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SV Jogdand

Professor, Department of Farm Machinery and Power Engineering, SVCAET&RS, IGKV, Raipur, Chhattisgarh, India

Priyanshu Rathour

M.Tech. (FMPE), Department of Farm Machinery and Power Engineering, SVCAET&RS, IGKV, Raipur, Chhattisgarh, India

Priya Sinha

Subject Matter Specialist, Krishi Vigyan Kendra, Kondagaon, Chhattisgarh, India

Shreyansh Humane

M.Tech. (FMPE), Department of Farm Machinery and Power Engineering, SVCAET&RS, IGKV, Raipur, Chhattisgarh, India

Bharat Sahu

M.Tech. (PFE), Department of Processing and Food Engineering, SVCAET&RS, IGKV, Raipur, Chhattisgarh, India

Yash kumar Dewangan

M.Tech. (FMPE), Department of Farm Machinery and Power Engineering, SVCAET&RS, IGKV, Raipur, Chhattisgarh, India

Corresponding Author:

Priyanshu Rathour

M.Tech. (FMPE), Department of Farm Machinery and Power Engineering, SVCAET&RS, IGKV, Raipur, Chhattisgarh, India

Status and economic analysis of custom hiring centres serving small and marginal farmers in selected districts of Chhattisgarh

SV Jogdand¹, Priyanshu Rathour², Priya Sinha³, Shreyansh Humane⁴, Bharat Sahu⁵, Yash kumar Dewangan⁶

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ABSTRACT

Agricultural mechanization improves the timeliness and efficiency of farm operations; however, the high cost of agricultural machinery restricts ownership among small and marginal farmers. Custom Hiring Centres (CHCs) provide agricultural machinery on a rental basis and facilitate access to mechanization without requiring individual ownership. The present study was conducted during 2025–26 to assess the operational status, infrastructure, machinery availability and utilization, economic performance and major constraints of selected CHCs in four districts of Chhattisgarh, namely Gaurela–Pendra–Marwahi, Raipur, Rajnandgaon and Kondagaon. A total of 20 CHCs, five from each district, were selected for the investigation. Primary data were collected through personal interviews, field observations and physical verification of machinery and infrastructure. The collected data were analysed using descriptive statistics, engineering cost analysis, Benefit–Cost (B:C) ratio and break-even analysis. The selected CHCs had an average capital investment of ₹15.40 lakh and served an average of 5.2 villages and 57 farmers per centre. A total of 131 agricultural machines were available across the 20 CHCs. Annual machinery utilization was 10,365 h, of which tractors, cultivators and threshers accounted for 35.89, 31.55 and 16.16%, respectively. The average annual operating cost was ₹5.20 lakh, with variable costs contributing 69.57% of the total cost. Fuel alone accounted for 45.94% of total annual cost. The B:C ratio of individual CHCs ranged from 0.66 to 1.41, with 16 CHCs (80%) recording a B:C ratio above one. The major constraints reported were high fuel cost and delayed payment by farmers, followed by low demand for some machinery and inadequate training facilities. The findings indicate that machinery utilization, hiring demand and cost management are important factors influencing the economic performance of CHCs.

Keywords: Agricultural mechanization, Custom Hiring Centres, Machinery utilization, Economic analysis, Benefit–Cost ratio, Break-even analysis, Chhattisgarh

1. Introduction

Agricultural mechanization plays an important role in improving the timeliness, efficiency and productivity of agricultural operations. It involves the application of mechanical power, improved agricultural machinery and engineering technologies throughout crop production and post-harvest operations. Mechanization improves farm power availability, field capacity, field efficiency, machinery utilization and labour productivity (Singh, 2006) [1]. However, ownership of agricultural machinery is often difficult for small and marginal farmers because of fragmented landholdings and limited investment capacity (Birthal *et al.*, 2015). Custom Hiring Centres (CHCs) provide an alternative mechanism through which farmers can access tractors, implements and specialized machinery on a rental basis. The establishment of CHCs under government mechanization programmes has been intended to improve access to farm machinery, particularly for farmers who cannot afford individual ownership. Government-supported mechanization programmes such as the Sub-Mission on Agricultural Mechanization have promoted machinery hiring services and Farm Machinery Banks to strengthen access to agricultural machinery (Government of India, 2018). The effectiveness of CHCs depends on machinery availability, infrastructure, machinery utilization, hiring demand, management practices and operating costs. Earlier studies have reported that custom hiring services can improve access to machinery and support timely agricultural operations among farmers (Kamboj *et al.*, 2012; Nagaraj *et al.*, 2020) [2, 3]. Economic performance is closely associated with machinery utilization, operational costs and the demand for hiring services (Hiregoudar *et al.*, 2017) [4]. Chhattisgarh has a large proportion of small and marginal farmers and a predominantly rice-based agricultural system. Differences in terrain, cropping pattern, farm size, mechanization level and machinery ownership create variations in demand for custom hiring services among districts. Previous studies have high

lighted the importance of CHCs in improving access to farm machinery in Chhattisgarh (Sahu, 2019; Tayade *et al.*, 2022) [5, 6]. However, comprehensive district-level information combining infrastructure status, machinery inventory, utilization and economic performance of CHCs remains limited for selected regions of Chhattisgarh. Therefore, the present study was undertaken to evaluate the operational and economic performance of selected CHCs and identify major constraints affecting their functioning.

2. Materials and methods

2.1 Study area

The investigation was conducted in four selected districts of Chhattisgarh, namely Gaurela–Pendra–Marwahi (GPM), Raipur, Rajnandgaon and Kondagaon. The districts were selected to represent differences in agro-climatic conditions, cropping systems, mechanization levels and demand for agricultural machinery.

The study was conducted during 2025–26. Five operational CHCs were selected from each district, resulting in a total sample of 20 CHCs. The selected centres primarily provided agricultural machinery services to farmers on a custom hiring basis. The thesis confirms the four-district study design and five-CHC sample from each district.

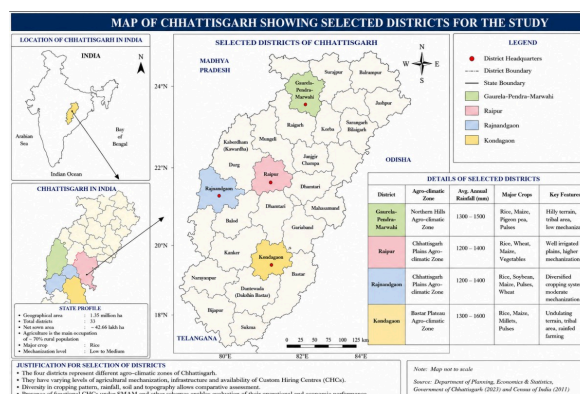


Figure 1. location map of the selected districts in Chhattisgarh

2.2 Sampling and data collection

A multistage sampling approach involving purposive and simple random sampling was adopted. The selected districts represented different agricultural and mechanization conditions. From each district, five operational CHCs were selected through simple random sampling. Primary information was collected from CHC operators/owners through personal interviews, field observations and physical verifica-

tion. Information relating to machinery inventory, infrastructure, annual operating hours, hiring charges, capital investment, income, expenditure and operational constraints was collected. Beneficiary farmers associated with the selected CHCs were also considered for information concerning machinery services and operational constraints.



Figure 2. Primary data collection during field visit of selected CHCs

2.3 Assessment of operational status

The operational status of CHCs was assessed using:

- ownership pattern;
- capital investment;
- government subsidy and institutional loan;

- villages and farmers served;
- infrastructure facilities;
- machinery inventory;
- annual machinery utilization; and
- machinery hiring charges.

Infrastructure facilities considered included office, machinery shed, workshop, skilled operator, fuel storage, electricity, parking and boundary wall.

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2.4 Economic analysis

The economic performance of CHCs was evaluated using ownership cost, operating cost, total annual cost, annual gross income, annual net income, Benefit–Cost ratio and break-even utilization.

The annual net income was calculated as:

$$ANI = AGI - TAC$$

Where,

ANI = Annual net income (₹ year⁻¹) AGI = Annual gross income (₹ year⁻¹) TAC = Total annual cost (₹ year⁻¹)

The Benefit–Cost ratio was calculated as:

$$B:C = AGI/TAC$$

where:

AGI = Annual gross income (₹ year⁻¹) TAC = Total annual cost (₹ year⁻¹)

Cost estimation followed the standard farm machinery costing procedure cited in the thesis as **IS 9164:1979**

2.5 Constraint analysis

Constraints faced by CHC operators were collected through the structured survey schedule. The responses were classified into financial, operational, technical and managerial constraints. Frequency and percentage analysis was used to identify the major constraints.

3. Results and Discussion

3.1 General characteristics of selected CHCs

The selected CHCs were established between 2021 and 2025. The average capital investment was ₹15.40 lakh, ranging from ₹10.00 to ₹39.00 lakh. The average government subsidy was ₹5.78 lakh, while the average institutional loan was ₹5.30 lakh.

Each CHC served an average of 5.2 villages and 57 farmers. The average machinery density was approximately 6.55 machines per CHC. These findings indicate that the selected centres provided machinery services across multiple villages and agricultural operations.

Table 1. General characteristics of selected Custom Hiring Centres

Parameter	Mean	Minimum	Maximum
Capital investment (₹ lakh)	15.40	10.00	39.00
Government subsidy (₹ lakh)	5.78	4.00	11.50
Loan amount (₹ lakh)	5.30	0.00	20.00
Villages served per CHC	5.20	2	15
Farmers served per CHC	57.00	25	110
Machinery density (machines/CHC)	6.55	5	9

Among the selected CHCs, 18 (90%) were owned by individual entrepreneurs and 2 (10%) were managed by Self-Help Groups. The financing structure consisted of government subsidy, bank loan and

owner contribution. Government subsidy accounted for 37.50% of the total investment, followed by bank loan (34.42%) and own contribution (28.08%).by bank loan (34.42%) and own contribution (28.08%).

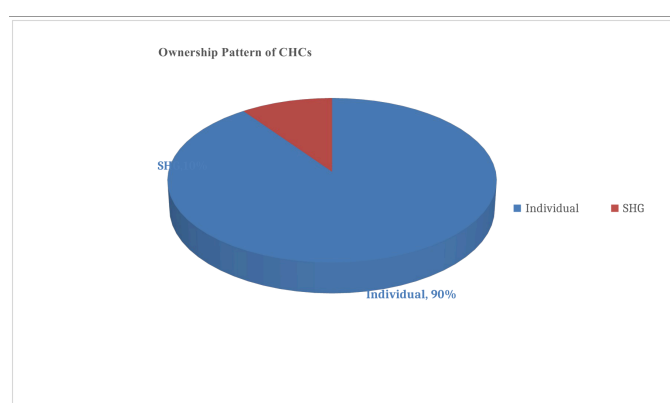
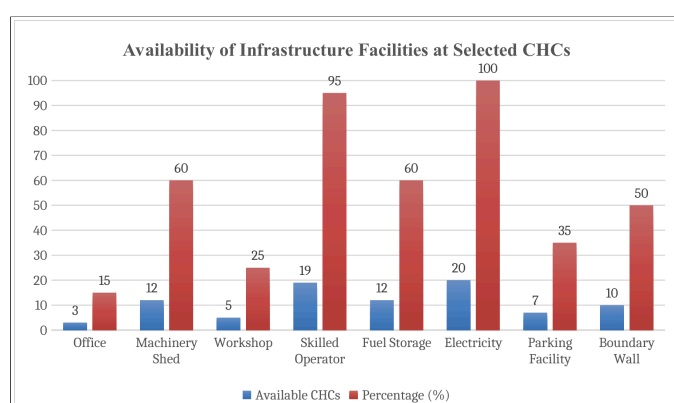


Figure 3. Ownership pattern of selected CHCs

3.2 Infrastructure status of CHCs

Infrastructure availability varied among the selected centres. Electricity was available in all 20 CHCs, while 19 CHCs had skilled operators. Machinery sheds and fuel-storage facilities were available

in 60% of the centres. Workshop facilities were available in only 25% of CHCs. Office facilities were available in 15%, parking facilities in 35% and boundary walls in 50% of the centres.

Table 2. Availability of infrastructure facilities at selected CHCs

Infrastructure facility	CHCs available	Percentage (%)
Office	3	15
Machinery shed	12	60
Workshop	5	25
Skilled operator	19	95
Fuel storage	12	60
Electricity	20	100
Parking facility	7	35
Boundary wall	10	50

The results show that basic operating facilities such as electricity and skilled operators were widely available, whereas dedicated workshops, offices and parking facilities were comparatively limited. The infrastructure pattern suggests scope for strengthening maintenance and storage facilities at several CHCs.

Figure 4. Availability of infrastructure facilities at selected CHCs

3.3 Machinery availability and inventory

A total of 131 agricultural machines were available across the 20 selected CHCs. Tractors constituted the largest share of the inventory with 22 units (16.79%), followed by seed drills with 20 units (15.27%), cultivators with 19 units (14.50%), reapers and threshers with 18 units each, and sprayers with 17 units. Only two combine harvesters and two MB ploughs were available.

Table 3. Machine-wise availability of farm machinery at selected CHCs

Machine	Quantity	Share (%)
Tractor	22	16.79
Seed drill	20	15.27
Cultivator	19	14.50
Reaper	18	13.74
Thresher	18	13.74
Sprayer	17	12.98
Rotavator	7	5.34
Pump set	6	4.58
MB plough	2	1.53
Combine harvester	2	1.53
Total	131	100.00

The inventory indicates that the selected CHCs were mainly equipped with machinery required for land preparation, sowing, harvesting, threshing and plant protection. The limited number of combine harvesters and MB ploughs indicates relatively specialized or seasonal demand for these machines.

3.4 Machinery utilization

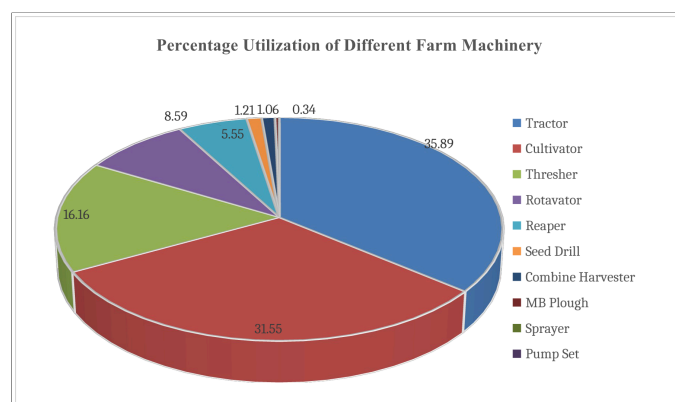
The total annual machinery utilization recorded across the 20 CHCs was 10,365 h. Tractors accounted for the largest share of utilization at 35.89%, followed by cultivators at 31.55% and threshers at 16.16%. Together, these three machine categories contributed 83.60% of total annual utilization.

Rotavators contributed 8.59%, reapers 5.55%, seed drills 1.21%, combine harvesters 1.06% and MB ploughs 0.34%. Sprayers and pump sets recorded no utilization during the survey period.

Table 4. Annual utilization of major farm machinery through selected CHCs

Machine	Total annual hours	Mean hours/CHC/year	Utilization (%)	Rental rate (₹ h ⁻¹)
Tractor	3,720	186.00	35.89	1,000
Cultivator	3,270	163.50	31.55	1,000
Thresher	1,675	83.75	16.16	1,000–1,200
Rotavator	890	44.50	8.59	1,200–1,500
Reaper	575	28.75	5.55	800–900
Seed drill	125	6.25	1.21	1,000
Combine harvester	110	5.50	1.06	2,500
MB plough	35	1.75	0.34	1,000
Sprayer	0	0.00	0.00	400
Pump set	0	0.00	0.00	200

The high utilization of tractors and cultivators reflects their broad applicability across field operations. Threshers also recorded substantial utilization because of their importance during post-harvest operations. In contrast, specialized machinery such as combine harvesters and seed drills showed lower utilization because of seasonal and crop-specific demand.

**Figure 5.** Percentage utilization of different farm machinery

3.5 District-wise machinery utilization

District-wise annual machinery utilization was highest in GPM at 3,230 h (31.16%), followed by Rajnandgaon at 2,765 h (26.68%), Kondagaon at 2,265 h (21.85%) and Raipur at 2,105 h (20.31%).

Table 5. District-wise machinery utilization

Table 5. District-wise machinery utilization

District	Total annual utilization (h)	Share (%)
GPM	3,230	31.16
Rajnandgaon	2,765	26.68
Kondagaon	2,265	21.85
Raipur	2,105	20.31
Total	10,365	100.00

Table 6. District-wise economic performance of selected CHCs

District	Capital investment (₹ lakh)	Gross income (₹ year ⁻¹)	Total cost (₹ year ⁻¹)	Net income (₹ year ⁻¹)	B:C ratio
GPM	11.70	650,800	508,070.59	142,729.41	1.26
Kondagaon	11.00	485,000	396,827.86	88,171.15	1.21
Rajnandgaon	15.60	611,000	569,856.22	41,143.78	1.08
Raipur	23.30	488,000	604,159.07	-116,158.07	0.87

The district-wise analysis demonstrates that higher capital investment did not necessarily correspond to higher economic returns. The Raipur CHCs had the highest average capital investment but also had higher average annual costs relative to gross income. In contrast, lower average investment combined with comparatively favourable machinery utilization and cost control was associated with higher B:C ratios in GPM.

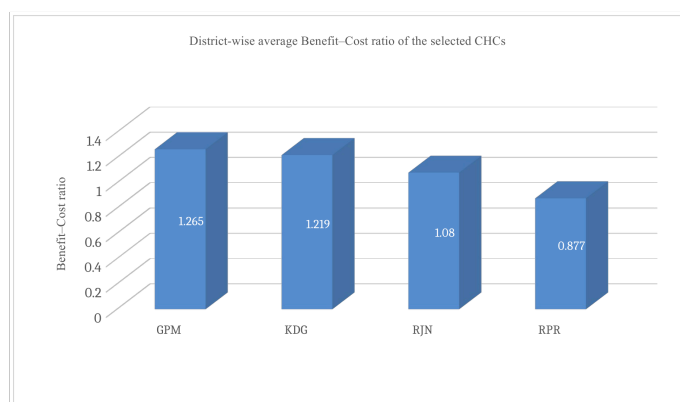


Figure 6. District-wise average Benefit-Cost ratio of selected CHCs

3.7 Annual cost structure of CHCs

The average annual operating cost of the selected CHCs was ₹519,728.43. Variable costs accounted for 69.57%, while fixed costs accounted for 30.43%.

Fuel constituted the largest component of annual cost, accounting for 45.94%, followed by depreciation (14.82%), repair and maintenance (11.85%) and interest on investment (9.69%). Lubrication, labour, insurance and housing accounted for smaller shares.

The district-wise variation indicates that utilization of CHC machinery was influenced by local agricultural conditions, demand for mechanized operations, existing private machinery ownership and availability of alternative hiring services.

3.6 Economic performance of selected CHCs

The economic performance of the selected CHCs varied considerably. Capital investment ranged from ₹10.00 lakh to ₹39.00 lakh, while annual gross income ranged from ₹2.44 lakh to ₹8.54 lakh. Annual operating cost ranged from ₹2.62 lakh to ₹9.71 lakh.

The individual CHC B:C ratio ranged from 0.66 to 1.41. Sixteen out of the 20 CHCs (80%) recorded B:C ratios above one, whereas four CHCs recorded ratios below one. Break-even utilization varied from 366.69 to 2,268.72 h year⁻¹.

Table 7. Average annual cost structure of selected CHCs

Cost component	Annual cost (₹ year ⁻¹)	Share (%)
Depreciation	77,000.00	14.82
Interest on investment	50,350.00	9.69
Insurance	15,400.00	2.96
Housing	15,400.00	2.96
Total fixed cost	158,150.00	30.43
Fuel	238,778.80	45.94
Lubrication	35,816.82	6.89
Repair and maintenance	61,600.00	11.85
Labour	25,382.81	4.88
Total variable cost	361,578.43	69.57
Total annual cost	519,728.43	100.00

The dominance of variable expenditure, particularly fuel, indicates that operating-cost management is an important component of CHC economic performance. Preventive maintenance, appropriate machinery scheduling and efficient fuel management may help control recurring expenditure.

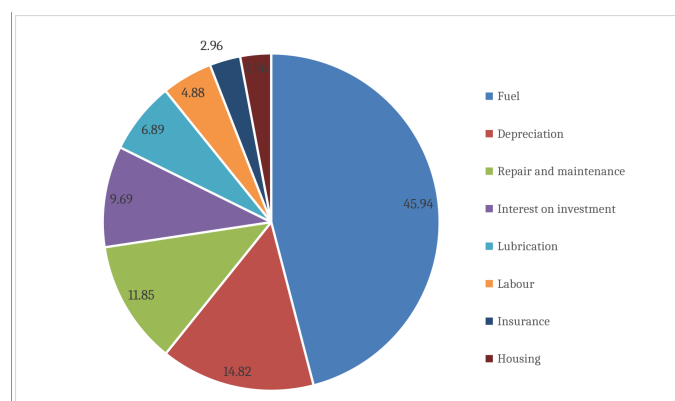


Figure 7. Contribution of different cost components to total annual cost.

3.8 Constraints faced by CHC operators

The major constraints were identified from responses of the 20 selected CHC operators. High fuel cost and delay in payment by farmers were reported by all 20 CHCs (100%). Low demand for some machinery was reported by 18 CHCs (90%). Loan repayment and lack of training facilities were each reported by 15 CHCs (75%). Poor road connectivity was reported by 60% and repair delay by 55% of the CHCs.

Other constraints included high repair and maintenance cost (30%), machinery breakdown during peak season (25%), shortage of skilled operators (15%) and seasonal demand variation (15%).

Table 8. Major constraints faced by selected CHCs

Constraint	CHCs reporting	Percentage (%)
High fuel cost	20	100
Delay in payment by farmers	20	100
Low demand for some machinery	18	90
Loan repayment	15	75
Lack of training facilities	15	75
Poor road connectivity	12	60
Repair delay	11	55
High repair and maintenance cost	6	30
Machinery breakdown during peak season	5	25
Shortage of skilled operators	3	15
Seasonal demand variation	3	15

The findings indicate that financial and operational constraints were more frequently reported than technical constraints. High fuel expenditure directly increases operating costs, while delayed payments may affect the working capital available to CHC operators. Low demand for specialized machinery can reduce annual utilization and make recovery of ownership costs more difficult.

Conclusion

The study assessed the operational status, infrastructure, machinery availability and utilization, economic performance and constraints of 20 Custom Hiring Centres in four selected districts of Chhattisgarh during 2025–26.

The selected CHCs had an average capital investment of ₹15.40 lakh and served approximately 5.2 villages and 57 farmers per centre. A total of 131 agricultural machines were available across the 20 centres. Electricity and skilled operators were widely available, whereas workshops, offices and parking facilities were comparatively limited. Annual machinery utilization was 10,365 h, with tractors, cultivators and threshers accounting for the major share of utilization. The results indicate that routine and versatile machinery formed the major operational base of the selected CHCs, whereas specialized machinery showed comparatively lower utilization.

The average annual operating cost was approximately ₹5.20 lakh, with variable costs contributing 69.57% of total expenditure. Fuel was the largest individual cost component, accounting for 45.94%. The B:C ratio of individual CHCs ranged from 0.66 to 1.41, and 16 of the 20 centres recorded B:C ratios above one. Break-even utilization varied considerably among the centres, demonstrating the importance of machinery utilization and operating-cost control.

The major constraints were high fuel cost, delayed payment by farmers, low demand for some machinery, loan repayment and inadequate training facilities. The study indicates that improvement in machinery utilization, preventive maintenance, timely payment mechanisms, farmer awareness and operator training can support the operational and economic sustainability of CHCs.

Suggested measures

- Fuel management: Promote fuel-efficient machinery, optimize field operations and encourage preventive maintenance.
- Timely payment: Promote digital payment systems and strengthen institutional credit support for farmers.
- Demand generation: Conduct field demonstrations and awareness programmes for specialized machinery such as seed drills and other equipment with low utilization.
- Training: Conduct periodic operator and farmer training through the Department of Agriculture, KVKs and agricultural universities.
- Small-farm mechanization: Promote compact and small-scale machinery suitable for fragmented holdings.
- Machinery scheduling: Facilitate inter-village and inter-district movement of machinery to improve utilization of specialized equipment.
- Maintenance facilities: Establish district-level service facilities and improve the availability of spare parts.
- Diversification: Expand CHC services to post-harvest, horticultural and allied agricultural machinery.

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