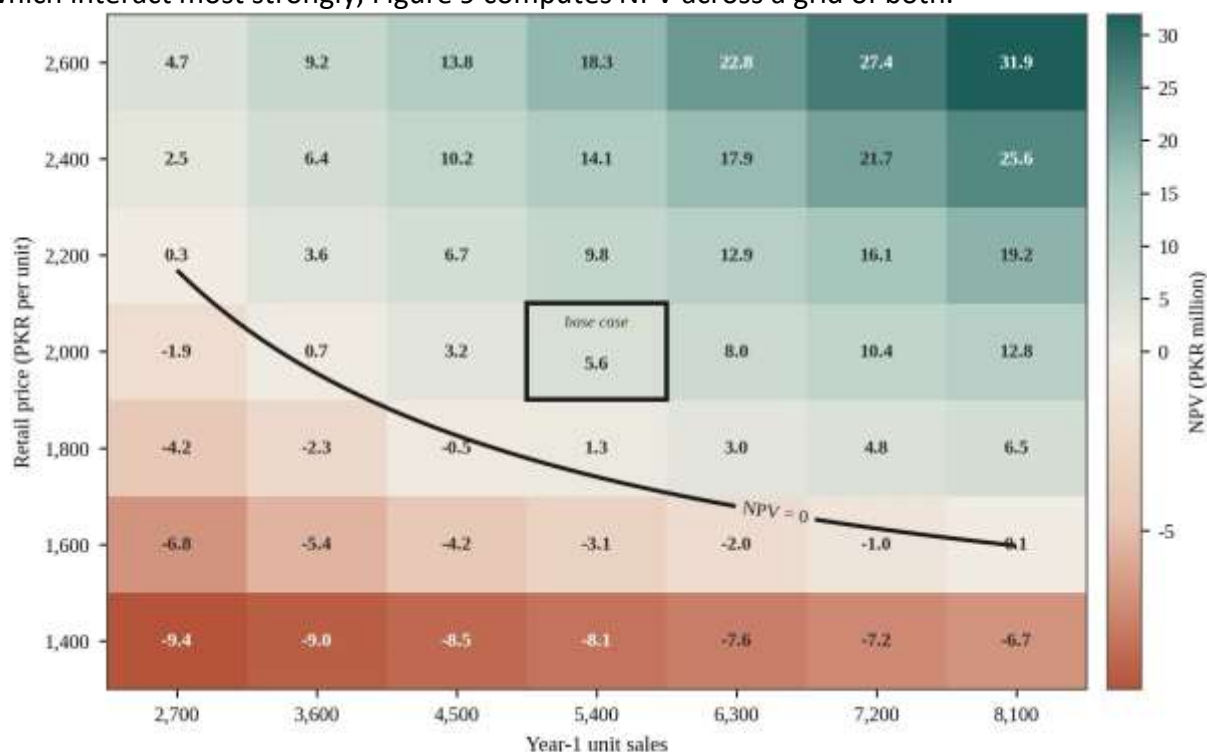


Figure 9. Net present value across price and Year-1 volume combinations (PKR million). The heavy contour marks the zero-NPV frontier; the outlined cell marks the base case. Combinations below and to the left of the frontier destroy value.

The zero-NPV frontier runs diagonally, and its slope carries the practical message. At the base price of PKR 2,000, the venture tolerates a volume shortfall to roughly 4,200 units before value turns negative. But at PKR 1,600 — a 20 per cent discount, the sort of concession a founder facing slow initial trial would be tempted

to make — break-even volume rises above 7,200 units, well beyond the base-case plan. Discounting to accelerate trial is therefore self-defeating in this business: the volume required to compensate for a price cut exceeds the volume the cut is likely to generate.

The practical rule that follows is unusually clear. Faced with slow initial uptake, management should spend on education, sampling and placement rather than reduce price, and should accept a slower ramp at full price over a faster one at a discount. The map also shows that upside is asymmetric: raising price to PKR 2,400 at base volume produces an NPV of PKR 11.4 million, roughly double the base case, which suggests the PKR 2,000 price point may itself be conservative if the product's positioning holds.

5.8 Scenario analysis

Table 10 defines three internally coherent states and Figure 10 reports the results. The pessimistic case assumes not merely lower volume but the correlated deterioration that would accompany it in practice: price concession, cost inflation, higher marketing intensity, a higher required return, and — reflecting the operational response a founder would actually make — a reduced fixed-cost base.

Parameter	Pessimistic	Base	Optimistic
Year-1 volume (units)	3,400	5,400	7,800
Price per unit (PKR)	1,750	2,000	2,200
Variable cost per unit (PKR)	1,130	1,046	980
Year-2 volume growth	22%	50%	65%
Marketing intensity	15%	12%	10%
Discount rate	30%	26%	23%
Fixed cost base (Year 1)	PKR 2.40m	PKR 2.82m	PKR 2.82m
Net present value	(PKR 5,672,744)	PKR 5,575,014	PKR 31,545,888
Internal rate of return	Undefined	78.6%	220.9%
Discounted payback	Not achieved	2.64 years	1.05 years

Table 10. Scenario definitions and results. The internal rate of return is undefined in the pessimistic case because free cash flow is negative in every year, so the cash-flow stream never changes sign and no discount rate sets net present value to zero.

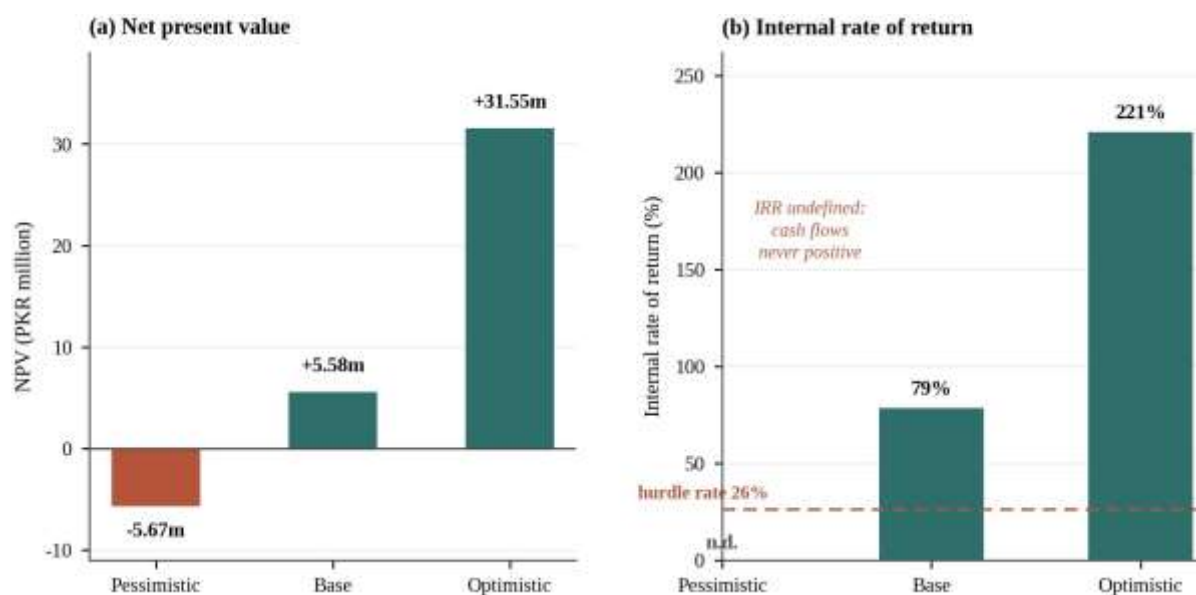


Figure 10. Scenario comparison. Panel (a) shows net present value; panel (b) shows internal rate of return against the 26 per cent hurdle rate. The pessimistic case admits no internal rate of return because its cash flows never turn positive.

The pessimistic case does not merely underperform — it fails structurally. Free cash flow is negative in every year, the venture never generates a return on capital at any discount rate, and the IRR is undefined rather than low. The mechanism is operating leverage: at 3,400 units the gross contribution of PKR 2.1 million does not cover a fixed base of PKR 2.4 million plus marketing, and no rate of growth from that starting point recovers the position within five years. The optimistic case, conversely, produces an NPV of PKR 31.5 million and recovers capital in just over a year.

The spread between these outcomes — from negative PKR 5.7 million to positive PKR 31.5 million — is the honest characterisation of this venture's risk profile. It is a business with a wide outcome distribution, not a low-risk one, and the width comes from the interaction of fixed costs with an unproven demand curve.

5.9 Monte Carlo simulation

Scenario analysis characterises three points in the outcome space but says nothing about their relative likelihood. Table 11 specifies distributions over six inputs and Figure 11 reports the resulting distribution across 10,000 trials.

Input	Distribution	Parameters	Rationale
Year-1 volume	Triangular	2,800 / 5,400 / 8,200	Wide and right-skewed: no domestic precedent for trial rates
Retail price	Triangular	1,600 / 2,000 / 2,400	Positioning may fail downward or succeed upward
Variable cost per unit	Normal	$\mu = 1,046$, $\sigma = 105$	Accumulation of many small independent cost components

Year-2 volume growth	Triangular	15% / 50% / 80%	Later-year growth scaled proportionally
Marketing intensity	Triangular	8% / 12% / 18%	Education spend may need to rise if trial is slow
Discount rate	Triangular	20% / 26% / 34%	Uncertainty in the risk premium itself

Table 11. Monte Carlo input distributions. Triangular parameters are stated as minimum / mode / maximum. Growth rates for Years 3 to 5 are scaled proportionally to the sampled Year-2 rate at ratios of 0.76, 0.60 and 0.48, preserving the dependence between them.

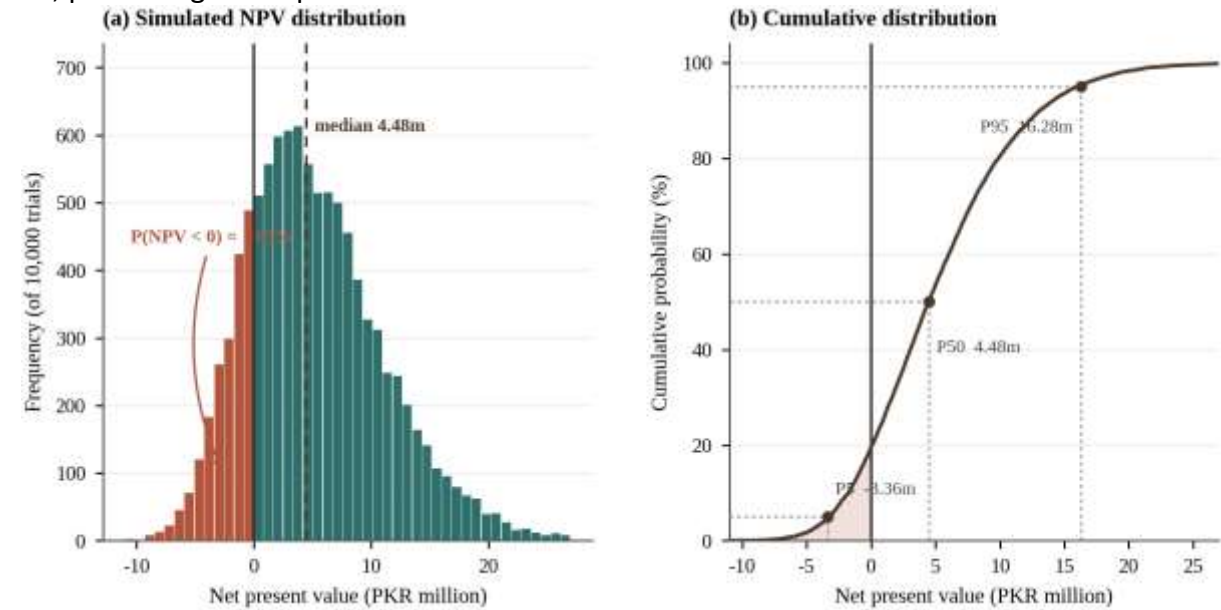


Figure 11. Monte Carlo simulation of net present value across 10,000 trials. Panel (a) shows the distribution, with value-destroying outcomes shaded. Panel (b) shows the cumulative distribution with the fifth, fiftieth and ninety-fifth percentiles marked.

The simulation returns a median NPV of PKR 4.48 million and a mean of PKR 5.18 million, with a standard deviation of PKR 6.04 million. The ninety per cent confidence interval spans negative PKR 3.36 million to positive PKR 16.28 million. The median internal rate of return is 72.9 per cent.

The decisive figure is the probability of negative net present value: 19.3 per cent. Approximately one launch in five, on these assumptions, destroys value. This is the single most important number in the study and it has no counterpart anywhere in the antecedent appraisal, whose language — “extremely low-risk,” “investors love this” — asserts the opposite without quantification.

Two further features of the distribution merit comment. Mean exceeds median by PKR 0.71 million, reflecting right skew: the upside tail is longer than the downside, because volume and price can exceed expectations by more than they can fall below the point at which the venture simply fails. This is Savage’s (2009) flaw of averages in operation — the base case computed from central inputs sits above the median outcome, so a founder who plans to the base case is planning to an outcome that is less likely than not to be achieved. Second, the gap between the tenth percentile at negative PKR 1.84 million and the fifth at negative

PKR 3.36 million shows that the downside deteriorates sharply once it begins, again reflecting operating leverage.

5.10 Feasibility synthesis

Table 12 consolidates the six-dimension assessment introduced in Figure 1.

Dimension	Assessment	Evidence and residual concern
Technical	Feasible	Process route established in the peer-reviewed literature; conventional coffee equipment suffices; roast profile involves a genuine flavour-versusphenolics trade-off requiring formulation work
Economic	Feasible with material risk	NPV PKR 5.58m, IRR 78.6% against a 26% hurdle; but 19.3% probability of value destruction and a margin of safety of only 21.7% in Year 1
Legal	Feasible	SFA and PSQCA pathways are established and inexpensive; no seedspecific mycotoxin standard exists, so the coffee-bean ochratoxin A limit should be adopted voluntarily
Operational	Feasible with qualification	Raw material is abundant, but provincial output varies by over a third year to year; dual-province sourcing is required, and no seed aggregation infrastructure currently exists
Scheduling	Feasible	Roughly seven months from initiation to commercial launch; the binding constraint is consumer education, not construction
Social	Strongly favourable	Diverts a discarded residue into food use, creates rural collection income, and substitutes for imported premium beverages; aligns with SDGs 8, 9, 12 and 15

Table 12. Six-dimension feasibility synthesis. The economic dimension is the binding one; every other dimension clears comfortably.

6. Discussion

6.1 Feasible, but not on the terms claimed

Both this study and the antecedent one conclude that the venture should proceed, and it would be easy to read that agreement as vindication of the original work. It is not. The two studies agree on the direction of the recommendation and disagree about almost everything that would inform how to act on it. An investor told to expect a 378 per cent return recovered in fourteen weeks will capitalise the business at PKR 84,000, will not build a cash buffer, will treat the first year as a formality, and will have no framework for interpreting a slow start. An investor told to expect a 78.6 per cent return with a 19.3 per cent chance of loss and a break-even at 78 per cent of plan will capitalise at PKR 2.1 million with a working-capital reserve, will treat Year-1

volume as the hypothesis to test rather than the plan to execute, and will recognise a shortfall as a signal rather than a delay.

The recommendation is the same; the venture that results is not. This is the practical significance of appraisal quality, and it is not captured by asking whether a study reached the right conclusion.

6.2 The capitalisation illusion

The mechanism producing the antecedent study's headline figures is worth stating precisely, because it generalises well beyond this case. Both IRR and payback are ratios of returns to invested capital. Understating the denominator by a factor of k inflates both by approximately k , while leaving every revenue and cost assumption untouched. No individual assumption need be unreasonable for the resulting metrics to be absurd.

This creates a detection problem, because the standard tools of appraisal review are assumption-focused. A reviewer who examines the price, the volume ramp, the cost structure and the growth rates will find nothing objectionable in the antecedent study — we retained all of them. The error is not in any assumption but in the boundary drawn around the investment base, and boundaries are precisely what assumption-by-assumption review does not interrogate.

The reconciliation test of Section 3.7 addresses this. Because NPV responds to an omitted investment additively while IRR and payback respond multiplicatively, the three metrics drift apart at different rates when the base is understated. Their mutual inconsistency is therefore a signature of the underlying error, detectable without reconstructing the model. We suggest this test be applied routinely — it costs a few minutes, requires only the reported metrics and the stated discount rate, and detects a class of error that no amount of assumption review will surface.

We note also that the antecedent study's investment schedule has an internal logic that is itself revealing. It includes logo design at PKR 5,000 and website development at PKR 20,000 — items that are salient, easily priced, and among the first a founder actually pays for. It omits roasting equipment, inventory and working capital — items that are larger, less salient, and paid for later. The schedule is a record of what came to mind, not of what the business requires. Kahneman and Tversky's (1982) inside view describes exactly this: a forecast assembled from the vivid particulars of the case rather than from a structural account of what a manufacturing venture needs.

6.3 Margin, not volume, is the value driver

The sensitivity results invert the strategic emphasis of the antecedent study, which frames market awareness and volume growth as the central challenge and proposes influencer marketing, sampling and content as the response. Figure 8 shows that a 15 per cent price concession destroys more value than a 30 per cent volume shortfall, and Figure 9 shows that discounting to buy volume is self-defeating: the additional units required to offset a price cut exceed those the cut would plausibly generate.

For a category with no domestic precedent this is a demanding discipline, because the temptation to discount is greatest exactly when trial is slowest, and slow initial trial is the most likely early outcome. The correct response to a soft launch is to spend on education and placement while holding price, accepting a longer ramp. This is easier to specify in a model than to sustain under commercial pressure, which is why it is worth establishing before launch rather than in the middle of one.

The finding also implies that positioning is not a marketing decision downstream of the financial model but an input to it. The PKR 2,000 price is only defensible if the product is understood as a specialty functional beverage rather than as a coffee substitute. Should that positioning fail — should consumers file it mentally

alongside instant coffee — the price collapses toward the substitute's level and, per Figure 9, the venture with it.

6.4 Operating leverage and downside fragility

The pessimistic scenario fails in a specific and instructive way: not through low returns but through cash flows that never turn positive, leaving the IRR undefined. The cause is the interaction of a substantial fixed cost base with an unproven demand curve. At planned volume the fixed base of PKR 2.82 million is covered comfortably; at 3,400 units it is not covered at all, and the venture cannot grow out of the position within the forecast horizon.

This suggests a design implication that the financial model can identify but not itself implement: the fixed base should be made as variable as possible during the validation phase. Contract roasting rather than owned equipment, co-packing rather than an owned facility, and commission-based rather than salaried sales would each convert fixed cost to variable, lowering break-even volume and narrowing the loss region of Figure 9 — at the price of a lower ceiling on margin. Given a 19.3 per cent probability of value destruction, that trade appears worth making until demand is demonstrated, after which insourcing becomes attractive. The model as specified assumes owned equipment from the outset, and we would now regard that as the less defensible configuration.

6.5 Circular-economy and development implications

The venture's environmental logic is genuine rather than decorative, which is not always the case for products marketed on sustainability. The raw material is a residue with essentially no competing food use, currently discarded or sold as low-value feed. Converting it to a beverage moves material to a higher position in the fooduse hierarchy that Teigiserova et al. (2020) describe, and does so without extraction, fractionation or reformulation — the residue becomes the product. Kirchherr et al. (2017) note that circular-economy practice tends to collapse into recycling; this is one of the comparatively rare cases where the higher-value loop is the commercially natural one.

The development case is more modest than the antecedent study suggests and should be stated at its actual scale. At Year-5 volume the venture requires roughly 4.5 tonnes of finished product annually, against a national seed stream of 54,000 to 81,000 tonnes. The direct rural income effect is correspondingly small. The plausible contribution is demonstrative rather than material: establishing that a seed-collection channel can be organised and that a processed date product can command a premium creates a template that others may follow. If Pakistan's date sector is to capture more value than raw export allows, it will be through many such ventures rather than any one of them.

The SDG alignment claimed in the antecedent study holds, with qualification. Contributions to SDG 12 (responsible consumption and production) and SDG 9 (industry, innovation and infrastructure) are direct. Contributions to SDG 8 (decent work) and SDG 15 (life on land) are real but proportionate to the venture's scale, which is small. We would caution against the framing that a single early-stage venture materially advances national development outcomes; the honest claim is that it demonstrates a replicable model.

6.6 Implications for feasibility-study methodology

Three recommendations follow for feasibility analysis more broadly, and particularly for the student and promoter studies that constitute much of this literature in emerging markets.

First, the investment base should be constructed from a structural checklist rather than from recall. A manufacturing venture requires production equipment, packaging capability, opening inventory, working capital, market-entry expenditure, regulatory compliance and contingency. Each should be present with a

value or an explicit statement of why it is zero. The antecedent study's schedule would not have survived this test.

Second, appraisal metrics should be reported together with the horizon and discount rate used, and should be checked for mutual reconcilability before publication. A study reporting NPV, IRR and payback is making three claims about one cash-flow stream, and those claims are jointly falsifiable.

Third, and most importantly, a probability of loss should accompany every point estimate. Monte Carlo simulation is no longer computationally demanding — the analysis reported here runs in seconds — and it converts a claim that a project is “low-risk” from rhetoric into a number that can be checked, compared and argued with. The difference between “extremely low-risk” and “a 19.3 per cent probability of negative NPV” is the difference between a persuasive statement and an informative one.

7. Conclusion

7.1 Summary of findings

This study assessed the financial feasibility of a premium date-seed coffee venture in Pakistan and audited an antecedent promoter appraisal of the same venture. On the substantive question, the venture is feasible: restated on a complete investment base of PKR 2.10 million and discounted at a risk-adjusted 26 per cent, it generates a net present value of PKR 5.58 million, an internal rate of return of 78.6 per cent, a profitability index of 3.66, and discounted payback in 2.64 years. Supply conditions are ample, the process route is established, and the regulatory pathway is inexpensive.

The venture is not, however, low-risk. Break-even at 4,230 units leaves a margin of safety of only 21.7 per cent against the Year-1 plan; Year-1 free cash flow is negative despite accounting profitability; and Monte Carlo simulation places the probability of value destruction at 19.3 per cent. Sensitivity analysis identifies unit margin rather than volume as the dominant value driver, implying that price defence should take precedence over volume acquisition — a reversal of the antecedent study's strategic emphasis.

On the methodological question, the antecedent appraisal fails all four audit tests. Its stated investment total exceeds the sum of its line items by PKR 20,000; the same net present value appears in rupees in one section and dollars in another; its investment base omits equipment, inventory, working capital and pre-launch marketing entirely; and its reported net present value, internal rate of return and payback period cannot be reconciled to any single cash-flow stream at the discount rate and horizon it states. The reported 378 per cent internal rate of return is not an overestimate so much as a computation performed against the wrong denominator.

7.2 Limitations

Four limitations bound these findings. The most serious is that price and volume are assumed rather than observed. No primary consumer research was conducted, no willingness-to-pay was elicited, and no sensory testing was performed with Pakistani consumers on a product they have not encountered. Given that Figure 8 identifies price as the dominant value driver, this is precisely the parameter about which the evidence is weakest, and the confidence intervals reported in Section 5.9 reflect uncertainty in our assumptions rather than in observed data.

Second, cost parameters are indicative rather than quoted. Equipment prices, commercial rents and salary levels are constructed from general market knowledge rather than from supplier quotations, and actual procurement would produce different figures. Third, the model describes one configuration — owned equipment, a Karachi facility, a direct-to-consumer channel, a 250 g format at PKR 2,000 — and Section 6.4 argues that an asset-light configuration would likely dominate it during validation. Fourth, the five-year

horizon with no terminal value is deliberately conservative and understates the value of a business that succeeds; the terminal-value-inclusive figures in Table 9 bound the alternative.

We also note that we retained the antecedent study's price and variable cost precisely to isolate the effect of restating the investment base. This served the methodological purpose but means our headline figures inherit whatever error those parameters contain.

7.3 Future research

Four directions follow directly. Primary consumer research is the priority: a discrete-choice experiment among urban Pakistani consumers, eliciting willingness to pay for a caffeine-free date-seed beverage against both coffee and herbal alternatives, would replace the study's weakest assumption with evidence and would sharply narrow the distribution in Figure 11. Sensory optimisation is the natural complement, resolving empirically the flavour-versus-phenolics trade-off that Shi et al. (2025) identify, using Pakistani cultivars, which are not represented in the existing cultivar literature.

A supply-chain study of seed collection economics would address the operational gap this analysis identifies but does not resolve: what it costs to aggregate a residue currently dispersed across pitting operations with no collection infrastructure, and at what scale that becomes efficient. Finally, the audit protocol of Section 3.7 invites application at scale. Applying the four tests to a corpus of published feasibility studies from emerging markets would establish whether the defects documented here are idiosyncratic or systematic — and our expectation, on the basis of the optimism-bias literature, is that they are systematic.

Declarations

Acknowledgements. The authors thank Mr Muhammad Shams of the Faculty of Business Administration, Mohammad Ali Jinnah University, for supervision and guidance throughout this research.

Funding. This research received no external funding.

Conflicts of interest. The authors declare no conflict of interest and hold no financial interest in the venture appraised.

Data availability. The financial model, simulation code and figure-generation scripts are available from the corresponding author on reasonable request. All input parameters are disclosed in Tables 1, 2, 7 and 11, permitting independent reconstruction.

Author contributions. All authors contributed to conceptualisation, data collection, analysis and writing, and approved the final manuscript.

References

- 6Wresearch. (2025). *Pakistan roasted coffee market (2025–2031): Size, share, trends and forecast*. 6Wresearch.
- Besbes, S., Blecker, C., Deroanne, C., Drira, N.-E., & Attia, H. (2004). Date seeds: Chemical composition and characteristic profiles of the lipid fraction. *Food Chemistry*, 84(4), 577–584.
[https://doi.org/10.1016/S03088146\(03\)00281-4](https://doi.org/10.1016/S03088146(03)00281-4)
- Brealey, R. A., Myers, S. C., & Allen, F. (2020). *Principles of corporate finance* (13th ed.). McGraw-Hill Education.
- Damodaran, A. (2012). *Investment valuation: Tools and techniques for determining the value of any asset* (3rd ed.). John Wiley & Sons.

- Flyvbjerg, B. (2008). Curbing optimism bias and strategic misrepresentation in planning: Reference class forecasting in practice. *European Planning Studies*, 16(1), 3–21. <https://doi.org/10.1080/09654310701747936>
- Geissdoerfer, M., Savaget, P., Bocken, N. M. P., & Hultink, E. J. (2017). The circular economy — A new sustainability paradigm? *Journal of Cleaner Production*, 143, 757–768. <https://doi.org/10.1016/j.jclepro.2016.12.048>
- Ghnimi, S., & Almansoori, R. (2015). Quality evaluation of coffee-like beverage from date seeds (*Phoenix dactylifera* L.). *Journal of Food Processing & Technology*, 6(6), 525. <https://doi.org/10.4172/21577110.1000525>
- Hertz, D. B. (1964). Risk analysis in capital investment. *Harvard Business Review*, 42(1), 95–106.
- Kahneman, D., & Lovallo, D. (1993). Timid choices and bold forecasts: A cognitive perspective on risk taking. *Management Science*, 39(1), 17–31. <https://doi.org/10.1287/mnsc.39.1.17>
- Kiesler, R., Franke, H., & Lachenmeier, D. W. (2024). A comprehensive review of the nutritional composition and toxicological profile of date seed coffee (*Phoenix dactylifera*). *Applied Sciences*, 14(6), 2346. <https://doi.org/10.3390/app14062346>
- Kirchherr, J., Reike, D., & Hekkert, M. (2017). Conceptualizing the circular economy: An analysis of 114 definitions. *Resources, Conservation and Recycling*, 127, 221–232. <https://doi.org/10.1016/j.resconrec.2017.09.005>
- Lovallo, D., & Kahneman, D. (2003). Delusions of success: How optimism undermines executives' decisions. *Harvard Business Review*, 81(7), 56–63.
- Mrabet, A., Jiménez-Araujo, A., Guillén-Bejarano, R., Rodríguez-Arcos, R., & Sindic, M. (2020). Date seeds: A promising source of oil with functional properties. *Foods*, 9(6), 787. <https://doi.org/10.3390/foods9060787>
- Najjar, Z., Stathopoulos, C., & Chockchaisawasdee, S. (2020). Utilization of date by-products in the food industry. *Emirates Journal of Food and Agriculture*, 32(11), 808–815. <https://doi.org/10.9755/ejfa.2020.v32.i11.2192>
- Rahman, M. S., Kasapis, S., Al-Kharusi, N. S. Z., Al-Marhubi, I. M., & Khan, A. J. (2007). Composition characterisation and thermal transition of date pits powders. *Journal of Food Engineering*, 80(1), 1–10. <https://doi.org/10.1016/j.jfoodeng.2006.04.030>
- Savage, S. L. (2009). *The flaw of averages: Why we underestimate risk in the face of uncertainty*. John Wiley & Sons.
- Sezer, A., & Engindeniz, S. (2025). Production estimates of leading countries in date production for the period 2023–2028. *Applied Fruit Science*, 67, Article 118. <https://doi.org/10.1007/s10341-025-01307-9>
- Shi, Y., et al. (2025). Impact of roasting temperature on antioxidant activities and characterization of polyphenols in date seed beverages from different cultivars. *Journal of Food Science*, 90(5), e70242. <https://doi.org/10.1111/1750-3841.70242>
- StrategyHelix Group. (2025). *Pakistan coffee market 2025: Analysis and forecast to 2030*. StrategyHelix.
- Teigiserova, D. A., Hamelin, L., & Thomsen, M. (2020). Towards transparent valorization of food surplus, waste and loss: Clarifying definitions, food waste hierarchy, and role in the circular economy. *Science of the Total Environment*, 706, 136033. <https://doi.org/10.1016/j.scitotenv.2019.136033>
- Whitten, J. L., & Bentley, L. D. (2007). *Systems analysis and design methods* (7th ed.). McGraw-Hill/Irwin.

Appendix A. Model Specification

The model is fully specified by the equations below, applied over $t = 1, \dots, 5$ with parameters as stated in Table 2.

Volume and prices. Unit volume follows $Q_t = Q_1 \cdot \Pi(1 + g_j)$ for $j = 2$ to t , where g_j is the growth rate for year j . Unit price and unit variable cost escalate geometrically: $P_t = P_1(1 + \pi_p)^{t-1}$ and $V_t = V_1(1 + \pi_v)^{t-1}$.

Operating result. Revenue is $R_t = Q_t \cdot P_t$. Fixed cash operating cost is $F_t = F_1(1 + \pi_f)^{t-1}$, where F_1 is the sum of salaries, rent, utilities and administrative cost. Marketing is $M_t = m \cdot R_t$. Then $EBITDA_t = R_t - Q_t \cdot V_t - F_t - M_t$, and operating profit is $EBIT_t = EBITDA_t - D$, where D is annual straight-line depreciation on the equipment component of the investment base.

Free cash flow. Tax is levied on positive operating profit only: $T_t = \tau \cdot \max(EBIT_t, 0)$. Net working capital is a constant fraction of revenue, $WC_t = \omega \cdot R_t$, so the investment in working capital is $\Delta WC_t = WC_t - WC_{t-1}$ with $WC_0 = 0$. Free cash flow is then $FCF_t = EBIT_t - T_t + D - \Delta WC_t$.

Appraisal metrics. With initial investment $I_0 = (1 + c) \cdot \Sigma C_i$, where C_i are the pre-operating cost items of Table 7 and c is the contingency rate, net present value is $NPV = \Sigma FCF_t / (1 + r)^t - I_0$ for $t = 1$ to 5. The internal rate of return solves $NPV(r^*) = 0$ by root-finding on the interval $(-0.95, 50)$; where the cash-flow stream does not change sign, no root exists and the IRR is reported as undefined. The profitability index is $PI = (NPV + I_0) / I_0$. Discounted payback is obtained by linear interpolation on cumulative discounted cash flow between the last negative and first non-negative period.

Break-even. Because marketing is proportional to revenue, it enters the contribution margin rather than the fixed base. Effective unit contribution is therefore $CM^* = P_1(1 - m) - V_1 = 2,000(0.88) - 1,046 = \text{PKR } 714$, and break-even volume is $Q^* = (F_1 + D) / CM^* = 3,020,000 / 714 = 4,230$ units.

Terminal value (disclosure only). Where reported, terminal value is $TV = FCF_5(1 + g)/(r - g)$ with $g = 3$ per cent, discounted at r over five years and added to the Year-5 flow. Terminal value is excluded from all headline metrics.

Appendix B. Reconciliation Test Detail

The reconciliation test of Section 3.7 asks what constant annual cash flow each reported metric independently implies. For a horizon of N years at discount rate r , an investment I and a constant annual cash flow C : the reported net present value implies $C = (NPV + I) / a(r, N)$, where $a(r, N) = (1 - (1 + r)^{-N}) / r$ is the annuity factor; the reported internal rate of return implies C solving $I = C \cdot a(IRR, N)$; and the reported payback implies $C = I / \text{payback}$. Table B1 applies this to the antecedent study's reported values of $NPV = 1,905,569$, $IRR = 3.78$ and $\text{payback} = 0.28$, at its stated discount rate of 11 per cent.

Investment base	Horizon	C implied by NPV	C implied by IRR	C implied by payback	Spread
PKR 83,900 (stated total)	5 years	538,291	317,269	299,643	80%
PKR 63,900 (sum of line items)	5 years	532,880	241,639	228,214	133%
PKR 83,900 (stated total)	10 years	337,815	317,142	299,643	13%
PKR 63,900 (sum of line items)	10 years	334,419	241,542	228,214	47%

Table B1. Reconciliation of the antecedent study’s reported metrics (PKR). “Spread” is the difference between the highest and lowest implied cash flow as a percentage of the lowest. Convergence is acceptable only under a ten-year horizon applied to the stated total, a combination the study nowhere states.