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Business performance of existing biomass briquette and pellet enterprises in Raipur district of Chhattisgarh: A firm-level economic assessment

¹Mariya Shilpa Ekka and ²Hulas Pathak

¹Department of Agri-Business and Rural Management, College of Agriculture, IGKV, Raipur, Chhattisgarh, India

²Professor and Head, Department of Agri-Business and Rural Management, College of Agriculture, IGKV, Raipur, Chhattisgarh, India

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Corresponding Author: Mariya Shilpa Ekka

Abstract

India's biomass briquette and pellet industry has acquired strategic importance following the Ministry of Power's mandate for 5 per cent biomass co-firing in coal-based thermal power plants, rising to 7 per cent from FY 2025-26, yet firm-level evidence on the economic viability of operating units remains scarce. The present study assessed the business performance of the biomass briquette and pellet industries of Raipur district, Chhattisgarh, through a complete enumeration of the six enterprises registered with the District Industries Centre. Primary data for the reference year 2025-26 were gathered from owners and managers through a pre-tested structured schedule and analysed using cost-of-production and cost-return analysis, the benefit-cost ratio, operating ratio and net margin, return on investment, the simple payback period, descriptive statistics with the coefficient of variation, and a Composite Business Performance Index. Installed capacity ranged from 2,500 to 9,000 tonnes per year and capacity utilisation from 72.0 to 87.5 per cent, so no unit worked its installed capacity fully during the reference year. The district-average cost of production was ₹6.12 per kg for briquettes and ₹7.28 per kg for pellets, with raw material alone accounting for about 57 per cent of variable cost. Briquettes returned a higher net margin than pellets in every unit, averaging ₹2.59 against ₹1.27 per kg, and the benefit-cost ratio averaged 1.42 for briquettes against 1.18 for pellets. The six enterprises together generated ₹50.29 crore in revenue and ₹9.27 crore in net profit (18.4 per cent), with return on investment between 12.1 and 30.5 per cent and payback averaging 5.24 years. Shri Dhaniram Biomass Industries ranked first on the composite index and Balaji Hitech Industries last. The industry is uniformly viable but internally uneven, its profitability governed by the interaction of cost discipline and price realisation with scale rather than by scale alone.

Keywords: biomass briquettes, biomass pellets, cost-return analysis, benefit-cost ratio, business performance, Raipur, Chhattisgarh

1. Introduction

Biomass briquettes and pellets densified solid fuels made from agricultural residues such as paddy husk and straw offer a coal substitute that reduces emissions while providing a productive outlet for residue that would otherwise be burnt. Their commercial relevance has grown sharply with the Ministry of Power's revised biomass policy, which mandates 5 per cent biomass co-firing in coal-based thermal power plants from FY 2024-25, rising to 7 per cent from FY 2025-26 (Ministry of Power, 2023) ^[6]. Supply has lagged well behind this policy-backed demand: The National Mission on the use of biomass in thermal power plants estimated a requirement of about 95,000 to 96,000 tonnes of pellets per day against an installed capacity of only around 7,000 tonnes per day (Down To Earth, 2024) ^[1], leaving a large and under-exploited investment opportunity for manufacturing enterprises.

Chhattisgarh, and Raipur district in particular, is well placed to serve this market. Known as the "Rice Bowl of India," the district generates abundant paddy husk and crop residue and hosts the largest concentration of registered biomass enterprises in the state, yet the industry is young, its operating units having been established only between 2016 and 2021. Existing economic work on solid biofuels is largely macro-

level or technology-oriented covering the cost structure of briquetting (Jagtap & Derle, 2019) ^[5], the techno-economics of pellets for power generation (Purohit & Chaturvedi, 2018) ^[7], small-scale pellet processing (Yuldashev, Illukpitiya, Tegegne & Ekanem, 2020) ^[8] and aggregate market cost models (IMARC Group, 2024; EAI, 2025) ^[4, 2]. Firm-level evidence on how existing enterprises actually perform within a single district remains scarce, though it is a prerequisite for judging the replicability and bankability of new units.

The present study was therefore undertaken to assess the business performance of the existing biomass briquette and pellet industries of Raipur district profiling their structural and operational characteristics, quantifying the cost of production and net returns for both product lines, evaluating financial efficiency through the benefit-cost ratio, operating ratio, net margin, return on investment and payback period, examining marketing performance and ranking the enterprises through a Composite Business Performance Index.

2. Materials and Methods

2.1 Study area and enterprises

The study was conducted in Raipur district of Chhattisgarh, selected purposively because it hosts the largest

concentration of registered biomass briquette and pellet enterprises in the state and possesses an abundant supply of paddy husk and crop residue. All enterprises registered with the District Industries Centre (DIC), Raipur, were covered by complete enumeration, and the six operating units so identified were included: Major Hitech India Pvt. Ltd. (MHIPL), M/S Natural Fuels & Minerals (NFM), Shri Dhaniram Biomass Industries (SDBI), Manish Traders (MT), Green Energy Corporation (GEC) and Balaji Hitech Industries (BHI). As the six units constitute the entire population of the district, the analysis relies on descriptive statistics rather than inferential tests.

2.2 Data collection

Financial and operational data pertained to the reference year 2025-26, while a five-year selling-price series (FY 2020-21 to FY 2024-25) was compiled to examine the price trend. Primary data were collected through personal interviews with the owners or managers of the six enterprises using a pre-tested structured schedule covering the enterprise profile, installed capacity and actual production, the cost structure, sales and revenue particulars, buyer segments and market coverage, and self-reported business performance on a five-point Likert scale. Secondary data were drawn from the DIC Raipur, the Ministry of New and Renewable Energy, the Chhattisgarh State Renewable Energy Development Agency and related sources.

2.3 Analytical tools

The data were analysed using the following tools, computed for both product lines:

Cost of production (₹/t) = Total cost / Total output; Net return = Gross returns – Total cost

Benefit–cost ratio = Gross returns / Total cost

Operating ratio (%) = (Total cost / Gross revenue) × 100; Net margin (%) = (Net profit / Gross revenue) × 100

Return on investment (%) = (Net profit / Total cost) × 100 [total cost used as a proxy for capital employed]

Simple payback period (years) = Total cost / Net profit

Capacity utilisation (%) = (Actual production / Installed capacity) × 100; Labour productivity (t/worker) = Actual production / Employment

Coefficient of variation (%) = (Standard deviation / Mean) × 100

Min–max normalised score = $(X_i - X_{\min}) / (X_{\max} - X_{\min})$; CBPI = mean of the normalised indicator scores (equal weights)

Return on investment and the payback period were computed on a proxy basis, using total cost of production as a proxy for capital employed, since formal investment particulars were not available for all units. The Composite Business Performance Index (CBPI) integrated production-scale and per-unit efficiency indicators, each min–max normalised to a 0–1 scale and averaged with equal weights, a higher score denoting better overall performance.

3. Results and Discussion

3.1 Structural and operational profile

The structural profile of the six units is presented in Table 1. Installed capacity ranged from 2,500 tonnes a year at Balaji Hitech Industries to 9,000 tonnes at Green Energy Corporation a spread of better than three to one and actual production followed the same order. Capacity utilisation varied over a much narrower band, from 72.0 per cent at Balaji Hitech to 87.5 per cent at Shri Dhaniram Biomass Industries, so no unit worked its installed capacity fully during the reference year. Labour productivity was highest at Shri Dhaniram Biomass Industries and Manish Traders, both at 200 tonnes per worker, and lowest at Balaji Hitech at 150 tonnes per worker; the two leading firms reach the same ratio from very different employment bases (35 workers against 18), so an identical productivity figure conceals a substantial difference in scale. Balaji Hitech is the smallest unit on every count and also the least effective at converting labour into output.

Table 1: Firm-wise industrial profile of the sampled enterprises

Enterprise	Year estd.	Installed cap. (tpy)	Actual prod. (tpy)	Cap. util. (%)	Employment	Labour prod. (t/worker)
Major Hitech India Pvt. Ltd. (MHIPL)	2018	5,000	4,200	84.0	22	190.9
M/S Natural Fuels & Minerals (NFM)	2016	3,000	2,500	83.0	15	166.7
Shri Dhaniram Biomass Industries (SDBI)	2020	8,000	7,000	87.5	35	200.0
Manish Traders (MT)	2017	4,500	3,600	80.0	18	200.0
Green Energy Corporation (GEC)	2019	9,000	7,600	84.4	42	181.0
Balaji Hitech Industries (BHI)	2021	2,500	1,800	72.0	12	150.0

Source: Primary data.

3.2 Cost of production

The district-average cost of production, decomposed by cost head, is presented in Table 2. Briquette manufacturing carried a total cost of ₹6.12 per kg (₹6,123 per tonne) and pelletisation a higher ₹7.28 per kg (₹7,282 per tonne). Consistent with the wider evidence on Indian solid-biofuel economics (Jagtap & Derle, 2019) ^[5], the activity is raw-material intensive: raw material alone accounted for ₹2.99 per kg in briquetting and ₹3.53 per kg in pelletisation about 57 per cent of variable cost in both lines and remained by a

wide margin the single largest cost head. Labour was the second largest variable head (14.1 per cent for briquettes, 13.6 per cent for pellets), followed by electricity and transport. On the fixed side, depreciation on machinery and equipment was the leading item (32.2 per cent of fixed cost for briquettes, 34.3 per cent for pellets), with interest on fixed capital and building depreciation next; the two depreciation heads together claimed just over half of fixed cost. Variable cost accounted for about 85 per cent of total cost and fixed cost for the remaining 15 per cent in both products, so day-

to-day input costs raw material above all rather than capital charges separate a comfortable unit from a marginal one. The higher pellet cost arises from the heavier per-unit draw that pelletisation makes on raw material, electricity and labour,

and from the larger asset base created by its additional grinding and die-pressing equipment, rather than from a different mix of inputs altogether.

Table 2: Per-unit cost structure of briquette and pellet production, district average

Cost component	Briquette (₹/kg)	Briquette (₹/ton)	Pellet (₹/kg)	Pellet (₹/ton)
A. Variable cost				
Raw material (biomass / agro-residue)	2.99	2,992	3.53	3,533
Labour (skilled + unskilled)	0.73	733	0.83	833
Electricity / power	0.40	395	0.49	488
Transportation	0.31	312	0.36	362
Fuel (diesel for machinery)	0.26	263	0.31	312
Packaging	0.21	213	0.26	262
Repair and maintenance	0.17	173	0.21	212
Miscellaneous / contingency	0.13	125	0.15	147
Sub-total variable cost	5.21	5,207	6.15	6,148
B. Fixed cost				
Depreciation on machinery & equipment	0.30	295	0.39	388
Depreciation on building / shed	0.17	167	0.21	212
Interest on fixed capital	0.22	217	0.26	258
Land rent / lease value	0.12	115	0.13	132
Insurance premium	0.05	45	0.06	55
Licence, registration & statutory fees	0.08	78	0.09	88
Sub-total fixed cost	0.92	917	1.13	1,133
Total cost of production	6.12	6,123	7.28	7,282

Source: Primary data

3.3 Cost, price and net returns by firm

Table 3 combines the total cost of production with the realised selling price and net returns for each firm. For briquettes, total cost ran from ₹5.46 per kg at Manish Traders to ₹6.80 per kg at Major Hitech India Pvt. Ltd.; pellet cost was higher than briquette cost within every single firm. The cost ranking of the six firms was identical on both product lines, which points to firm-level characteristics machine vintage, plant layout and procurement practice as the drivers of cost efficiency rather than anything intrinsic to the product. Net returns on briquettes ranged from ₹1.65 per kg at Green Energy Corporation to ₹3.15 at Shri Dhaniram Biomass Industries (district average ₹2.59), while pellet returns were

thinner throughout, from ₹0.96 at Major Hitech to ₹1.59 at Manish Traders (district average ₹1.27). Because the district-average selling prices of the two products differ by only about 2 per cent (₹8.72 against ₹8.55 per kg), the profitability gap between briquettes and pellets arises almost wholly on the cost side. The two highest briquette margins are earned in different ways: Shri Dhaniram converts its low cost straight into margin, whereas M/S Natural Fuels earns its margin on the second-highest realised price; Manish Traders, the cheapest producer, ends with only a middling margin because it also takes the lowest price. Neither low cost nor high price alone is sufficient to secure a leading margin.

Table 3: Firm-wise cost of production, selling price and net returns (₹/kg)

Enterprise	Total cost (₹/kg) Briq.	Price (₹/kg) Briq.	Net return (₹/kg) Briq.	Total cost (₹/kg) Pellet	Price (₹/kg) Pellet	Net return (₹/kg) Pellet
MHIPL	6.80	9.50	2.70	8.04	9.00	0.96
NFM	6.24	9.15	2.91	7.48	8.60	1.12
SDBI	5.85	9.00	3.15	6.95	8.30	1.35
MT	5.46	8.00	2.54	6.41	8.00	1.59
GEC	6.50	8.15	1.65	7.71	8.90	1.19
BHI	5.89	8.50	2.61	7.10	8.50	1.40
District average	6.12	8.72	2.59	7.28	8.55	1.27

Source: Primary data

3.4 Company-level revenue and profitability

At company level (Table 4), Green Energy Corporation recorded both the highest gross revenue (₹12.40 crore) and the highest net profit (₹2.90 crore), followed by Shri Dhaniram Biomass Industries; Balaji Hitech Industries was lowest on both counts. Together the six enterprises generated ₹50.29 crore in gross revenue against ₹41.02 crore in total cost, leaving an aggregate net profit of ₹9.27 crore, or 18.4 per cent of district revenue for the year. Absolute profit

favoured the two largest firms, but margin tells a sharper story: net margin was highest at Green Energy Corporation (23.4 per cent) and Shri Dhaniram Biomass Industries (21.9 per cent) and lowest at Balaji Hitech Industries (10.8 per cent), a spread of more than twelve percentage points within a sample of six. The firms differed from one another considerably more in how well they controlled cost below the gross-profit line than in how they priced above it.

Table 4: Firm-wise revenue and profitability at company level (FY 2025-26)

Enterprise	Gross revenue (₹ cr)	Total cost (₹ cr)	Gross profit (₹ cr)	Net profit (₹ cr)	Gross margin (%)	Net margin (%)
MHIPL	8.25	6.75	2.40	1.50	29.1	18.2
NFM	6.58	5.62	1.76	0.96	26.8	14.6
SDBI	10.50	8.20	3.50	2.30	33.3	21.9
MT	7.10	6.08	1.87	1.02	26.3	14.4
GEC	12.40	9.50	4.40	2.90	35.5	23.4
BHI	5.46	4.87	1.29	0.59	23.6	10.8
District total / average	50.29	41.02	16.22	9.27	32.3	18.4

Source: Primary data.

3.5 Financial efficiency, benefit–cost ratio, return on investment and payback

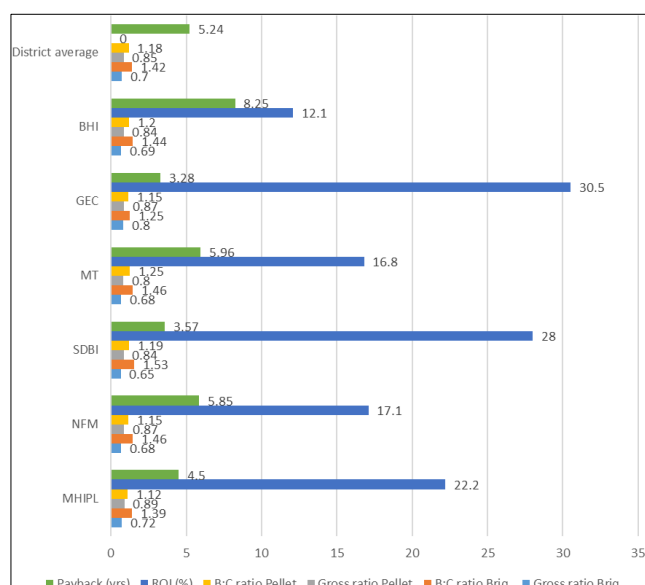
Table 5 reports the gross ratio, benefit–cost ratio, return on investment and payback period for each firm. For briquettes the district gross ratio was 0.70 (operating ratio 0.60 and fixed ratio 0.11), confirming that every unit recovered its full cost of production from sales; Shri Dhaniram showed the tightest cost structure (0.65) and Green Energy Corporation the loosest (0.80). Pellet production returned a markedly higher gross ratio of 0.85, the increase driven overwhelmingly by the operating (working-cost) component rather than by fixed cost, so the additional burden of pelletisation is essentially an input-cost matter. The benefit–

cost ratio mirrored these findings: it averaged 1.42 for briquettes against 1.18 for pellets, and every firm recorded a ratio above one on both products, so none of the six was loss-making. The wider briquette margin held in all six firms without exception—the clearest single pattern in the cost data. On the proxy basis, return on investment ranged from 12.1 per cent at Balaji Hitech to 30.5 per cent at Green Energy Corporation, and the payback period from 3.28 years at Green Energy Corporation to 8.25 years at Balaji Hitech, averaging about 5.24 years for the district. Green Energy Corporation and Shri Dhaniram Biomass Industries recovered their annual cost base fastest, in keeping with their leading net margins and benefit–cost ratios.

Table 5: Financial efficiency, benefit–cost ratio, return on investment and payback period by firm

Enterprise	Gross ratio Briq.	B:C ratio Briq.	Gross ratio Pellet	B:C ratio Pellet	ROI (%)	Payback (yrs)
MHIPL	0.72	1.39	0.89	1.12	22.2	4.50
NFM	0.68	1.46	0.87	1.15	17.1	5.85
SDBI	0.65	1.53	0.84	1.19	28.0	3.57
MT	0.68	1.46	0.80	1.25	16.8	5.96
GEC	0.80	1.25	0.87	1.15	30.5	3.28
BHI	0.69	1.44	0.84	1.20	12.1	8.25
District average	0.70	1.42	0.85	1.18	—	5.24

Source: Primary data

**Fig 1:** Financial Performance Indicators of Selected Enterprises

3.6 Marketing performance

Marketing indicators are summarised in Table 6. Shri Dhaniram Biomass Industries and Green Energy Corporation both reported national market coverage, the two highest self-reported Business Performance scores (4.88 and 5.00) and a strongly increasing sales trend, while Manish Traders and

Balaji Hitech Industries recorded the lowest scores (3.25 and 3.12). Firms operating in national markets recorded higher sales volumes, larger customer networks and stronger self-reported performance than those confined to district or state markets, because wider geographical reach lets a firm spread its buyer base and ride out regional swings in demand. Selling price moved inversely with scale: the smallest units (Balaji Hitech at ₹30,333 per tonne and M/S Natural Fuels at ₹26,320) charged the highest prices, whereas the largest (Shri Dhaniram at ₹15,000 and Green Energy at ₹16,316) charged the lowest. This reflects two marketing strategies rather than two levels of competence the larger firms pursue volume by supplying bulk industrial consumers such as boiler operators at wholesale-type prices, while the smaller firms pursue value by supplying limited quantities to localised buyers such as brick kilns and commercial users at a higher unit price. Given the stronger net margins and returns already recorded for the volume-driven units, the volume model appears the more durable of the two in this district. Regular buyers ranged from eight at Balaji Hitech to thirty at Green Energy Corporation, tracking market coverage and production scale fairly closely; Balaji Hitech, with only eight regular buyers, is the most exposed of the six to the loss of a single account. The selling price of every unit was on a rising trend over the five-year period, at a district-average compound annual growth rate of about 4.6 per cent (firm-level range 3.0 to 6.0 per cent), with the two smallest, highest-priced units raising price the fastest.

Table 6: Marketing performance indicators of the sampled enterprises

Enterprise	Sales vol. (tpy)	Selling price (₹/t)	Major buyer	Market coverage	Regular buyers	Sales trend	BP score (1–5)
MHIPL	4,200	19,643	Boilers	State	18	Increased	4.25
NFM	2,500	26,320	Brick kilns	District	12	Increased	3.75
SDBI	7,000	15,000	Industries	National	25	Strongly increased	4.88
MT	3,600	19,722	Hotels	State	10	Stable	3.25
GEC	7,600	16,316	Boilers	National	30	Strongly increased	5.00
BHI	1,800	30,333	Commercial	District	8	Increased	3.12

Source: Primary data

3.7 Composite ranking and statistical dispersion

The enterprises were ranked on a Composite Business Performance Index that combines production-scale indicators with per-unit efficiency indicators, each min–max normalised to a 0–1 scale and averaged with equal weights, so that the index rewards firms that are both large and efficient rather than efficient alone (Table 7). Shri Dhaniram Biomass Industries ranked first (0.864), pairing high capacity utilisation, the lowest per-tonne cost in the district and the highest benefit–cost ratio with above-average scale. Green Energy Corporation ranked second (0.734) on the strength of its scale, turnover and absolute profit, notwithstanding the weakest per-tonne cost efficiency in the sample an illustration of how scale and per-unit efficiency can pull a composite ranking in opposite directions. M/S Natural Fuels & Minerals and Balaji Hitech Industries came fifth and sixth, both held back more by small scale than by poor unit economics. The ranking is sensitive to the choice of indicators: restricting the index to the per-unit efficiency measures alone moves Manish Traders ahead of Green Energy Corporation, so which firm counts as the district's best performer depends on whether performance is judged per unit of output or per enterprise.

Table 7: Comparative ranking of enterprises on the Composite Business Performance Index

Rank	Enterprise	Composite score (CBPI)
1	Shri Dhaniram Biomass Industries (SDBI)	0.864
2	Green Energy Corporation (GEC)	0.734
3	Manish Traders (MT)	0.512
4	Major Hitech India Pvt. Ltd. (MHIPL)	0.468
5	M/S Natural Fuels & Minerals (NFM)	0.324
6	Balaji Hitech Industries (BHI)	0.145

Source: Primary data.

Descriptive statistics across the six firms confirm this pattern. The average total cost of briquette production was ₹6.12 per kg (₹6,123 per tonne) with a coefficient of variation of only 7.9 per cent, a fairly narrow spread of cost efficiency for the district. Net returns per unit dispersed more (coefficient of variation 19.8 per cent), and company-level net profit showed the widest relative spread of any indicator examined (coefficient of variation 57.4 per cent). Scale differences, in short, amplify profitability differences that are comparatively modest when measured per tonne.

3.8 Profitability, efficiency and sustainability

Shri Dhaniram Biomass Industries stands out as the most complete operator in the district, combining the lowest per-tonne cost with the highest capacity utilisation, the strongest briquette benefit–cost ratio and a net margin second only to

Green Energy Corporation's, all at mid-to-large rather than the largest scale. Green Energy Corporation illustrates the opposite combination: it records the highest absolute revenue, profit and return on investment, drawn from the largest installed capacity and the widest buyer network, but the weakest per-tonne cost structure in the sample, so its profitability currently rests more on the volume it can move than on the efficiency with which each tonne is made. Balaji Hitech Industries is the clearest case of a genuine efficiency gap rather than a simple scale disadvantage: its capacity utilisation, labour productivity, buyer count and return on investment are all the lowest in the sample, and its payback period of 8.25 years is more than double the district average, even though its briquette cost sits a little below the district mean. As it is also the youngest and smallest unit, established in 2021, it may not yet have reached the operating maturity of the older firms; but age alone does not account for the gap, since Shri Dhaniram was established only a year earlier and already leads the district. The likelier reading is that Balaji Hitech has yet to build the production scheduling, feedstock sourcing and buyer diversification that separate the district's stronger units from the rest a managerial constraint rather than a structural one, and in principle addressable without fresh capital.

On long-term financial sustainability, every firm recovers its full cost of production, returns a benefit–cost ratio above one on both product lines, and recovers its annual cost base as profit within nine years at the outside, though the margin of safety varies considerably. Shri Dhaniram Biomass Industries and Green Energy Corporation, with payback periods under four years, hold a wide buffer against a raw-material price shock or a fall in selling price, whereas Balaji Hitech Industries combining the lowest return on investment, the longest payback period and the thinnest buyer base is the most financially exposed unit of the six. For managerial practice the data point to different priorities depending on where a firm sits: the largest units need cost containment above all, particularly on raw material and electricity, since further growth in volume without matching control of cost would widen the efficiency gap with the district's leaders; the smaller units need attention to capacity utilisation, production scheduling and buyer diversification, their per-unit cost being much closer to the district average than their utilisation and customer networks are. For the sector as a whole, the consistently thinner pellet margin suggests that any firm considering a shift towards pellets should first satisfy itself that its raw-material and electricity costs can carry the higher working-cost share that pelletisation demands.

4. Conclusion

This assessment of all six biomass briquette and pellet enterprises of Raipur district shows a uniformly viable but

internally uneven industry. Every unit recovers its full cost of production and earns a benefit–cost ratio above one on both product lines, and the six firms together turned ₹50.29 crore of revenue into ₹9.27 crore of net profit (18.4 per cent) in the reference year. The activity is raw-material intensive, with raw material alone accounting for about 57 per cent of variable cost, and briquette manufacture is more profitable than pelletisation in every single firm a difference that arises on the cost side rather than from any pricing disadvantage on pellets. Performance varies less in cost efficiency, which is fairly tight across the district, than in profitability, which widens sharply once scale is taken into account; the leading firms combine cost discipline with either strong price realisation or large volume, while the weakest unit is held back by low capacity utilisation, a narrow buyer base and weak operational maturity rather than by high unit cost. The policy and managerial implication is that this young industry is fundamentally bankable and well placed to serve the large, policy-backed demand created by the biomass co-firing mandate, but that support and firm-level effort are best directed towards raising capacity utilisation, diversifying buyers and containing raw-material and energy costs, so that the district's weaker units can close the gap with its established leaders.

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