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RESEARCH PAPER

Break-Even Analysis, Milk-Feed Cost Squeeze, and Earned Income Vulnerability in North Indian *Gaushalas*

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ABSTRACT

How many productive animals would have to be on a *Gaushala* to be independent of donations, and why is it that milk revenue never really fills the gap? These questions are at the heart of *Gaushala* financial policy, but neither has been addressed by previous multi-state work with audited data. This paper does that with the help of primary information obtained from the 32 *Gaushalas* surveyed in Haryana, Punjab, Rajasthan, and Uttar Pradesh in 2024–25. The results are presented in the context of three interrelated analyses. First, a break-even productive animal share analysis reveals that, for earned income self-sufficiency, a sector mean of nearly 37.5% (SD: 16.1 pp; range: 10.4–81.6%) would be required, whereas the break-even threshold for the sector under simulation is around 30%. Second, a milk-feed cost squeeze analysis reveals that the average institution is spending 150.8 per litre of milk for feed, resulting in a negative margin, which highlights why a sector that relies on milk revenue to achieve self-sufficiency is a challenge. Third, sensitivity scenarios to earned income show that the highest single intervention to income in the sector is 0.445, and the highest combined intervention is 0.422, both well below the BCR of 1.0 required for self-sufficiency. These findings challenge the policy debate: dependency on transfer income isn't a stage that can be managed more effectively; it is the financial imprint of a welfare mandate. The policy issue is what to do to make that dependency more stable, closer to the true cost, and conditional on institutional performance.

HIGHLIGHTS

- First multi-state, audited break-even productive-share estimate for Indian gaushalas: sector mean 37.5% vs observed 11.8% - a 25.7 pp gap that prices the welfare mandate.
- Milk-feed cost squeeze quantified for the first time: feed costs ` 150.8/litre against a ₹ 42.6 milk price, a − ₹ 108.2/litre margin at each of the 32 institutions.
- No revenue intervention, individually or combined, achieves self-sufficiency; even increasing by-product revenue by three times raises the sector-earned BCR to only 0.445 (threshold = 1.0).
- Dung revenue (BCR + 0.071) beats a 5/litre milk price hike (+0.017) because it comes from the total herd, not the productive minority.
- The negative correlation between EPA and productive share ($\rho = -0.670$) indicates that the 30% break-even target needs to be met by real productivity gains and not by animal reclassification.
- Dependence on transfer income is structural, not transitional - support should be cost-anchored, tiered, and durable, not framed as a "bridge to self-sufficiency."

Keywords: *Gaushalas*, Milk, break-even productive animal share, milk-feed cost squeeze, benefit-cost analysis, North India

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India's relationship with its cattle has always been complicated. The sacred and cultural status accorded to the cow in most states also creates an economic paradox, which is witnessed on the roadsides, among the crops and in municipal garbage dumps every day along the length of the Hindi belt: once a dairy cow's productivity drops below her feed value, she cannot be sold for slaughter. According to the 20th Livestock Census (Government of India, 2019), India has 5.02 million stray cattle, of which 1.18 and 1.27 million are in Uttar Pradesh and Rajasthan, respectively. The fact that seven of the top ten most impacted states have seen a rise in their number of impacted cattle between 2012 and 2019 indicates that this trend is not changing. Bullocks have become redundant due to mechanisation of farms; the economic productive life of dairy cows is curtailed owing to improved crossbreeds and the removal of the option of slaughter due to state-level slaughter bans. The overlap of these structural changes, mechanisation, breed turnover and limited exit is indicative of wider processes of agricultural transformation that have transformed rural livestock systems in developing economies (World Bank, 2007). This results in a stray cattle population that grows year-on-year, causes communities measurable damage, causes road accidents, creates a municipal burden, and from which communities cannot escape.

This problem has been addressed through the institutional effort of the *Gaushala* network. Its name is Sanskrit for cow (*gau*) and shelter (*shala*), and the idea of organised cattle shelters was established centuries before modern India, documented in the Arthashastra and in the records of medieval regional courts. The modern *Gaushala* as a formally registered and publicly accountable institution came into existence in the late nineteenth century, in part due to cow protection societies (*Gau Raksha Sabhas*) which sprung up in northern India in the 1880s and 1890s in response to colonial economic policies and Hindu revivalism. In 1879, the first formally registered *Gaushala* in the modern sense was set up in Rewari (Haryana). In the subsequent 100 years, the network has steadily increased, and today it consists of more than 5,000 registered institutions in India, the highest density being found in the four states under this study-Haryana, Punjab, Rajasthan and Uttar Pradesh.

These institutions are in an uncharacteristic location on the institutional landscape of India. They are simultaneously welfare groups (sheltering animals, feeding, veterinary care, etc.), religious groups (integrated into the devotional practice of cow protection in Hinduism), commercial groups (generating income from milk, dung, by-products, and cattle-derived products) and quasi-public groups (receiving grants from the government and funds from corporations, and providing a de facto public service in keeping stray cattle out of public places). This institutional hybridity engenders financial structures that don't easily fit into charitable non-profit or productive agricultural enterprise models.

The financial problem these institutions are confronted with is not incidental. *Gaushalas* are formed to take in the animals who are rejected by the market: the aged cows whose lactation period has ended, injured animals found on the roadsides, bulls who are no longer useful on their farms and stray cattle who are disposed of by the local authorities. The percentage of stray animals, non-productive by definition at the time of their admission, is between 77% and 81% of all admissions in the four states that were the subject of this study, and they will probably be non-productive for most or all of their lives. This demographic fact is that only a small percentage of any *Gaushala* herd can be used for earned income from milk, dung or by-products; the rest need to be taken care of with no commercial benefit, as a welfare issue. The difference between the money that an institution receives and the operating expenses, which are largely funded by charitable donations and government grants, is also volatile and insufficient, and does not keep pace with the number of animals supported.

The question of this paper, namely what share of productive animals a *Gaushala* would have to employ to earn enough to cover its costs, is both practically urgent and analytically important. It is analytically significant because the existing *Gaushala* economics literature, internally complete, hasn't addressed these issues with audited multi-state data and a transparent analytical approach. It is almost imperative because the government support programmes run under the banner of the *Rashtriya Gokul Mission*, the Government *Gau Seva Ayog* programme and the municipal corporation grant

programme, both in terms of design and attempted outcomes, do not take into account the break-even thresholds or any structural cost limits, which are independently verified.

This picture is further confirmed by recent work since 2020. Financial constraint is identified as the primary constraint on shelter cattle welfare by Sharma *et al.* (2020), while Singh *et al.* (2021) and Rohith *et al.* (2021) report that Gaushalas in Haryana and Telangana respectively are dependent on donations; Chandra *et al.* (2023) document housing and infrastructure gaps in shelters; and the NITI Aayog (2023) task force places the economic viability of *Gaushalas*, particularly through organic and bio-fertiliser value chains, at the centre of national stray cattle policy.

Three research gaps follow directly from this literature: (i) no multi-state study with audited financial records has estimated the productive animal share at which a *Gaushala* breaks even on earned income; (ii) the per-litre milk-feed cost structure of shelter herds has not been quantified; and (iii) no study has stress-tested realistic revenue interventions against the self-sufficiency threshold. This paper addresses each of these gaps.

Conceptually, the paper links welfare economics with institutional sustainability. The care of non-productive cattle is a merit good with public good characteristics: its benefits- fewer road accidents, less crop damage and a lower municipal burden- accrue to society at large and are not captured as institutional revenue. Institutional sustainability, in turn, requires that costs be covered by some combination of earned and transfer income. The break-even productive animal share is the bridge between the two: it converts the welfare mandate into the herd composition that earned income self-sufficiency would demand, and thereby prices the mandate.

This paper makes three contributions. First, it provides the break-even productive animal share for each institution: the share of productive animals required for all costs to be covered by earned income alone, without any transfer income. This computation has not been attempted in the *Gaushala* literature before, and its outcome, a sector mean of 37.5% as opposed to an observed mean of 11.8%, is directly interpretable for policy in quantifying the financial cost of the welfare mandate. Secondly, it dissects the milk-feed cost squeeze, the structural difference between the income institutions receive from milk and the cost of their feed to produce it, which means that earned income improvements, no matter how large, cannot close the gap. Third, it stress tests the sector's earned income position using sensitivity scenarios to determine what is achievable with specific revenue interventions, and concludes that even the most ambitious and combined interventions fail to get the sector close to being self-sufficient.

REVIEW OF LITERATURE

The Historical and Institutional Context

The first step to understanding the economics of *Gaushalas* is to understand the institutional nature of *Gaushalas*, which is neither a business dairy nor a charitable organisation. The most complete history of the cow shelter tradition in South Asia is provided by Lodrick (2005), who traces the tradition from the public cattle pounds of the medieval kingdoms to the religious endowment (*dharmashalas*) that used to shelter old and injured cattle to the modern registered institution. The cow protection movement of the nineteenth century made the practice of cow protection a public and politically charged one instead of a mainly private and philanthropic one. In the 1880s, *Gau Raksha Sabhas* were created throughout northern India, and *Gaushala* registration was formalised under provincial legislation, laying the groundwork for most of today's organisations: a registered society with a committee, relying mostly on the generosity of the community and operating on a mandate to provide shelter for all cattle, irrespective of their economic value.

The most recent systematic documentation of *Gaushala* management practices is by Sharma *et al.* (2020), and they have surveyed 110 *Gaushalas* in seven states in India. They identify several baseline facts which help contextualise the financial analyses of subsequent studies: the average *Gaushala* accepts 70-90% of its animals as stray; the average productive animal share is 10-20%; a typical service offered is feed and shelter, and the provision of welfare services for veterinary care and animal comfort varies widely. Many institutions

fail to deliver care which is even lower than the internationally recognised welfare standard; not out of indifference, as Sharma *et al.* (2020) mention, but due to financial constraints. Chandra *et al.* (2023) also report a substantial difference among the housing facilities in the *Gaushalas*, where the highest standards of housing facilities are generally provided according to the financial means and not necessarily the welfare definition.

The policy of the Government of India has been reviewed, according to which these institutions are to be registered under the State Societies Acts, and the per-animal support rates to them under various central and state schemes are to be provided, while they are to be placed under the auspices of the State *Gau Seva Ayog*. These reviews conclude that per-animal support rates are determined through administrative and political means, and not necessarily in reference to independently-verified cost-of-care information, which is what the break-even and cost-squeeze analyses in this paper make more apparent.

Agricultural economics literature on *Gaushala* finances

Although the research on *Gaushala* financial performance is limited, the research is consistent. The benchmark income-expenditure structure for a comparative study exists in the survey of ten *Gaushalas* conducted by Bijla and Singh (2019), in which donations contributed 75% of the total income and feed absorbed 50% of total expenditure, and the mean gross ratio (total cost/total income) was 0.97, just dipping into loss territory. ROVC was positive for all ten institutions, but several had a negative net income when depreciation and fixed charges were added.

Singh *et al.* (2021) expanded on this framework and developed a composite *Gaushala* Sustainability Index (GSI) using six financial and operational dimensions for a larger sample size in Haryana. They found that 62% of institutions were below the minimum threshold of survivability and that the single strongest negative correlate of the index was donation dependency (74%). Significant scale effects were also identified by Singh *et al.* (2021), with larger institutions having higher sustainability scores, which were mainly due to more milk market development and higher government support access.

A survey of *Gaushalas* in Karnataka by Mandi and Subash (2019) showed a completely different income pattern, wherein the large *gaushalas* received 45% of their income from government or corporations and 20% from milk sales. In contrast, small *gaushalas* had more than half of their income from individual donors. It is important to note that Rohith *et al.* (2021) reported negative net incomes in the sampled Telangana *Gaushalas*, which was mainly attributed to increased feed costs relative to milk income as an early sign of a milk-feed cost squeeze, the same of which is systematically captured through this current paper for the first time.

The By-Product and Energy Revenue Literature

A growing literature documents the commercial potential of cattle by-products and energy generation at *Gaushalas*, partly because of government interest in making these institutions financially self-sustaining and partly because of engineering innovations by the *Gaushalas*. Sen *et al.* (2020) have performed a detailed techno-economic feasibility study on a community biogas plant at a *gaushala* in Rajasthan, and showed that with conservative assumptions, the payback period would be 7-9 years and the electricity production cost could be achieved at ₹ 4.79 per kWh, a reduction of about 40% from the existing grid tariff. Such a Kanpur educational institution has been reported to generate about 40 units of electricity per day with a bullock-driven generator, and the capital cost is recovered in 3 years by avoiding electricity purchases.

One of the largest *gaushalas* in India, the Kanpur *gaushala* has been documented as having an integrated system of by-products which includes vermicompost production, organic agriculture using panchgavya, use of bullock energy and biogas, and this is able to generate a significant portion of the operating revenues.

The common theme in this literature is its exceptionalism. As mentioned above, practices described in Sen *et al.* (2020) and other techno-economic analyses repeatedly appear in policy documents, because these practices are not representative of the sector. The majority of *Gaushalas* are not able to replicate such models

because of a lack of capital investment, management skills, and the size of the operations. The sensitivity scenarios for earned income (Section 4.3 of this paper) do not consider what improvements in by-product revenues can achieve at the level of individual exemplary institutions, but rather at the sector level; even if by-product revenues were tripled, the sector-mean earned BCR would only improve from 0.334 to 0.445.

Allied Livestock Welfare Literature – Cost of Care Benchmarking

Unlike other countries with an institutional livestock welfare setting and a verified per-animal cost benchmark, India has no verified benchmark for the cost of an animal in *Gaushalas*. The ASPCA and Maddie's Fund release annual cost-of-care benchmarks for animal shelters in the United States, broken down by species, level of care and shelter type. The RSPCA release similar statistics for cattle rescues in the United Kingdom. A data series that is most similar to Indian livestock is the ICAR cost-of-production data series for dairy cattle, which provides state-wise estimates of milk production variable cost per litre. These figures, however, are for productive commercial dairy herds, rather than welfare-shelter numbers with a non-productive herd composition. The cost figures for commercial dairy cannot be used as benchmarks to assess *Gaushala* finances, as the composition of productive animals differs: 80-90% productive animals in commercial dairy and 10-12% productive animals in *Gaushala*.

In the general farm management field, it is common practice to use per-animal cost analysis as a tool to evaluate the institutional financial performance in livestock enterprises (FAO, 2012). Bojnec and Latruffe (2013) used per-animal cost analysis to assess the effects of agricultural subsidy levels on technical efficiency at the level of livestock farms in Slovenia. Latruffe and Desjeux (2016) employed a comparable approach of cost-per-animal to assess the impacts of Common Agricultural Policy support in French agriculture. It would, therefore, be convenient to say that the methodological footprints for break-even and cost-squeeze analysis in the livestock welfare context are well laid out internationally, and its application in the *Gaushala* institutional context is new.

The existing literature is lacking in the following areas. Based on the previous review, three gaps will be addressed in this paper. Firstly, it is to be noted that the break-even productive animal share, the productive proportion required for full earned income self-sufficiency, has not been estimated for any *Gaushala* institution and for the sector as a whole. Second, the milk-feed cost squeeze–the relationship between feed cost/ litre and milk revenue/litre–has not been analysed at the per-litre level, which leaves the question unanswered: why is it that milk revenue growth is never in step with the effort invested – in the form of feed cost? Thirdly, earned income sensitivity scenarios that validate specific revenue interventions against a confirmed baseline BCR have not been tried and the realistic financial impact of by-product development programmes cannot be assessed.

MATERIALS AND METHODS

Study Area and Sampling

A total of 32 *Gaushalas* were studied, with 8 in each state of Haryana, Punjab, Rajasthan and Uttar Pradesh, obtained using purposive stratified sampling of herds (small < 500 animals, medium 500-1500 animals, large > 1500 animals), urban or rural area, and formal financial records. The minimum operating age was 5 years. During 2024–25, a face-to-face structured interview was completed with each institution's president, secretary and accounts manager. For 19 institutions, the three-year averages were used. For the remaining 13 institutions, the single-year audited accounts were used (which is a non-uniformity recognised as a limitation in Section 6).

In detail, a multistage purposive-cum-random design was followed: the four states were selected purposively for their stray cattle concentration and shelter density; districts and blocks were then chosen using secondary data from the Livestock Census, state animal husbandry records and state *Gau Seva Ayogs*; and within each state, *Gaushalas* were stratified by herd size, urban or rural location and availability of maintained financial records, with the final selection made at random within each stratum to minimise selection bias.

Per-Animal Cost and Income Metric

All cost and income variables are adjusted by the total herd numbers to obtain the per-animal values. This single measure, cost per total animal, reflects the total cost of running the institution and takes into account the cost of caring for the non-productive majority (77-81% of all admissions). It does not need any conversion weights, is transparent, can be easily replicated from the institution-level totals, and is directly comparable with Bijla and Singh (2019) and Singh *et al.* (2021) for validation across the studies.

Earned income is reported in two ways throughout: sale of animals (8.5% of sector earned income, reported by all 32 institutions), and then excluding sale of animals, since this income stream is not always present and does not necessarily occur year to year. The difference at the sector level is the earned BCR (0.334 versus 0.310), which is small but analytically significant for the break-even and sensitivity analysis.

Productive Animal Share – Break-even

The total income earned by institution i divided by the number of productive animals is called the earnings per productive animal (EPA) for institution *i*. The break-even is then computed in two steps:

Step 1: Break-even productive count = Total expenses ÷ EPA

Step 2: Break-even productive share (%) = (Break-even count ÷ Total animals) × 100

Formally, for each institution, with *TE* denoting total expenses, *EI* earned income, *P* the number of productive animals and N total animals: EPA = EI/P; break-even productive count = *TE*/*EPA*; break-even productive share (%) = (*TE*/*EPA*)/*N* × 100; and earned *BCR* = *EI*/*TE*, with self-sufficiency defined as earned *BCR* ≥ 1.0. In the scenario analysis, simulated earned income at productive share s is *EI*(*s*) = (*N* × *s*/100) × *EPA*.

A variable-cost break-even is also calculated, where the total expenses in Step 1 are replaced by variable costs (total expenses minus depreciation) and thereby the productive share is calculated that is necessary to cover the cash operating costs without the burden of the fixed infrastructure.

EPA shows considerable variation across institutions (*CV* = 50.6% and range from ₹ 38,300 to ₹ 3,06,376), and hence break-even results have been reported with mean, standard deviation and range and not with point estimates alone. The scenario analysis assumes a range of values for the productive animal share (15%–40%) and calculates the earned income for each institution at a given productive animal share *s*% as (total animals × *s*/100) × *EPA*. *EPA* is constant as this is a conservative estimate (or assumption) as in a genuine breed improvement situation both productive share and *EPA* would increase at the same time. This extends beyond the range of productive shares (3.8%-25.9%) observed and should be interpreted as a desired direction instead of an exact prediction. In Section 4.2, the empirical relationship between *EPA* and productive share is reported and the implications for holding *EPA* constant, especially for those institutions that increase their count of productivity through reclassification is evaluated.

Milk-Feed Cost Squeeze

Feed cost per litre is calculated as the total expenditure on feed per year divided by the total milk production per year (daily milk volume × 365) for each institution. Milk revenue per litre is total milk income received in a year/annual volume of milk sold. The margin per litre is the difference between the milk revenue and feed cost per litre. The fact that the feed cost per litre comes out so high is due to the fact that the entire feed bill of the institution, which includes all animals of which 77-81% are non productive, is divided by the milk production of the productive minority only. This is a proper representation of the true cost per litre in the case of the *Gaushala* where non-productive animals are not separable from the feeding budget and is the per-litre financial expression of the cross-subsidy that the welfare mandate imposes.

Earned Income Sensitivity Scenarios

Five different revenue improvement scenarios are simulated (dung revenue doubled, milk price + ₹ 5/litre, milk price + ₹ 10/litre, by-products tripled, and dung doubled and milk price + ₹ 5/litre) and compared with the current base, to identify the revenue levers that would most enhance the financial self-sufficiency. All factors are assumed to be constant except the revenue stream being simulated. Results indicate the sector-mean earned

BCR (with and without animal sale) and number of self-sufficient institutions (earned *BCR* ≥ 1.0).

The simulations rest on four explicit assumptions: (i) the cost base is held constant at observed levels; (ii) *EPA* is held constant at each institution's observed value; (iii) herd size and composition are unchanged; and (iv) only the simulated revenue stream varies, with all others held at baseline (ceteris paribus). The scenarios are therefore deterministic accounting simulations, not econometric forecasts. All computations were carried out in R and Python, supplemented by spreadsheet workbooks for transparent institution-level accounting; non-parametric statistics (Spearman's rank correlation, Kruskal-Wallis tests) were preferred given the sample size (n = 32).

RESULTS

Break Even Productive Animal Share

Table 1 and Fig. 1 show the per animal cost and the per animal earned income by state and the break-even productive animal shares. The total-cost break-even varies from 10.4% at Salawas (Rajasthan) to 81.6% at Lambra (Punjab). The sector mean is 37.5% and the standard deviation is 16.1 percentage points, which is large enough to indicate substantial heterogeneity across institutions. All institutions in the sample lie below their break-even productive share.

State-wise contrasts were tested non-parametrically given the sample size. A Kruskal-Wallis test shows that the observed productive animal share does not

Table 1: Per-animal cost and income by state, with break-even productive animal share (primary survey 2024–25)

State	Cost per Animal (₹/yr)	Earned per Animal (₹/yr)	BE Share, Total Cost (%) [Mean±SD]	BE Share, Var. Cost (%)
Haryana	28,216	9,291	40.3	37.7
Punjab	36,190	12,261	39.1	35.7
Rajasthan	33,401	11,722	32.8	28.1
Uttar Pradesh	37,044	10,276	37.8	34.2
Sector Mean	33,713	10,888	37.5 ± 16.1	33.9

BE = Break-even. Variable-cost break-even excludes depreciation from the numerator. Source: Primary survey data, 2024–25.

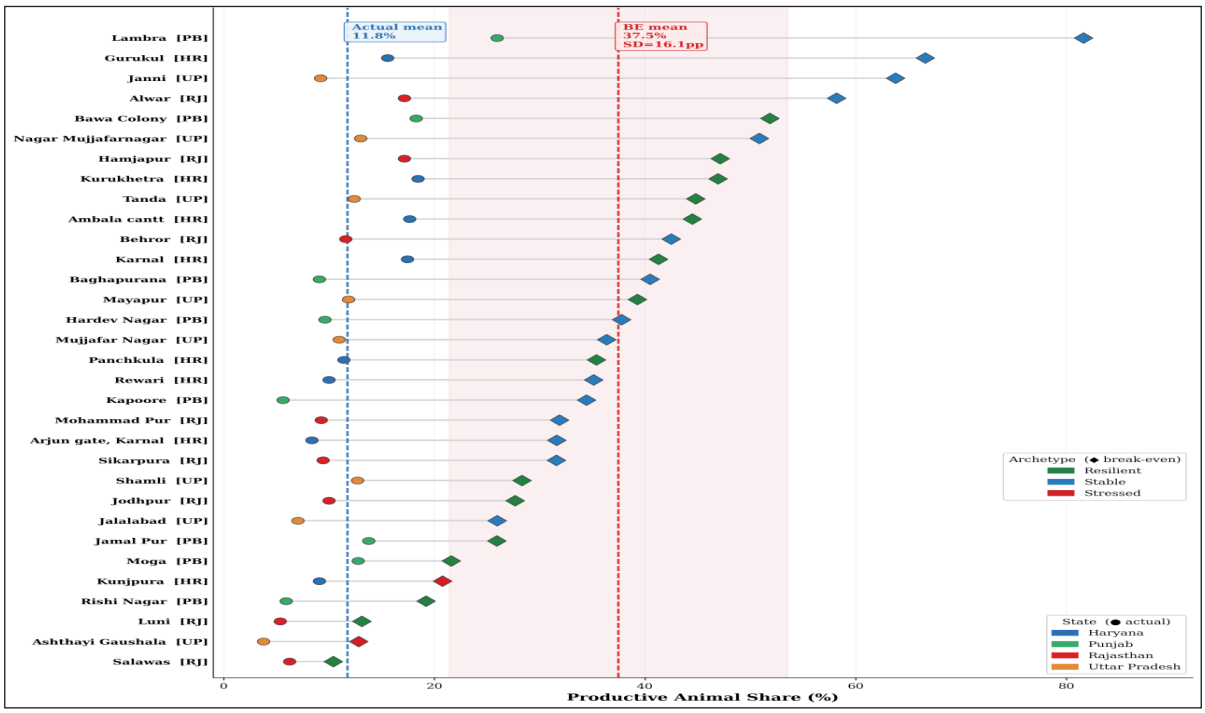

Fig. 1: Actual productive animal share (circle, coloured by state) vs. break-even productive animal share (diamond, coloured by financial archetype) for all 32 institutions, sorted ascending by break-even share. Shaded band = ±1 SD around mean break-even

differ significantly across the four states (H = 1.89, p = 0.595), and nor does milk yield per productive animal (H = 0.85, p = 0.837). The break-even gap is therefore a sector-wide structural feature rather than a state-specific one, although its severity varies with state-level cost and price conditions (Tables 1 and 3).

This 25.7 percentage point difference between the sector-mean break-even (37.5%) and observed productive share of the *Gaushala* mandate is the single number financial cost of the *Gaushala* mandate. The institutions find a place where it is possible to take care of the animals the dairy market has forsaken, 77-81% of the animals can earn no income no matter what care they receive. This is not a failure of performance; it is a consequence of the welfare purpose these institutions serve.

Two case studies at the institutional level highlight that the break-even point is a function of cost structure and earnings and not only of productive share. Although Lambra (Punjab) shows the highest productive share in the sector (25.9%), it has also the highest break-even (81.6%), problem is that it's cost base has been increasing at a much faster rate than its earning potential. Salawas (Rajasthan) has the lowest break-even at 10.4% on a productive share of only 6.2%, due to having one of the lowest per-animal cost (in the sample) of ₹ 23,245. Cost is as important as expanding the productive herd.

Scenario Analysis: What Productive Animal Share Would Achieve Self-Sufficiency?

The results of scenarios are shown in Table 2 and Fig. 2. At the observed mean of 11.8%, sector-mean earned *BCR* is 0.334 (incl. sale) or 0.310 (excl. sale). When the mean earned BCR is 1.0 (sector break-even), 10 of 32 institutions would individually become self-sufficient when productive animal share is approximately 30.1%. At 35%, the count rises to 14; at 40%, to 19.

Table 2: Scenario analysis: sector-mean earned BCR at alternative productive animal shares (n = 32)

Productive Animal Share	Mean Earned BCR (incl./ excl. sale)	Cost Recovery (%)	Self-Sufficient Institutions	Residual Donation Need (%)
Current 11.8% (observed)	0.334 / 0.310	33.4	0 of 32	66.6
15%	0.499 / 0.463	49.9	3 of 32	50.1
20%	0.665 / 0.617	66.5	4 of 32	33.5
25%	0.831 / 0.771	83.1	6 of 32	16.9
30% (sector break-even)	0.998 / 0.926	99.8	10 of 32	0.2
35%	1.164 / 1.080	116.4	14 of 32	0.0
40%	1.330 / 1.234	133.0	19 of 32	0.0

EPA was kept at the level observed at each institution. Results extend outside of observed productive share range (3.8-25.9%). Where sector-mean BCR>1.0, residual donation need calculated as max(0, 100-Cost Recovery %); aggregated arithmetic surplus used to residual needs at sector level but individual institution might still need transfer income.

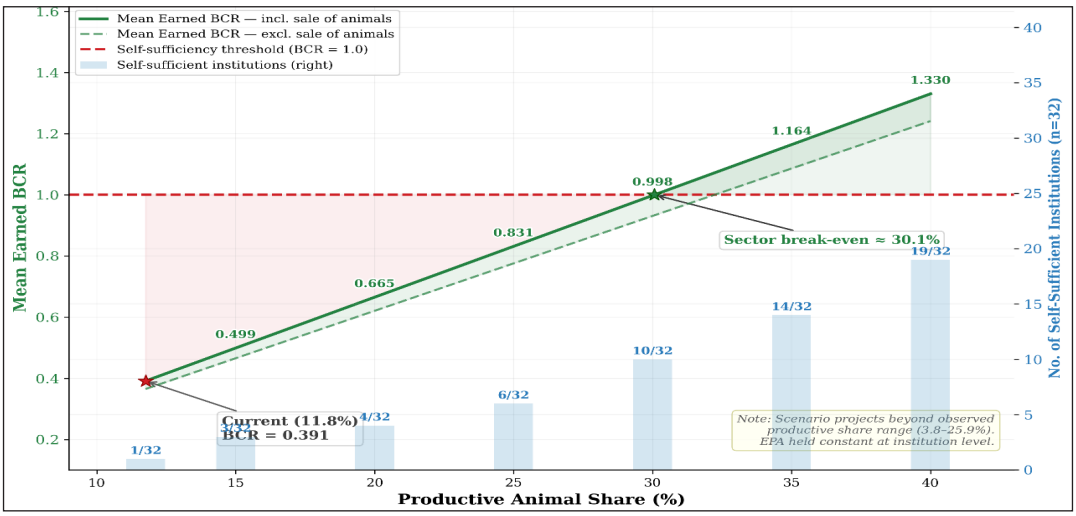

Fig. 2: Sector-mean Earned BCR at alternative productive animal shares. Solid line includes sale of animals; dashed excludes it. Break-even occurs at approximately 30.1%

These outcomes are policy targets and not predictions. The negative *EPA*-productive share correlation (Spearman's $\rho = -0.670$, $p < 0.001$) indicates that institutions that would be growing their productive herd based on increased reclassification, and not true breeding, would have a lower EPA than that assumed in the simulation and would not be able to reach break-even even at 30%. The 30% can be achieved only under a programme that increases productive animal share and management quality, not by reclassification of animals.

The Milk-Feed Cost Squeeze

The milk-feed cost squeeze is shown in Table 3 and Fig. 3. The mean feed cost per litre of milk produced is ₹ 150.8 as compared to the mean milk price of ₹ 42.6 per litre. Each of the institutions in the sample has a negative milk-feed margin and none is able to cover its feed cost through milk production alone. The gap between the two sector means is ₹ 108.2 per litre. At − ₹ 144.0 per litre, Uttar Pradesh is the worst hit, whereas Haryana with its lower fodder prices and higher milk prices compared to other states is the least hit at − ₹ 71.9 per litre.

The welfare mandate is the structural explanation for this negative margin. The *gaushalas* feed the whole herd, 77-81% of which are non-productive, and apportion the total feed bill among the productive minority to determine the cost of milk. Feed cost / litre correctly reflects the actual cost of milk production in a shelter context: each litre of milk must effectively subsidize the provision of food for 7-8 non-productive animals. That's not inefficiency, that's the cost of the mandate at the product level.

The policy implication is clear: cooperative marketing could improve the margin, but a price deficit of ₹ 108 per litre could not be bridged under

Table 3: Milk-feed cost squeeze by state, feed cost per litre, milk revenue per litre, and margin (primary survey 2024–25)

State	Feed Cost/Litre (₹)	Milk Price/Litre (₹)	Margin per Litre (₹)	Feed Cost Gap (₹/L)
Haryana	113.5	41.6	−71.9	71.9
Punjab	159.5	45.8	−113.7	113.7
Rajasthan	148.8	45.7	−103.1	103.1
Uttar Pradesh	181.5	37.5	−144.0	144.0
Sector Mean	150.8	42.6	−108.2	108.2

Feed cost/litre = annual feed expenditure ÷ annual milk production. Margin = milk price − feed cost.

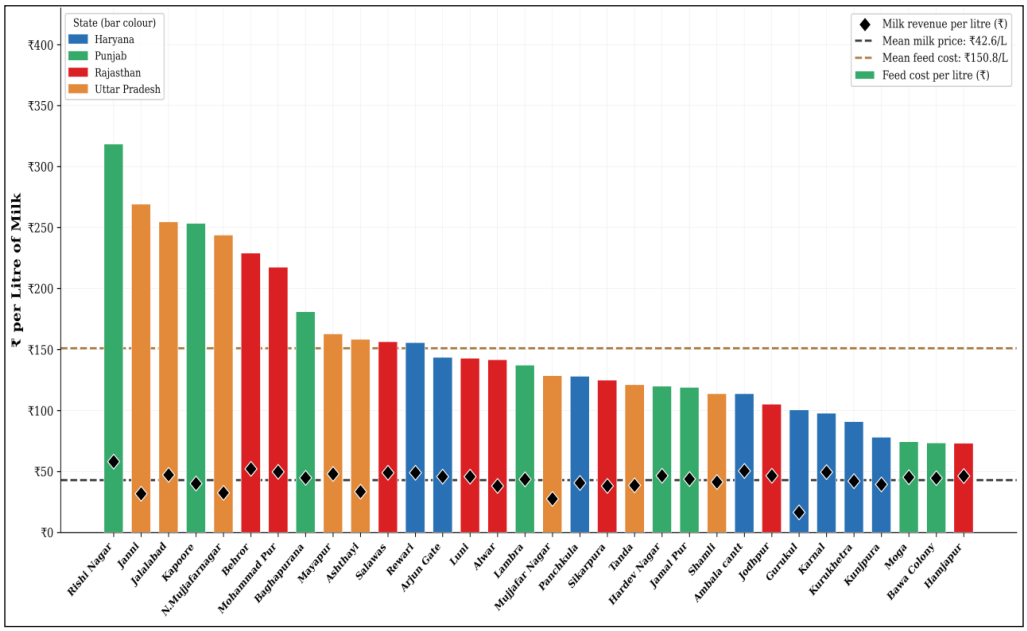

Fig. 3: Feed cost per litre (bars, coloured by state) vs. milk revenue per litre (diamond markers). Every institution shows a negative margin; vertical red lines mark the gap

any realistic condition. It is the milk-feed squeeze that explains why milk revenue - however enhanced - cannot be the only way of achieving financial self-sufficiency, and why dung, by-products, productive animal share and government support all need to be tackled together.

Earned Income Sensitivity Scenarios

What targeted revenue improvements would achieve is shown in Table 4 and Fig. 4. None of the interventions, nor any combination of interventions, tested, leads to self-sufficiency for the sector. The biggest increase is with the increase of by-product revenue by 3 times, which increases the sector mean earned *BCR* from 0.334 to 0.445, and increases the yearly revenue by around ₹ 31.4 lakh per institution on an average. The highest combined scenario used, a doubling of dung revenue and a price of ₹ 5/litre of milk (MPM), is calculated at 0.422. In all cases, even the best outcome of those with a single intervention (0.445), the sector is below the BCR that is necessary for being fully self-sufficient.

A price increase of ₹ 5/litre, which is significant in current milk market, increases only 0.017 to the sector-mean earned BCR (from 0.334 to 0.351), indicating that the milk volume involved is small in comparison to the overall cost base of the *Gaushalas*. Dung doubling gives more (0.071) since although the dung revenue per animal is low compared to the production, it comes from all animals, irrespective of productive status, and is not subject to the milk-feed cross-subsidy constraint.

These findings are not dismal. They are realistic. They set the cap on what earned income gains

Table 4: Earned income sensitivity scenarios, sector-mean earned BCR under alternative revenue improvement scenarios (n = 32)

Scenario	Earned BCR (incl. sale)	Earned BCR (excl. sale)	Self-Sufficient	Addl. Earned Income (₹ lakh)
Current baseline	0.334	0.310	0 of 32	,
Dung revenue doubled	0.405	0.381	0 of 32	+19.1
Milk price + ₹5/litre	0.351	0.328	0 of 32	+5.3
Milk price + ₹10/litre	0.369	0.345	0 of 32	+10.6
By-products tripled	0.445	0.422	0 of 32	+31.4
Dung doubled + Milk + ₹5/L	0.422	0.398	0 of 32	+24.4

All non-simulated variables held constant. Addl. earned income = sector-mean increase above baseline..

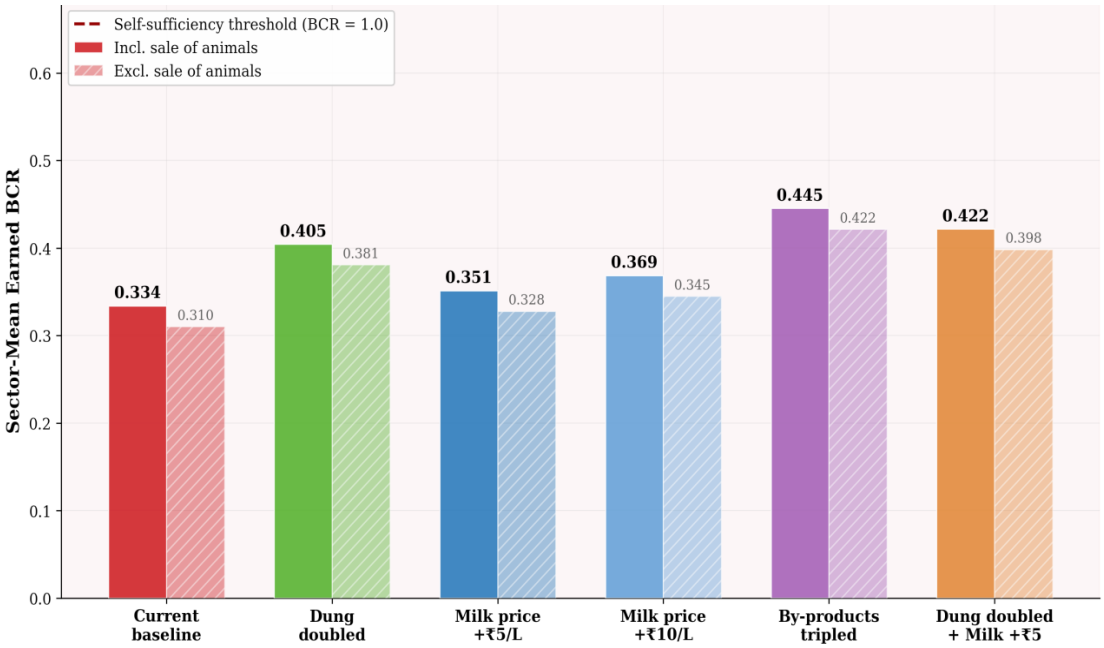

Fig. 4: Sector-mean Earned BCR under five revenue improvement scenarios relative to the current baseline. No scenario reaches the self-sufficiency threshold (1.0)

can do, and endorse that transfer income, which can come from donations or government, will be a structural requirement for the foreseeable future. That dependence is not the policy question, but how to get it right.

DISCUSSION

The Break-Even Gap and its Policy Relevance

The key result of this paper is the difference between the sector's break-even point (37.5%) and the observed productive animal share (11.8%), which is 25.7 percentage points. It measures, in a single number (which is directly interpretable), the cost of the welfare obligation that is characteristic of the *Gaushala* sector. These institutions are made for those cows that have been rejected by the dairy market, those cows that are at intake, by definition, no longer productive, and that are likely to be unproductive. The break-even gap is thus not a performance gap that can be filled by improved management, but the structural price of the mandate in terms of the only measure that is a bridge between herd composition and financial viability.

These results are consistent with, and extend, the existing literature. The donation dependence documented for Haryana by Bijla and Singh (2019), across institution sizes by Singh *et al.* (2021) and for Telangana by Rohith *et al.* (2021) is reproduced here at the four-state level, and the finding of Sharma *et al.* (2020) that financial constraint, rather than intent, limits shelter welfare is given a precise financial magnitude: the 25.7 percentage point break-even gap.

The findings also sit consistently within the most recent national and international evidence. Nationally, the NCAER estimates prepared for the NITI Aayog (2023) task force place feed and fodder above 90 per cent of the variable costs of *Gaushalas*, and Mandi and Subash (2019) report a feed share of about 68 per cent of expenditure and an operating ratio of 0.69 in Karnataka; the present four-state estimates fall within this band and confirm that feed dominance, rather than administrative overhead, is what drives the cost side. Official livestock statistics (DAHD, 2023) show that the structural drivers of abandonment remain in place, so the cost burden documented here is unlikely to ease on its own.

Internationally, the pattern is not unique to India. Kennedy *et al.* (2018) show that the sheltering of commercially unwanted cattle raises the same financing problem wherever it occurs, because the sheltered herd is by definition outside the production cycle that would otherwise pay for it. The welfare economics literature explains why earned income cannot close the gap: farm animal welfare carries strong public good characteristics, and although stated willingness to pay for welfare is positive, the premiums recovered in the market are modest and unreliable (Lagerkvist and Hess, 2011; Clark *et al.* 2017). Welfare-oriented institutions elsewhere are therefore financed predominantly through public payment and philanthropy rather than product sales, which is precisely the configuration that the 25.7 percentage point break-even gap implies for *Gaushalas*.

The scenario analysis brings in a crucial element. The sector break-even threshold of about 30% productive animals is a concrete policy target. Still, it cannot be achieved by reclassifying existing animals, but only by real productivity improvement, subsidised AI services, breed improvement of existing milch animals, feed supplementation and cooperative market linkages. The negative correlation between the number of productive counts and the EPA ($\rho = -0.670$) is obvious and illustrates that institutions that expanded productive counts without a genuine improvement of the breeding stock would see the EPA decline and so the 30% goal receding instead of coming closer. It is important that these two pathways are distinguished when designing a programme.

The institution-level variation is also key for policies. In Lambra (Punjab) and in Salawas (Rajasthan), it is shown that cost management is as significant as expansion of productive herd. A uniform approach based strictly on increasing the productive share, by means of breeding or AI services, would fail to account for the cost-side opportunities that some institutions may be able to make use of more readily. The data suggest a greater heterogeneity than is captured by a single-tiered system that combines productivity requirements and cost-efficiency incentives.

Why Earned Income Cannot Close the Gap

The single interaction of the milk-feed cost squeeze

and the earned income sensitivity analyses addresses the question of why earned income will not replace transfer dependency in the foreseeable future. The milk-feed margin of − 108.2 per litre is not incidental; it is the per-litre cost of feeding a non-productive (77-81%) herd. This is a gap that is too large to be bridged with any commercially realistic milk price increase. The highest BCR obtained in all the scenarios tested is 0.445 (when by-products are tripled), and the most ambitious combined scenario is 0.422. Even with a switch in institutional mandate and herd composition, the path to even 0.445 to 1.0 is not possible via revenue management alone.

This is an important aspect to consider when designing programmes. While interventions such as building by-product value chains, biogas plants, or cooperative milk marketing are all worthwhile, they should be sized to the data and not to an expectation of self-sufficiency that is not supported by the evidence. Meanwhile, the lack of earned self-sufficiency in any institution, under the best of circumstances, shouldn't be interpreted as an institutional failure. That's the price of the mandate, put in monetary terms.

Of particular interest is the dung-revenue finding. Because dung is generated by all animals irrespective of their productive status, dung doubling contributes more towards the earned BCR (0.071) than a ` 5/ litre price increase for milk (0.017). This makes the potential for the *Gaushala* sector to earn revenue from dung, by producing vermicompost, biogas and organic fertiliser, the most structurally appropriate, as it is not aimed against the herd composition. A policy that focuses on the dung value-chain development rather than milk marketing would be more in line with the financial arithmetic of the sector.

The dung finding also connects with a wider set of alternative revenue models now receiving policy attention. The NITI Aayog (2023) task force recommends organic and bio-fertiliser value chains as the principal route to improved *Gaushala* viability, and biogas capital subsidies and community-scale dung-to-energy plants (Sen *et al.* 2020) provide the institutional scaffolding for a dung-based economy. Beyond direct sales, methane avoidance from institutional biogas could in principle be monetised through voluntary carbon credits, although verification costs at current institutional scales remain a barrier. These options merit appraisal as complements to, not substitutes for, transfer income.

Implications for Transfer Income Design

The quality of the transfer income is the binding policy variable if earned income does not fill the gap. The data in this paper support three design principles for government support. Firstly, per-animal support rates should be compared with independently verified cost information; the sector-mean cost of ₹ 33,713 per animal per year serves as a benchmark. Secondly, tiered support is needed, not universal: a base rate coupled with the cost benchmark, and performance support coupled with productive share improvement and cost discipline. Third, support should be durable, predictable and structural, rather than transitional; it should not be oriented towards self-sufficiency for which there is evidence that current mandates are not conducive.

For funding frameworks, this implies that support rates under the Rashtriya Gokul Mission, state *Gau Seva Ayog* schemes and municipal grants should be indexed to audited per-animal cost norms and revised periodically, and that performance conditions should reward productive share gains and cost discipline rather than an unattainable self-sufficiency deadline.

CONCLUSIONS AND POLICY RECOMMENDATIONS

This paper has provided the first multi-state, audited answers to three questions about which *Gaushala* financial policy has lacked: what is the productive share required for self-sufficiency; why is milk revenue insufficient; and what margin for improvement in milk revenue is achievable.

Recommendation 1: The concrete intermediate goal supported by the evidence is a five-year programme that is focused on achieving 30% productive animal share through subsidised AI services, Breed Improvement of existing Milch animals, Feed supplementation and Cooperative milk market linkages. It is important to note that the negative EPA–productive share correlation ($\rho = -0.670$) indicates that these have different financial consequences than reclassification of existing animals.

Recommendation 2: All interventions in the dung value chain, such as vermicompost, biogas and organic fertiliser, should be preferred in the government by-product development programmes over the milk marketing support as the revenue is generated from all animals, irrespective of their productive status, and is not constrained by the cross-subsidy challenge of financial improvement of the milk. The processing and marketing infrastructure for dung products should be developed at the cluster level for cooperative processing to realize the economies of scale.

Recommendation 3: The level of support from the government should be moved from uniform maintenance support to a tiered support system that includes a base level which is based on the cost norm of ₹ 33,713 per animal plus a performance-based proportion linked with self-sufficiency improvement. Support design must acknowledge that transfer dependency is the money trail of the welfare mandate, and should focus on sustainability and certainty, rather than "bridge to self-sufficiency" models for which there is no evidence.

GENERATIVE AI DECLARATION

The author(s) confirm that there was no use of artificial intelligence (AI)-assisted technology for assisting in the writing or editing of the manuscript, and no images were manipulated using AI. The authors developed and verified all scientific content, data analysis, interpretation of results, and conclusions. The authors take full responsibility for the accuracy, integrity, and originality of the work presented, and no AI tool was listed as an author.

Limitations and scope for further work

The conclusions should be read against the design of the study. The sample of 32 institutions was drawn purposively from four North Indian states with a high concentration of stray cattle and shelters, and although randomisation was applied within strata, the sample is not statistically representative of all *Gaushalas* in India; the estimates are therefore best generalised to institutions operating under comparable cost, price and regulatory conditions rather than to the sector nationally. Financial records of audited quality were not uniformly available across institutions, so multi-year averaging was possible for only part of the sample, and the single-period design cannot capture year-to-year volatility in donation flows or fodder prices.

The scenarios are deterministic accounting exercises conducted under ceteris paribus assumptions: the cost base, earnings per productive animal, and herd size and composition are held at observed levels while a single revenue stream is varied. Each of these would tend to make the break-even threshold harder, not easier, to reach, so the estimates reported here should be treated as an upper bound on what earned income interventions alone can deliver. Panel data across multiple years, a wider state coverage, and stochastic simulation with price feedback are the natural extensions of this work.

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