Journal DOI: 10.36713/epra1013 | SJIF Impact Factor (2026): 8.748 ISSN: 2347-4378
EPRA International Journal of Economics, Business and Management Studies (EBMS)
Volume: 13 | Issue: 3 | March 2026 -Peer-Reviewed Journal

OPERATIONAL EFFICIENCY AND FINANCIAL PERFORMANCE IN SMALL-SCALE RICE MILLING: EVIDENCE FROM A TAMIL NADU AGRO-PROCESSING ENTERPRISE

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ABSTRACT
India's rice milling sector sits at the heart of its agricultural economy, yet enterprise-level studies that link operational decisions to financial outcomes remain surprisingly few. In this study, the research reviewed the operations and financial results of the Saroja Modern Rice Mill in Tiruvallur District, Tamil Nadu from the years 2023-24 through 2025-26. This information came from a combination of two months' worth of firsthand observation of the mill's production and an analysis of the mill's internal financial records for a period of three years. Ratio analysis and comparative financial statement analysis form the primary analytical tools. The numbers tell a story of a financially healthy unit: net profit margin held between 14% and 15% throughout the period, the current ratio improved from 1.71 to 1.78, and the debt-equity ratio fell from 0.31 to 0.27 as bank borrowings were steadily retired from operating surplus. The most important finding, however, is not about these headline ratios. It is about rice bran. This by-product of the husking and whitening process contributes only 27% of total revenue — but because its incremental production cost is essentially zero, it generates an estimated gross margin of around 85%. In practical terms, bran is what keeps the mill profitable; rice provides the throughput but not the returns. This research also shows that capacity utilization is only 65–75% of the installed capacity. This is mainly because the drying stage is a batch process without automated moisture control. The study connects these operational problems to their financial effects and suggests specific improvements that could significantly increase profitability.

KEYWORDS—*Rice Milling; Operational Efficiency; Financial Performance Analysis; Rice Bran Profitability; Agro-Processing; Ratio Analysis; Process Improvement*

I. INTRODUCTION

Rice is central to Indian food culture in a way few other crops are. The country harvests more than 137 million tonnes of paddy each year, and almost every kilogram of it has to pass through a rice mill before it reaches a kitchen. These mills — tens of thousands of them, scattered across agricultural districts — clean, husk, whiten, polish, and grade paddy into the rice people actually buy. How well they do this work matters not just to the mill owner but to the farmers who sell paddy and the consumers who depend on affordable rice.

Academic attention to rice milling tends to focus either on the agronomic side — seed varieties, soil, yield — or on broad policy questions about the sector. The firm-level question gets less coverage: what actually happens inside a specific mill, and how do day-to-day operational choices affect its financial results? For small and medium mills, this gap is not just academic. These are businesses operating on thin commodity margins, often run by owner-managers who make decisions based on experience rather than analysis. A single persistent inefficiency — a machine that runs hot, a drying stage that wastes fuel — can quietly erode what little profit is there.

This paper looks at one such mill. Saroja Modern Rice Mill is located in Eliyambedu Village, Ponneri, Tiruvallur District, Tamil Nadu. It is a small-scale but reasonably modern facility that processes several paddy varieties into rice and by-products. The study is based on a two-month field placement at the mill and on three years of financial records spanning 2023–24 to 2025–26.

Two questions anchor the analysis. First, where are the operational inefficiencies, and what do they actually cost in financial terms? Second — and this one is less obvious — why does the mill's profitability seem to be driven by rice bran rather than rice? Bran is a by-product of the whitening stage that most mill operators barely think about. As the data show, they probably should.

II. LITERATURE REVIEW

The connection between operational discipline and financial performance in manufacturing is well established in the management literature. Kauhanen [1] and Bauer [2] both showed that organizations with structured, continuously reviewed operational systems consistently outperform those without them — fewer delays, better resource use, stronger outcomes overall. These findings carry over into agro-processing. Sun et al. [3] looked specifically at rice milling and found that optimizing the husking and whitening sequence reduced broken grain output and improved head rice recovery, with a direct effect on revenue per tonne. Obianefo et al. [4] studied small Nigerian rice processors and reached a similar conclusion: mills that adopted modern equipment and better practices recorded measurable gains in throughput and profitability.

On the financial side, ratio analysis remains the most practical tool available to small-enterprise managers. Pandey [5] makes the case clearly — profitability trends, liquidity positions, and leverage risks all become visible through a disciplined reading of financial ratios. Rani [6] and Bhunia and Mukhuti [7] applied this framework to agro-processing contexts specifically and found that net profit margin and return on assets are particularly informative metrics, partly because commodity price swings can distort aggregate revenue figures in ways that obscure underlying operational performance.

By-product economics in rice milling are comparatively under-researched. Lim et al. [8] explored integrated milling systems and showed that bran, husk, and broken rice together can generate margins that exceed those of core rice sales — a finding that the present study strongly corroborates. Prom-u-thai [9] made a related point: the quality of whitening directly determines bran extraction quality, which means any inconsistency in upstream processing has financial consequences that extend well beyond the primary product.

What the literature has not done much of is connect these two streams at the level of a single firm. Studies on milling operations rarely look at financial statements; financial performance studies rarely trace their findings back to specific operational decisions. That integrated, enterprise-level view is what this paper attempts to provide.

III. METHODOLOGY

The study combines a descriptive mapping of the mill's operations with a quantitative analysis of its financial performance. The descriptive work covers all nine stages of the milling process — paddy receiving, thermal drying, cleaning, destoning, husking, whitening, polishing, grading, and packaging. The financial analysis works through three complete fiscal years of data.

A. Data Collection

Data was collected over a two-month field placement at the millfrom February through March 2026 through direct observation every day to see how long different processes took, where the materials traveled through the facility, how much moisture was lost in each batch during the drying process, how much energy was used in each process, and how much time there was while the equipment was not operating. The researcher conducted informal interviews with owner Mr. Sivakumar and the supervisors/operators to get context on the overall operations of the facility, rather than using only records. To complete the assessment of the facility's financial viability, the researcher obtained the Profit & Loss Statements and Balance Sheets for the fiscal years 2023/2024 through 2025/2026, from internal mill records.

B. Analytical Tools

Financial performance is assessed using four categories of ratios: profitability (net profit ratio), liquidity (current ratio and cash ratio), leverage (debt-equity ratio), and efficiency (fixed asset turnover). Working capital trends are examined through a comparative statement across all three years. On the operational side, capacity utilization analysis estimates the gap between installed and actual processing volume; a Pareto breakdown maps the relative contribution of each downtime source; and an energy cost comparison quantifies the financial advantage of the mill's husk-based drying practice. Revenue contribution analysis isolates bran's profit share from that of core rice products.

C. Scope and Sampling

The study uses a purposive case methodology, focusing on a single mill chosen for its operational accessibility and its representativeness of small agro-processors in the Tiruvallur-Ponneri belt. All financial data cover complete fiscal years; all operational observations reflect the conditions present during the field study. Findings are analytically valid for this mill and for comparable units, though they are not intended as a statistical generalization across the wider industry.

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IV. RESULTS AND DISCUSSION

A. Financial Performance Overview

Table I summarizes the key financial ratios for the three-year study period. The numbers are, on the whole, reassuring. The mill sustained a net profit margin between 14% and 15% throughout — well above the 6–10% range typical of comparable agro-processors in this segment. Net profit itself grew from Rs. 10.75 lakhs in 2023–24, growing to Rs. 13.65 lakhs by 2025–26, which is a total increase of 26.9%.

Table I: Key Financial Ratios — Saroja Modern Rice Mill (2023–24 to 2025–26)

Financial Indicator	2023–24	2024–25	2025–26
Net Profit (Rs. Lakhs)	10.75	11.38	13.65
Net Profit Margin (%)	14.69	14.21	15.14
Current Ratio	1.71	1.75	1.78
Cash Ratio	0.21	0.23	0.24
Debt-Equity Ratio	0.31	0.30	0.27
Fixed Asset Turnover (x)	4.07	4.01	4.10
Net Working Capital (Rs. Lakhs)	5.00	6.00	7.00

A closer look at the liquidity figures shows a current ratio that has steadily improved from 1.71 to 1.78 — comfortably above the standard benchmark without tying up excess idle cash. The cash ratio is low relative to current assets, and that is not accidental. The mill holds bran inventory rather than selling immediately, waiting for market prices to peak before liquidating. This practice compresses the cash ratio but improves the margin actually realized on bran sales. It is a deliberate working capital decision, and it appears to be working.

The debt story is striking. Over three years, bank borrowings fell by 76.5% — entirely funded from operating profit, with no new equity raised and no refinancing. Reserves and Surplus grew 79% over the same window, rising 33% in Year 2 and 34% in Year 3. For a small commodity processor, that kind of equity accumulation is unusual. It reflects a mill that is consistently generating surplus well beyond what it needs for day-to-day operations, and then using that surplus to pay down debt rather than expand spending.

The fixed asset turnover of roughly 4.0x means the mill generates Rs. 4 of revenue for every rupee invested in machinery. That is a solid utilization rate. What it does not show — and what the operational analysis makes clear — is that the machines are capable of more. The throughput constraint is not the equipment; it is what happens before the paddy reaches the milling line.

B. Rice Bran: The Actual Profit Engine

The most important thing this study found has nothing to do with rice. It is about bran. Table II breaks down the revenue and profit contribution by product segment, and the numbers tell a story that is easy to miss in the aggregate financials.

Table II: Revenue & Profit Contribution Analysis (* Primary profit driver)

Revenue / Profit Item	2023–24 (Rs.)	2024–25 (Rs.)	2025–26 (Rs.)
Total Revenue	73,20,000	80,10,000	90,15,000
Rice Sales (~52%)	38,06,400	41,65,200	46,87,800
Rice Bran Sales (~27%)*	19,76,400	21,62,700	24,34,050
Husk & Broken Rice (~13%)	9,51,600	10,41,300	11,71,950
Est. Bran Gross Profit (~85%)	16,79,940	18,38,295	20,68,943
Mill Net Profit	10,75,000	11,38,000	13,65,000

Bran accounts for 27% of total revenue. Rice accounts for about 52%. So on the face of it, rice looks like the main event. But the cost structures are completely different. Rice is expensive to produce — paddy procurement alone absorbs a large share of rice revenue, before you add milling costs, energy, labour, transport, and finance charges. Bran, by contrast, comes out of the husking and whitening machinery as a physical separation of the grain. There is no additional raw material cost. The market — edible oil refineries, animal feed producers, pharmaceutical manufacturers — pays well for it. The estimated gross margin on bran is around 85%.

The implication of that margin difference is not subtle. In 2025–26, bran sales generated an estimated gross profit of Rs. 20.69 lakhs. The mill's total net profit that year was Rs. 13.65 lakhs. Bran's gross contribution exceeded the whole mill's net profit — the gap being absorbed by the shared fixed cost overhead. Interestingly, this means

that if bran revenue were somehow removed from the picture, the rice milling operation on its own would barely cover its costs at current pricing.

This is not merely an interesting accounting observation. It changes how the mill's operations should be understood strategically. Rice drives throughput and keeps the machines running. Bran is what makes running those machines financially worthwhile. Any operational decision that affects bran yield — how consistently paddy enters the huller at the right moisture level, how the whitener is calibrated, how long paddy dwells in each stage — is effectively a profit decision, whether or not it is framed that way. A 5% improvement in bran yield, based on current volumes, would add roughly Rs. 0.8–1.2 lakhs to annual net profit. No comparable investment in rice pricing or distribution would come close.

The same logic explains the mill's remarkable debt reduction. Bank borrowings fell from Rs. 7.75 lakhs to Rs. 1.82 lakhs over the study period — a Rs. 5.93 lakh reduction, all from operating cash flow. Rice margins alone could not have generated that kind of surplus. Bran's high-margin economics is what made it possible.

C. Operational Efficiency Analysis

During field observation, it was noticed that the drying stage operates as a fully manual batch process — and that this single design choice is the root cause of most of the mill's operational constraints. Paddy is loaded into the drying chamber, heated using firewood and rice husk, then unloaded before the next batch can be started. There is no automated temperature sensing, no moisture metering, and no continuous feed. Only 55–60% of each drying cycle is actually productive thermal drying time. The rest is loading, unloading, and waiting. Across a full working year, the study estimates this architecture causes a 10–15% throughput loss against theoretical output capacity.

The absence of moisture control compounds the problem. Moisture levels within a single drying batch can vary by 2–4 percentage points around the target range of 12–14%. That variation matters more than it might seem, because head rice recovery — the proportion of paddy weight that emerges as whole, unbroken grains — drops sharply when paddy enters the huller either too wet or too dry. Whole rice sells at a premium over broken rice. Even a 1–2 percentage point improvement in recovery translates to measurably higher revenue per tonne.

Capacity utilization across the mill is estimated at 65–75% of installed capacity, which sits at 10,000–18,000 MT per year. That leaves somewhere between 2,500 and 4,500 MT of annual processing volume unrealized — capacity that exists and is paid for, but not used. A Pareto breakdown of downtime sources found that three factors account for over 65% of all lost production time: inter-batch waiting, machine feed jams, and manual coordination delays. The concentration of causes is useful; it means a relatively small number of targeted fixes could recover a disproportionate share of that lost capacity.

One area where the mill is genuinely doing something right is fuel management. Rice husk — which the husking machines produce in volume and which would otherwise need to be disposed of — is fed directly into the drying furnace as fuel. This eliminates both the disposal cost and the fuel procurement cost in one step. Compared to grid electricity, this approach reduces drying cost by roughly 13× per 100 kg of paddy. The gap that remains is thermal insulation: the drying chamber walls are not insulated to modern standards, and an estimated 15–20% of generated heat is lost to the environment per batch. Fixing that would reduce fuel consumption per batch and, as a bonus, leave more husk available to sell as a by-product.

D. Comparative Financial Performance

Looking at Year 1 to Year 2 (2023–24 to 2024–25), total income grew by 9.43% but expenditure grew by 14.17%. Net profit increased by only 5.86% as a result. The main culprit was paddy procurement costs, which rose faster than rice selling prices and squeezed the core rice margin. Bran revenue grew by Rs. 1.86 lakhs at near-zero marginal cost, and that growth was the main buffer against what would otherwise have been a flat or negative profit outcome.

Year 2 to Year 3 (2024–25 to 2025–26) looks quite different. Income grew 12.55% while expenditure grew only 8.18% — a reversal of the previous dynamic. Net profit rose 19.95%, from Rs. 11.38 lakhs to Rs. 13.65 lakhs. A noticeable trend here is bran's role in driving the turnaround: Rs. 2.71 lakhs of additional bran revenue at roughly 85% gross margin contributed the bulk of the profit improvement. When income growth outpaces cost growth and bran volumes are healthy, the mill's profitability accelerates quickly — because the fixed cost base does not change, and high-margin bran revenue drops almost entirely to the bottom line.

Across both periods, the pattern is consistent. Bran revenue growth is the dominant driver of profit improvement. Bran yield loss or price weakness is the dominant risk. This is a conclusion that the top-line financials would not

reveal on their own; it only becomes clear when you disaggregate the revenue mix and examine the margin structure of each product segment.

V. CONCLUSION

The main conclusion of this study is a simple one, but it has real implications for how small rice mills think about their business: profitability at Saroja Modern Rice Mill is not determined by how much rice it sells. It is determined by how efficiently it extracts bran.

Bran contributes 27% of revenue but generates an estimated 85% gross margin. Its gross profit contribution in 2025–26 exceeded the mill's total net profit for the year. Rice provides the operational throughput that also happens to produce bran — but the financial returns accrue almost entirely to the by-product side. This means that the decisions most worth making are the ones that protect and improve bran yield: keeping upstream moisture consistent, calibrating the whitener properly, timing bran sales strategically rather than selling to the nearest trader at spot price.

On the operational side, the constraints identified are real but fixable. Batch-based drying, absent moisture instrumentation, and inadequate chamber insulation are not fundamental limitations of the technology — they are incremental design gaps that can be addressed without rebuilding the mill. Closing the gap from 65–75% to 85–90% capacity utilization, which is achievable without adding new machinery, would generate an estimated Rs. 2–5 lakhs of additional annual net profit by spreading fixed costs over a larger output base and capturing more bran volume at high margin.

For agro-processing enterprises more broadly, this study reinforces a principle that probably applies well beyond rice milling: by-product economics tend to be strategically underweighted. When a by-product carries close to zero incremental cost and a strong market price, it can become more important to profitability than the primary product, even while representing a smaller share of revenue. Firms that recognize this and manage their by-product streams accordingly — rather than treating them as an afterthought — are likely to outperform those that do not.

Future work should extend this analysis across multiple mills to build regional benchmarks, run controlled trials of automated moisture control systems to quantify the yield impact, and trace the bran value chain through to refinery and feed manufacturer procurement to sharpen the pricing strategy.

ACKNOWLEDGMENT

The author thanks Dr. Ganesan alias Kanagaraj M (Supervisor) and Dr. S. Vasantha (Coordinator), Department of Management Studies, Saveetha Engineering College, for their guidance throughout this research. Sincere appreciation is extended to Mr. Sivakumar R, Sole Proprietor, and Mr. Ramamoorthy, Founder, Saroja Modern Rice Mill, Tiruvallur, for their cooperation and access to financial and operational records.

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