

RESEARCH PAPER

Economic Analysis and Determinants of Coir Yarn Production in Kerala's Co-operative Sector

Krishnapriya^{1*} and T Paul Lazarus²

¹Department of Agricultural Economics, College of Agriculture, Vellayani, Trivandrum, Kerala, India

²Department of Agricultural Economics, College of Agriculture, Padannakkad, Kasargod, Kerala, India

*Corresponding author: krish.priya1403@gmail.com (ORCID ID: 0009-0005-1201-1035)

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ABSTRACT

The study examined the economics and production determinants of coir yarn within Kerala's co-operative sector, focusing on the cost-efficiency of different spinning technologies and the influence of labour and energy inputs. Primary data were collected from 60 co-operative societies in Alappuzha and Kollam, Kerala's leading yarn-producing districts. Production was assessed for two yarn types – Vaikom coir yarn and Mangadan coir yarn, across varying technologies: Automatic Spinning Machines (ASM), electronic ratts, motorized traditional ratts, and traditional ratts. Cost and return analyses, along with multiple linear regression, revealed that ASM was the most cost-efficient method for both yarn types, yielding higher Benefit–Cost ratios and net returns. Regression results showed female labour and electricity consumption as significant production drivers, underscoring the gendered nature of the workforce and the importance of mechanization. The findings suggest that targeted policy measures—particularly those promoting mechanization, supporting female workers, and addressing capital constraints—can enhance the productivity and sustainability of Kerala's coir co-operatives.

HIGHLIGHTS

- ❶ Production of Vaikom and Mangadan coir yarn using Automatic Spinning Machine (ASM) was found out to be the most cost-effective option.
- ❷ Gradual mechanization adoption of ASM by coir co-operative societies can enhance the productivity.
- ❸ The factors such as female labour and electricity (with the coefficients 3.85 and 0.02) significantly influenced the coir yarn production at 1 percent level of significance.
- ❹ Since majority of the coir workers were female, empowering female workers is vital for sustaining Kerala's coir cooperative societies in the yarn sector.

Keywords: Automatic Spinning Machine, Coir co-operative societies, Cost of production, Mangadan coir yarn, Vaikom coir yarn

Coir, renowned as the golden fibre of Kerala, is derived from the coconut husks, with fibres carefully processed to produce it. Coir is a sustainable and biodegradable natural fibre, known for its exceptional strength among organic fibres (GOI, 2019). The coir industry is a key traditional industry in Kerala, consisting of three main components: fibre extraction, spinning, and product manufacturing. While co-operatives largely oversee the fibre extraction and spinning processes, the product manufacturing segment is primarily driven by

factory operations, with a notable involvement of private entrepreneurs and exporters (GOK, 2023).

Coir is primarily produced as a two-ply yarn, with coir fibre serving as the raw material for its creation. The fibre is twisted into yarn using either traditional spinning wheels called “Ratts” or modern machinery

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(Pritam, 2016). Coir yarn classification is based on regional variations in characteristics like colour, twist, pith content, and presence of sand, shaped by local production methods. Kerala produces several coir yarn varieties, each named after its place of origin, reflecting the unique traits of that region's production techniques. This study focuses on coir co-operatives in Alappuzha and Kollam districts, primarily producing Vaikom coir yarn and Mangadan coir yarn. Vaikom coir yarn, from the Vaikom region in Kottayam, is loosely spun with a medium twist and soft texture, while Mangadan coir yarn, from Mangad village in Kollam, is tightly twisted with light golden strands (Menon, 2002).

Coir yarn spinning employs modern or traditional methods; including mechanized, semi-mechanized, and traditional techniques using Automatic Spinning Machines (ASM), electronic ratts, motorized traditional ratts, and traditional ratts respectively (Velayutham and Dhandapani, 2019). In this study, 15% of coir cooperatives used mechanized ASM, 81% adopted semi-mechanized methods, and 4% relied on traditional ratts. Traditional ratt spinning requires three operators, while semi-mechanized methods need two, and electronic ratts and ASMs require only one operator per machine.

While prior studies have examined coir fibre economics (Selvan, 2018) and broader coir industry performance (Naik & Nagaraja, 2017), the economic viability of women-led agricultural enterprises (Devi *et al.* 2023), and labour-intensive production efficiency in related traditional industries such as the Indian carpet sector (Zeeshan *et al.* 2018), little attention has been given to yarn production economics within the co-operative sector, especially in relation to technology adoption, gendered labour dynamics, and cost-efficiency. Mechanization remains low in Kerala's coir sector (Raseena, 2023) The growth in the coir industry hinges on greater support for research, development, and technological advancement. It was also noted that many industrialists still rely on outdated cottage-based methods, highlighting the need for innovation and mechanization to boost productivity, competitiveness, and labour livelihoods (Manikandan and Vidhya, 2023). The coir workforce, especially in the coir co-operative societies of Alappuzha, Kollam and Trivandrum districts of Kerala, was predominantly female, with women workers comprising 73 percent (Kumar,

2018). Given the sector's dependence on female labour and the gradual shift toward mechanization, there is a pressing need to understand how production determinants interact with technology choice, labour structure, and co-operative viability. This study is grounded in concepts from co-operative performance theory, technology adoption models, and gendered labour frameworks. Analysing the interplay between technology, costs, and labour inputs offers insights for co-operative reform, mechanization strategies, and gender-sensitive policy design.

Given this background, the present paper aims to achieve two key objectives: first, to estimate the costs, returns, and cost-efficiency of coir yarn production across different spinning technologies in Kerala's co-operative sector. And second, to identify the key determinants influencing coir yarn production, with a focus on labour and mechanization.

MATERIALS AND METHODS

The study was conducted in Alappuzha and Kollam districts, selected purposively due to their high concentration of yarn-producing co-operatives. From each district, 30 co-operative societies were selected using simple random sampling from lists obtained from the official Coir Board project offices. The final sample included 38 societies producing Vaikom yarn and 22 producing Mangadan yarn.

Primary data were collected in 2024 through structured, pre-tested interview schedules administered to society secretaries and selected workers. The tool captured quantitative data on production, costs, labour inputs, energy use, and machinery, as well as qualitative information on management practices and constraints. Data consistency was ensured through cross-checking with society records, and any discrepancies were clarified on-site.

Costs were divided into Total Variable Cost (TVC) and Total Fixed Cost (TFC). The costs and returns from the production of Vaikom and Mangadan coir yarn in the coir co-operative societies using different machinery were estimated using percentages and weighted averages. The formula used for calculating the weighted averages is

$$\text{Weighted average} = \sum W_i X_i / \sum W_i$$

Where, W_i = The weight allocated to the i^{th} unit typically corresponds to the production output of the respective coir co-operative society, i.e., specifically the quantity of yarn produced.

X_i = The value of each of the cost components of TFC and TVC for the i^{th} coir co-operative society

ΣW_i = The total of all weights (total production) (Kumar, 2019).

A linear production function was utilized to examine the relationship between various inputs and output, with multiple linear regression analysis serving as the methodological approach to achieve this goal. Variables were selected based on their prevalence in prior coir studies and field observations indicating their critical influence. However, during preliminary regression analysis, inclusion of some other factors such as raw material quality, capital, and management skill resulted in statistically weak models, with either spurious relationships or only one variable showing significance. To ensure model robustness and avoid multicollinearity or inflated standard errors, these variables were excluded from the final specification. The model is expressed as

$$Y = a + b_1X_1 + b_2X_2 + b_3X_3 + e$$

Where,

Y = Quantity of coir yarn produced per annum (q)

X_1 = Quantity of female labour (number)

X_2 = Quantity of male labour (number)

X_3 = Quantity of electricity consumed (kWh)

a = Intercept

b_1, b_2, b_3 = Regression coefficients of the independent variables X_1, X_2 and X_3

e = Disturbance term

RESULTS AND DISCUSSION

The cost of production reflects the total expenditure incurred by the co-operative society for the production of per unit of coir yarn. It includes both fixed costs, like administrative expenses, depreciation on buildings, amortisation of machinery and rent, and variable costs, which vary with production. Variable costs cover labour wages, electricity, raw material (coir fibre) procurement, and expenses for operating ASMs, such as oil, grease, thread bobbins, and repair and maintenance charges. Transportation, loading and unloading charges for raw materials and finished goods also add to the variable costs.

A comparison of total production costs for Vaikom and Mangadan coir yarn using ASM versus other machinery showed that ASM incurred the lowest costs (₹ 3,357.13/q and ₹ 3,750.47/q respectively) compared to electronic ratt, motorized traditional ratt, and traditional ratt, due to its balanced combination of TVC and TFC, making it the most cost-effective choice in both districts. Analysis of returns further indicated that ASM was the most efficient and profitable option, yielding net returns of ₹ 546.58/q for Vaikom and ₹ 1,149.53/q for Mangadan yarn, while electronic ratt provided moderate profits and motorized/traditional ratts for Mangadan incurred heavy losses. Benefit–Cost ratio analysis confirmed ASM's economic superiority, with the highest B–C ratios of 1.16 for Vaikom and 1.30 for Mangadan yarn, establishing it as the most

Table 1: Costs and returns analysis in coir production (original)

Sl. No.	Yarn Type & District	Technology used	Total Variable Cost (₹/q)	Total Fixed Cost (₹/q)	Total Cost (₹/q)	Net Returns	B-C Ratio
1	Vaikom coir yarn - Alappuzha district	ASM	2,963.21	393.91	3357.13	546.58	1.16
		Electronic ratt	4,096.17	18.56	4114.74	293.62	1.07
2	Vaikom coir yarn – Kollam district	Electronic ratt	4,239.58	13.57	4253.15	140.72	1.03
3	Mangadan coir yarn – Kollam district	ASM	3,334.76	415.69	3750.47	1149.53	1.30
		Motorised	5,343.06	22.78	5365.86	-465.86	0.91
		Traditional ratt					
		Traditional ratt	6,153.03	19.18	6172.23	-772.23	0.87

Source: Author's own calculations.

Table 2: Breakdown of the total variable cost (TVC) in coir yarn production (original)

Sl. No. Components of TVC		Vaikom coir yarn production		
		Production using	Production using	Production using
		ASM	electronic ratt	electronic ratt
		Alappuzha district	Alappuzha district	Kollam district
Weighted average values (₹ per quintal)				
1	Labour cost	863.94 (29.15)	2,497.33 (60.96)	2,167.38 (51.12)
2	Cost of fibre	1,868.22 (63.04)	1,505.77 (36.76)	1,939.32 (45.74)
3	Electricity charges	129.08 (4.35)	13.13 (0.32)	17.59 (0.41)
4	Machine running charges	67.82 (2.28)	0 (0)	0 (0)
5	Transportation, loading & unloading charges	19.83 (0.67)	76.7 (1.87)	109.45 (2.58)
6	Machine repair & maintenance charge	14.30 (0.48)	3.21 (0.078)	5.82 (0.13)
7	TVC	2,963.21 (100)	4,096.17 (100)	4,239.58 (100)
Sl. No. Components of TVC		Mangadan coir yarn production		
		Production using	Production using	Traditional ratt
		ASM	motorised traditional ratt	
		Kollam district	Kollam district	Kollam district
Weighted average values (₹ per quintal)				
1	Labour cost	833.33 (24.99)	2,625.65 (49.14)	3,938.48 (64)
2	Cost of fibre	1,840.06 (55.17)	2,623.41 (49)	2,190.31 (35.59)
3	Electricity charges	422.06 (12.65)	54.03 (1.01)	4.50 (0.07)
4	Machine running charges	100.48 (3.01)	0 (0)	0 (0)
5	Transportation, loading & unloading charges	111.07 (3.33)	32.80 (0.61)	15.78 (0.25)
6	Machine repair & maintenance charge	27.76 (0.83)	7.15 (0.13)	3.94 (0.06)
7	TVC	3,334.76 (100)	5,343.06 (100)	6,153.03 (100)

Note: Figures in parentheses indicate percent to the respective total variable cost.

Source: Author's own calculations.

Table 3: Breakdown of the total fixed cost (TFC) in coir yarn production (original)

Sl. No. Components of TFC		Vaikom coir yarn production		
		Production using	Production using	Production using
		ASM	electronic ratt	electronic ratt
		Alappuzha district	Alappuzha district	Kollam district
Weighted average values (₹ per quintal)				
1	Rent	0 (0)	0.29 (1.56)	0.90 (6.63)
2	Depreciation on buildings	317.20 (80.52)	3.14 (16.92)	3.83 (28.22)
3	Amortised value of machinery	56.68 (14.39)	3.90 (21.01)	4.77 (35.15)
4	Office and administrative expenses	20.03 (5.08)	11.22 (60.45)	4.05 (29.84)
5	TFC	393.91 (100)	18.56 (100)	13.57 (100)
Sl. No. Components of TFC		Mangadan coir yarn production		
		Production using	Production using	Traditional ratt
		ASM	motorised traditional ratt	
		Kollam district	Kollam district	Kollam district
Weighted average values (₹ per quintal)				
1	Rent	3.70 (0.89)	0.76 (3.33)	0 (0)
2	Depreciation on buildings	348.20 (83.76)	11.77 (51.66)	12.89 (67.20)
3	Amortised value of machinery	62.22 (14.96)	3.34 (14.66)	3.64 (18.97)
4	Office and administrative expenses	1.57 (0.37)	6.91 (30.33)	2.65 (13.81)
5	TFC	415.69 (100)	22.78 (100)	19.18 (100)

Note: Figures in parentheses indicate percent to the respective total fixed cost; **Source:** Author's own calculations.

Table 4: Estimates of multiple linear regression (original)

Sl. No.	Particulars	Coefficient	Standard error	P value	VIF
1	Intercept	111.33	97.11	0.25	
2	Quantity of female labour (number)	3.85**	0.93	0.00012	2.45
3	Quantity of male labour (number)	-5.42	13.81	0.69	1.36
4	Quantity of electricity consumed (kWh)	0.02**	0.004	0.000029	1.95
5	R ²	0.706			
6	R ² _{adj}	0.69			
7	Calculated F	44.85			
8	No. of observations	60			

** Significant at 1 per cent level of significance; **Source:** Author's own calculations.

profitable machinery, delivering higher returns per rupee invested.

The breakdown of Total Variable Cost (TVC) showed labour costs dominating in traditional and semi-mechanized methods (traditional and motorized ratts for Mangadan and electronic ratts for Vaikom), while mechanized ASM operations had fibre costs as the major component. Mechanization reduced labour costs as a share of TVC compared to semi-mechanized or traditional methods, with fibre costs dominating in ASM operations, reflecting efficiency gains. Higher labour requirements in less mechanized methods increased the TVC, undermining their economic viability. Total Fixed Cost (TFC) was highest in ASM for both yarn types due to heavy depreciation, while minimal rent costs reflected co-operatives' land and building ownership. Machinery amortization was notable in mechanized setups, and office expenses peaked for Vaikom yarn with electronic ratts in Alappuzha, indicating overhead differences.

The results of regression analysis carried out to study the factors influencing coir yarn production as given in table 4, revealed that the model's R² value was 0.706 which indicated that 70.6% of the variation in the dependent variable is explained by the independent variables chosen. Female labour and electricity consumption positively and significantly impacted production at a 1% level of significance, with coefficients of 3.85 and 0.02, respectively. This highlights the critical role of female labour, rooted in Kerala's cultural history and the informal economy's flexibility, enabling women to balance work and household duties. Electricity is equally essential, powering modern machinery like ASM, motorized traditional ratt, and electronic ratt for efficient coir yarn production.

CONCLUSION

The findings affirm that mechanization via ASM offers substantial cost-efficiency gains in coir yarn production. However, adoption remains constrained by capital costs, access to credit, and training needs. Co-operative societies may require targeted subsidies or credit schemes to transition.

The role of female labour is both an economic asset and a structural vulnerability. While women's dominance in the workforce supports production stability, their employment is often informal, underpaid, and lacking in social security. Mechanization may alter labour demand, requiring proactive measures to retrain and redeploy affected workers.

From a policy perspective, gradual ASM introduction paired with worker reskilling programmes, strengthening co-operative access to affordable finance, and gender-responsive labour policies are crucial. Price stabilization measures for yarn can also help maintain co-operative profitability. ASM adoption offers clear economic advantages for both Vaikom and Mangadan yarn production, while female labour and electricity access remains as the critical determinants of output. The study highlights the need for integrated policy support, combining mechanization finance, gender-equitable labour reforms, and price stabilization measures to sustain Kerala's co-operative coir yarn sector.

Future research could extend this study by comparing quality parameters of coir yarn, alongside an analysis of supply chain dynamics to identify bottlenecks and improvement opportunities. A comparative assessment between yarn produced in co-operatives and the private sector could further reveal sector-specific strengths and challenges.

Additionally, evaluating the productivity of ASMs with varying capacities would aid in determining the most suitable and efficient type of ASM for mechanized coir yarn production.

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