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Resource use, cost structure and economic viability of commercial layer farms in Jorhat district, Assam

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ABSTRACT

Background: Egg production in Assam has grown slowly and the state depends on eggs from other states, yet little is known about the costs and viability of its commercial layer farms. This study examined resource management, cost structure, profitability and economic feasibility of commercial layer farms of different sizes in Jorhat district, Assam.

Methods: Three commercial layer farms with 200, 6,000 and 70,000 layers were selected as small, medium and large cases from a size-stratified list of farms. Primary data for 2021-22 were collected by personal interview. Resource-use indicators, standard cost concepts (Cost A1, B2 and C2), farm income measures, break-even analysis and sensitivity of net income to egg price and feed cost were estimated.

Results: Feed was the largest cost item (55.1–80.9% of total cost) and fixed costs formed only 2.3–4.0% of total cost. Labour use fell from 2,118 to 60 mandays per 1,000 layers with increasing farm size, and total cost per egg fell from ₹10.39 on the small farm to ₹8.30 and ₹8.02 on the medium and large farms. All farms recorded positive net income after accounting for by-product revenues with returns over total cost of 1.16, 1.07 and 1.05 and net income of ₹1.61, ₹0.54 and ₹0.44 per egg. By-products contributed 5.4–16.7% of gross income, and total cost per egg was at or above the selling price on all farms, so profit depended on by-product income. Although the margin of safety in output was 58–87%, a 5.5% fall in egg price or a 6.8% rise in feed cost would eliminate the profit of the large farm. Layer farming in Jorhat is economically feasible but operates on thin margins, which makes feed cost management and by-product marketing central to its viability.

Keywords: Break-even analysis, Cost of production, Economies of scale, Layer farming, Profitability

Introduction

Commercial layer farming provides year-round income and employment and is one of the fastest-growing segments of Indian agriculture. National egg production rose from 82.93 billion in 2015-16 to 114.38 billion in 2019-20, a compound growth of 8.4% per annum (Department of Animal Husbandry and Dairying, 2019) [1]. Assam has not shared in this growth. Its production increased only from 474 million to 515 million eggs over the same period, about 2.1% per annum, and per capita availability in the state was 15 eggs per annum in 2018-19 against 79 for India as a whole (Department of Animal Husbandry and Dairying, 2019 [1], Department of Animal Husbandry, Dairying and Fisheries, 2018) [2]. The state therefore meets much of its demand with eggs brought in from other states (The Sentinel, 2022) [3].

Expanding local egg production requires farms that can produce at a cost competitive with these supplies. Studies elsewhere in India report that layer farming is profitable but operates with modest returns, with feed as the dominant cost and larger farms generally more efficient (Singh, 2024; Nikhila *et al.*, 2025) [5, 4]. Evidence for Assam is limited to sector-level assessments (Borah *et al.*, 2014; Ningthoukhongjam *et al.*, 2022) [6, 7], and very little is known at the farm level about how layer farms of different sizes in the state use resources, what their eggs cost to produce and how much room they have to absorb changes in prices and input costs.

Jorhat district ranked fifth in Assam in poultry population in 2019, with 20.35 lakh birds, yet it continues to bring in eggs from outside the district (Naiding, 2022) [8]. The present study was undertaken to analyse resource management and economic feasibility of commercial egg production in the district. The specific aims were to (i) describe resource use and management practices on layer farms of different sizes; (ii) estimate the cost structure, cost of production per egg and profitability of these farms; and (iii) assess their economic feasibility through break-even analysis and the sensitivity of net income to egg price and feed cost.

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Materials and methods

Study area and selection of farms

The study was conducted in Jorhat district, located in the central Brahmaputra Valley of Assam (26°45' N, 94°13' E). The district was selected purposively because of its high demand for eggs and poultry products. Layer farms that had been in continuous production for at least one year were identified with the help of the District S.H. & Veterinary Office, Jorhat, the District Poultry Office, Baghchung, and poultry dealers. Farms maintaining basic records were listed in ascending order of flock size and stratified into small (up to 5,000 birds), medium (5,001–20,000 birds) and large (above 20,000 birds) groups. One farm was selected from each group, giving a small farm with 200 layers, a medium farm with 6,000 layers and a large farm with 70,000 layers. A case study approach was adopted because the district had few commercial layer farms.

Data collection

Primary data for the year 2021-22 were collected from the owners during January–April 2022 through personal interviews using a pre-tested structured schedule. The schedule covered farm characteristics, breed and source of birds, housing, feed and water management, labour use, equipment, disease control, production, sales, and itemised costs and returns. Cost and return data relate to one production cycle of 72 weeks and were converted to an annual basis. Labour use was measured in mandays of eight hours and valued at the prevailing wage of ₹300 per manday.

Analytical framework

Resource-use indicators: Labour use per 1,000 layers, eggs produced per manday, layers per hectare, eggs per layer per year and feed cost per egg were computed to compare the intensity and productivity of resource use across farm sizes.

$$P_{BE} = (\text{Cost C2} - \text{By-product income}) / \text{Eggs produced} \quad (2)$$

The margin of safety in price was the selling price minus P_{BE} , which equals net income per egg.

Sensitivity analysis: The percentage rise in feed cost that would reduce net income to zero, with all else unchanged, was computed as net income divided by feed cost. The effect on the small farm of selling at the ₹8 price received by the medium and large farms was also assessed.

As the study covers three case farms, results are reported descriptively without statistical inference.

Ethical statement

The study was based on interviews with farm owners who participated voluntarily after the purpose of the study was explained to them. No experimental procedures were performed on animals, and farm-level information was kept confidential and is reported without identifying the farms or their owners.

Results

Resource use and management

The profile and resource use of the sample farms are presented in Table 1. The small farm kept 200 layers of Kalinga Brown, Inbro Brown and Rainbow Rooster on 0.01 ha, half in deep litter and half in cages, and was operated entirely by two family members without formal training. The medium and large farms kept the commercial hybrid BV-300 in battery cages, sourced chicks from a private hatchery in Kolkata, operated their own feed mills and employed hired and permanent workers; their owners had specialised training in layer farming. The small farm reduced feed cost by producing 60% of its

Cost concepts: Costs were classified using standard farm management cost concepts. Cost A1 comprised all paid-out costs: feed, chicks, hired casual and permanent labour, medicines and vaccines, electricity, transportation, miscellaneous expenses, depreciation on buildings and equipment, and interest on working capital at 6% per annum. No land was leased in, so Cost A2 equalled Cost A1. Cost B2 was Cost A1 plus the rental value of owned land and interest on fixed capital at 6% per annum, and Cost C2 was Cost B2 plus the imputed value of family labour. Cost C2 was taken as the total cost of production. For the variable–fixed classification, all human labour (family, casual and permanent), feed, chicks, medicines, electricity, transportation, miscellaneous expenses and interest on working capital were treated as variable costs, and depreciation, rental value of land and interest on fixed capital as fixed costs. Cost per egg under each concept was obtained by dividing the cost by the number of eggs produced.

Returns and income measures: Gross income (GI) was the value of eggs, spent hens, manure and empty feed bags sold. Farm business income was GI minus Cost A1, family labour income was GI minus Cost B2, and net income was GI minus Cost C2. Return over total cost was GI divided by Cost C2.

Break-even analysis: Break-even production, the annual output at which gross income just covers total cost, was computed as:

$$Q_{BE} = TFC / (GI_e - AVC_e) \quad (1)$$

where TFC is total fixed cost per year, GI_e is gross income per egg and AVC_e is average variable cost per egg. The margin of safety in output was actual production minus Q_{BE} . Two break-even prices were computed. The gross break-even price, equal to total cost per egg (Cost C2 ÷ eggs produced), is the price at which egg sales alone would cover total cost. The net break-even price credits by-product income against total cost:

feed in its own mill from local ingredients and by feeding vegetable and kitchen waste and duckweed.

Resource-use intensity changed sharply with farm size. Labour use fell from 2,117.6 mandays per 1,000 layers on the small farm to 288.2 on the medium farm and 59.8 on the large farm, and output per manday rose from 91 to 676 and 3,293 eggs. Stocking density rose from 20,000 to 35,000 layers per hectare. Egg yield per layer was similar across farms (193.41–196.94 eggs per year). Feed cost per egg was lowest on the small farm (₹5.73) and similar on the medium (₹6.56) and large (₹6.49) farms.

Labour use in adult mandays of eight hours. Eggs per layer are annualised from a 72-week production cycle.

Cost of production

Annual costs per layer by item and cost concept are presented in Table 2. Feed was the largest cost on all farms, accounting for 55.12% of Cost C2 on the small farm and about 80% on the medium (79.02%) and large (80.87%) farms. On the small farm the imputed value of family labour was the second-largest item (31.60%), whereas on the medium and large farms labour of all kinds accounted for only 5.35% and 1.14% of total cost. Variable costs made up 96.03–97.67% of total cost, and fixed costs only 2.33–3.97%.

Total cost per layer (Cost C2) was ₹2,010.47 on the small farm, ₹1,616.84 on the medium farm and ₹1,579.82 on the large farm, and total cost per egg fell from ₹10.39 to ₹8.30 and ₹8.02. The ranking reversed for paid-out costs: Cost A1 per egg was lowest on the small farm (₹7.04), followed by the large (₹7.82) and medium (₹8.20) farms. The cost advantage of the larger farms therefore lay entirely in lower labour use per egg, which is shown together with the other cost components in Fig 1.

Table 1. Profile and resource use of sample layer farms in Jorhat district, 2021-22.

Particulars	Small farm	Medium farm	Large farm
Farm characteristics			
Layers kept per year (no.)	200	6,000	70,000
Area of farm (ha)	0.01	0.27	2.00
Years in operation	3	2	4
Specialised training in layer farming	No	Yes	Yes
Inputs and management			
Housing system	Deep litter (100 birds) and cages (100 birds)	Cages	Cages
Breed/strain	Kalinga Brown, Inbro Brown, Rainbow Rooster	BV-300	BV-300
Source of chicks	District Poultry Farm, Bagchung	Private hatchery, Kolkata	Private hatchery, Kolkata
Feed source	40% commercial; rest own mill, kitchen waste, duckweed	Own feed mill	Own feed mill
Source of water	Groundwater, rainwater	Groundwater, rainwater	Groundwater, pipeline
Workers: family / hired / permanent (no.)	2 / 0 / 0	2 / 3 / 5	2 / 40 / 10
Resource-use indicators			
Labour use (mandays per year)	423.5	1,729.4	4,185.9
Labour use (mandays per 1,000 layers)	2,117.6	288.2	59.8
Layers per hectare	20,000	22,222	35,000
Eggs per layer per year	193.41	194.82	196.94
Eggs per manday	91	676	3,293
Feed cost per egg (₹)	5.73	6.56	6.49

Table 2. Annual cost of egg production per layer (₹) on sample farms by cost item and cost concept, 2021-22.

Cost item	Small farm	Medium farm	Large farm
Variable costs			
Feed	1,108.24 (55.12)	1,277.65 (79.02)	1,277.65 (80.87)
Chicks	24.71 (1.23)	24.71 (1.53)	19.76 (1.25)
Hired casual labour	—	10.59 (0.65)	7.26 (0.46)
Permanent labour	—	70.59 (4.37)	10.59 (0.67)
Family labour (imputed)	635.29 (31.60)	5.29 (0.33)	0.09 (0.01)
Medicines and vaccines	72.00 (3.58)	72.00 (4.45)	84.00 (5.32)
Electricity	30.00 (1.49)	8.00 (0.49)	17.14 (1.09)
Transportation	11.29 (0.56)	11.29 (0.70)	11.29 (0.71)
Miscellaneous	5.00 (0.25)	5.00 (0.31)	2.14 (0.14)
Interest on working capital	77.02 (3.83)	90.29 (5.58)	87.11 (5.51)
Total variable cost	1,963.55 (97.67)	1,575.41 (97.44)	1,517.05 (96.03)
Fixed costs			
Depreciation on buildings	31.76 (1.58)	13.76 (0.85)	9.08 (0.57)
Depreciation on equipment	2.06 (0.10)	12.71 (0.79)	13.61 (0.86)
Rental value of owned land	12.35 (0.61)	14.12 (0.87)	37.82 (2.39)
Interest on fixed capital	0.74 (0.04)	0.85 (0.05)	2.27 (0.14)
Total fixed cost	46.92 (2.33)	41.44 (2.56)	62.77 (3.97)
Cost concepts (₹ per layer)			
Cost A1	1,362.08	1,596.58	1,539.64
Cost B2	1,375.17	1,611.55	1,579.73
Cost C2	2,010.47	1,616.84	1,579.82
Cost per egg (₹)			
Cost A1	7.04	8.20	7.82
Cost B2	7.11	8.27	8.02
Cost C2	10.39	8.30	8.02
Total cost per farm (₹ per year)			
Cost C2	402,094	9,701,054	110,587,271

(continued on next page)

Figures in parentheses are percentages of total cost (Cost C2). Cost A1 = paid-out costs including depreciation and interest on working

capital; Cost B2 = Cost A1 + rental value of owned land + interest on fixed capital; Cost C2 = Cost B2 + imputed value of family labour.

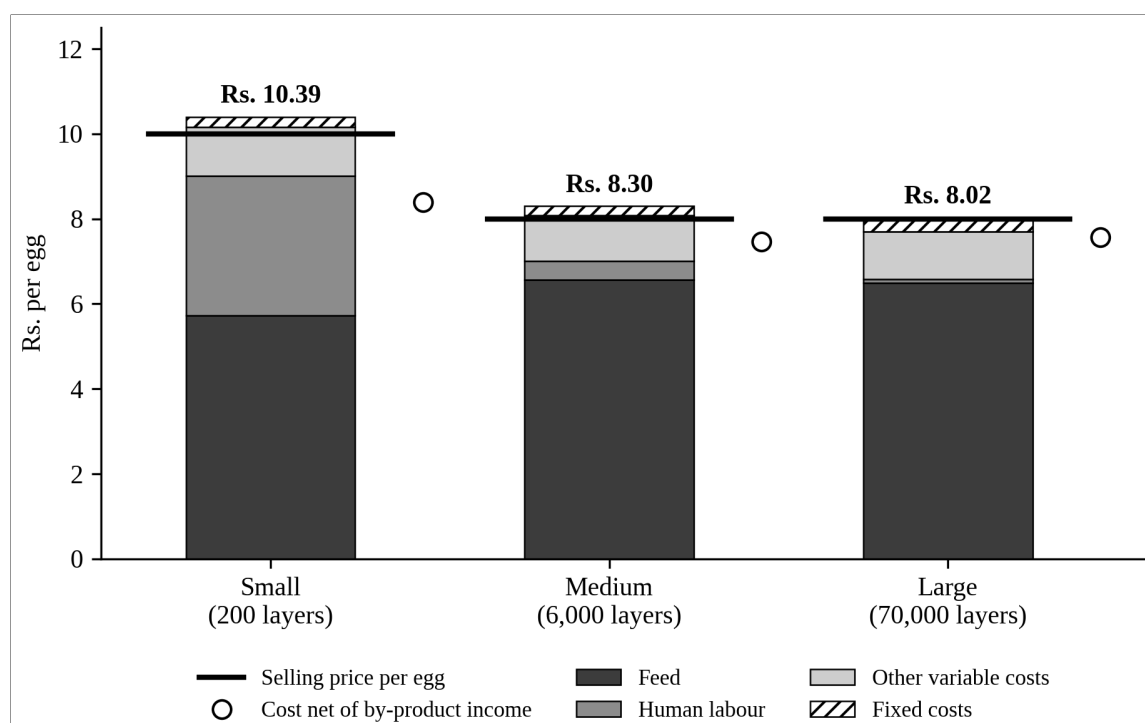


Figure 1. Total cost of production per egg (Cost C2) by component on sample layer farms, with the selling price of eggs and the cost net of by-product income, Jorhat district, 2021-22.

Returns and profitability

Returns and income measures are presented in Table 3. Sale of eggs provided 83.28%, 90.49% and 94.56% of gross income on the small, medium and large farms, with the remainder from spent hens, manure and empty feed bags. Gross income per layer was highest on the small farm (₹2,322.35), which sold eggs at ₹10 each against ₹8 on the other

farms and earned more from by-products. Net income was positive on all farms: ₹311.88, ₹105.57 and ₹86.41 per layer, or ₹1.61, ₹0.54 and ₹0.44 per egg. Return over total cost was 1.16, 1.07 and 1.05. In absolute terms, annual net income was ₹62,377 on the small farm, ₹633,417 on the medium farm and ₹6,048,494 on the large farm. Family labour income on the small farm, the return to its two family workers, was ₹189,436 per year.

Table 3. Annual returns and income measures of sample layer farms, Jorhat district, 2021-22.

Particulars	Small farm	Medium farm	Large farm
Gross income (₹ per layer)			
Eggs	1,934.12	1,558.59	1,575.53
Spent hens	105.88	105.00	84.65
Manure	70.59	—	3.63
Empty feed bags	211.76	58.82	2.42
Total gross income	2,322.35	1,722.41	1,666.23
Share of by-products in gross income (%)	16.72	9.51	5.44
Income measures (₹ per layer)			
Farm business income (GI – Cost A1)	960.27	125.83	126.58
Family labour income (GI – Cost B2)	947.18	110.86	86.50
Net income (GI – Cost C2)	311.88	105.57	86.41
Profitability			
Net income per farm (₹ per year)	62,377	633,417	6,048,494
Net income per egg (₹)	1.61	0.54	0.44
Return over total cost (GI/Cost C2)	1.16	1.07	1.05

GI = gross income. Cost concepts as defined in Table 2.

Economic feasibility

Break-even and sensitivity estimates are presented in Table 4. Break-even production was 5,059 eggs on the small farm, 329,482 on the medium farm and 5,800,923 on the large farm, well below actual production. The margin of safety in output was therefore large, at

86.92%, 71.81% and 57.92% of actual production, because fixed costs formed a small share of total cost.

Price margins were much narrower. Total cost per egg was above the selling price on the small (₹10.39 against ₹10.00) and medium (₹8.30 against ₹8.00) farms and almost equal to it on the large farm (₹8.02 against ₹8.00), so egg sales alone did not cover total cost on any farm.

After crediting by-product income, the net break-even price was ₹8.39, ₹7.46 and ₹7.56 per egg, leaving a margin of safety in price of 16.13%, 6.77% and 5.48% of the selling price. Net income would be eliminated by a rise in feed cost of 28.14% on the small farm, 8.26%

on the medium farm and 6.76% on the large farm. If the small farm sold its eggs at the ₹8 received by the larger farms, it would incur a net loss of ₹14,988 per year, or ₹0.39 per egg.

Table 4. Break-even analysis and sensitivity of sample layer farms, Jorhat district, 2021-22.

Particulars	Small farm	Medium farm	Large farm
Break-even production			
Actual egg production (no. per year)	38,682	1,168,941	13,785,882
Gross income per egg (₹)	12.01	8.84	8.46
Average variable cost per egg (₹)	10.15	8.09	7.70
Total fixed cost (₹ per year)	9,385	248,612	4,394,118
Break-even production (no. of eggs)	5,059	329,482	5,800,923
Margin of safety (no. of eggs)	33,624	839,459	7,984,959
Margin of safety (% of actual production)	86.92	71.81	57.92
Break-even price			
Selling price of egg (₹)	10.00	8.00	8.00
Total cost per egg, Cost C2 (₹)	10.39	8.30	8.02
By-product income per egg (₹)	2.01	0.84	0.46
Break-even price net of by-product income (₹)	8.39	7.46	7.56
Margin of safety in price (₹ per egg)	1.61	0.54	0.44
Margin of safety in price (% of selling price)	16.13	6.77	5.48
Sensitivity			
Rise in feed cost that eliminates net income (%)	28.14	8.26	6.76

Break-even production = $T_{FC}/(GI \text{ per egg} - AVC \text{ per egg})$. Net break-even price = $(\text{Cost C2} - \text{by-product income})/\text{eggs produced}$. Feed cost sensitivity = $\text{net income}/\text{feed cost} \times 100$.

Discussion

Resource use and cost structure

The dominance of variable costs, and of feed within them, is consistent with other studies of layer farming in India. In Punjab, variable and fixed costs accounted for 96.66% and 3.34% of total cost, and feed was the most important cost item (Singh, 2024) [5], closely matching the 96–98% variable-cost share observed here. Because feed accounts for about four-fifths of total cost on the medium and large farms, the cost and quality of feed largely determine their competitiveness. The ingredients used included maize, soybean, rice bran, mustard oil cake and fish meal, some of which were brought from outside the state, so local production of feed grains and oilseed meals would directly lower the cost of eggs produced in Assam.

Scale affected costs mainly through labour. The small farm used about 35 times more labour per layer than the large farm, and the imputed value of this family labour accounted for nearly a third of its total cost. On paid-out costs alone the small farm was the cheapest producer, helped by a low feed cost per egg from its own feed mill and from the use of kitchen waste and duckweed. Small layer units can therefore be viable as family enterprises that earn a return on household labour, but they cannot match larger farms on total cost per egg. The higher labour productivity of the medium and large farms reflects battery-cage housing with automatic waterers, larger flock sizes and trained management. Similar egg yields across the three farms suggest that the larger farms' advantage came from labour efficiency rather than from higher productivity per bird.

Profitability

Returns over total cost of 1.05–1.16 indicate that layer farming in Jorhat is profitable but with modest margins, comparable to the output–input ratio of 1.09 reported for layer farms in Punjab (Singh, 2024) [5]. Studies in Punjab and Andhra Pradesh found large layer farms to be more efficient or more profitable than small ones (Singh, 2024; Nikhila *et al.*, 2025) [5, 4]. In the present study the small farm

earned the highest return per layer and per egg, but this advantage rested on a ₹2 per egg price premium and on by-product income. At the price received by the larger farms it would have made a loss. The results are therefore consistent with economies of scale in total cost, with the small farm's higher returns explained by its prices and by-products rather than by lower costs.

By-products were essential to profitability. Since total cost per egg was at or above the selling price on every farm, income from spent hens, manure and feed bags turned a break-even or loss position on egg sales into a profit. The small farm made the most of this, earning 16.72% of gross income from by-products, including manure sold at ₹30–40 per kg. The medium farm did not market its manure. Systematic marketing of manure and spent hens is a low-cost way for larger farms to widen their margins.

Economic feasibility

All three farms were economically feasible, producing well above their break-even output. The large margin of safety in output, however, mainly reflects the small share of fixed costs, and it overstates the farms' resilience. The more relevant measures are the price and feed-cost margins. A fall in egg price of about 5–7%, or a rise in feed cost of about 7–8%, would remove the profit of the medium and large farms. Movements of this size in egg prices or feed costs are plausible within a single production cycle, so these farms are exposed to losses in unfavourable periods. Large farms elsewhere have been reported to show a higher margin of safety than small farms (Nikhila *et al.*, 2025) [4]; the opposite ranking here again reflects the small farm's price premium.

Implications

Four measures follow from the results. First, reducing feed cost should be the main priority, through bulk procurement, local production of maize and soybean, and support for farm-level feed mills. Second, by-products should be marketed systematically, particularly manure, which the medium farm did not sell. Third, training and support for caged housing and improved strains could help small units lower labour use per egg as they expand. Fourth, small producers that sell at a premium should protect it by marketing fresh, locally produced eggs directly to buyers. For state programmes such as the

Assam Poultry Development Project (Ningthoukhongjam *et al.*, 2022) [7], these findings suggest that support for feed supply and for scaling up from backyard to small commercial units would do most to improve the competitiveness of local egg production.

Limitations

The study is based on three case farms in one district for one year, and the results describe these farms rather than a population of farms. The data were largely based on the owners' recall, since detailed records were limited. Costs and returns were annualised from a 72-week production cycle, and data on mortality and capital investment were not analysed. A survey of a larger sample of layer farms across Assam would allow statistical comparison across size groups.

Conclusion

Commercial layer farming in Jorhat district was profitable on small, medium and large farms in 2021-22, with returns over total cost of 1.05–1.16. Feed accounted for 55–81% of total cost, and scale reduced total cost per egg from ₹10.39 to ₹8.02 mainly by reducing labour use per layer. Profit depended on by-product income, as total cost per egg was at or above the selling price on all farms, and the medium and large farms would lose their profit with a fall of about 5–7% in egg price or a rise of about 7–8% in feed cost. Layer farming in the district is therefore feasible but vulnerable, and its expansion depends above all on reducing feed cost. Future research should cover a larger sample of farms across Assam, include investment appraisal using discounted cash-flow measures, and examine the effect of feed price variation on farm viability over several production cycles.

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Conflict of Interest

The authors declare that they have no conflict of interest.

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