Research Article

Sustainability Analysis of Kub Chicken Farming in the Semerbak Urban Farming Program in Semarang City

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Abstract | The sustainability of Kampung Unggul IAARD (KUB) chicken farming in urban farming systems requires integrated evaluation to ensure long-term business viability. This study analyzed the sustainability of KUB chicken farming across 16 farmer and women farmer groups (KT/KWT) in the Semerbak Plant Program, Semarang City, covering technical, social, and economic dimensions. A survey method with a descriptive quantitative approach was applied, using the Business Sustainability Index (BSI) for the technical and social dimensions and the Revenue–Cost (R/C) ratio for economic feasibility. Based on the aggregate BSI, the technical dimension was dominated by the two highest categories, with 31.25% of groups classified as sustainable (category A) and 68.75% as moderately sustainable (category B); however, record-keeping was the most critical weakness: 81.25% of groups were unsustainable (category D) in production and maintenance administration, a foundational constraint that also limits the reliability of self-reported farm data. Chicken mortality ranged from 1.0% to 50.0% per group (mean 17.5%), substantially higher than the 1.88% reported for KUB chickens under controlled management and the 5–15% recorded at farmer level in Central Java, indicating uneven flock-health control. Socially, member participation was uneven (18.75% sustainable, 50.00% moderately sustainable, 31.25% less sustainable), while community acceptance was relatively good (25.00% sustainable, 62.50% moderately sustainable). Economically, only 18.75% of groups were feasible-efficient and 25.00% were of low worth, whereas 56.25% were not economically feasible, with R/C ratios ranging from 0.15 to 1.79. These results demonstrate that high technical productivity does not automatically translate into economic feasibility: groups with high mortality and low input efficiency consistently recorded R/C < 1. Strengthening flock-health management, data-based record-keeping, member participation, and input efficiency are therefore the key levers for improving the sustainability of urban KUB chicken farming.

Keywords | KUB chicken, Sustainability assessment, Technical performance, Social participation, Economic feasibility

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INTRODUCTION

Rapid urbanization and population growth have led to the conversion of agricultural land and a decrease in local food production capacity. This condition makes urban areas, including Semarang City, dependent on food supplied from outside the region, thereby increasing their vulnerability to distribution disruptions and price fluctuations. Based on data from the Central Statistics Agency (Central Statistics Agency (BPS), 2024), the population of Semarang city in 2023 reached 1,694,743 people with a density of around 4,531 people/km². The annual egg demand of the community is estimated to reach 11,640 tons per year, while meat consumption reaches

12.79 kg per capita per year. Although provincial egg supply (largely from commercial layers) is adequate, local egg production within Semarang City is limited; native chicken eggs, for example, contribute only about 2,114 tons per year. The city therefore relies heavily on supplies from outside its boundaries, which increases its exposure to distribution disruptions and price volatility rather than indicating an absolute shortage. This phenomenon shows that the increase in urban economic activity is not always followed by an increase in local food production capacity (Mosha, 2017). This dependence on external food supplies increases the risk of food instability in urban areas.

Urban farming through the use of limited land in urban areas is one of the strategies to increase local food availability (Kurnianto, 2024). This system allows for the integration of household-scale farming and livestock activities to support food security and increase community income. The Semerbak Program integrates crops, chickens, and rabbits, but poultry best suits household-scale urban systems. Rabbit meat has a narrow market and fish needs water infrastructure, whereas chicken is a familiar protein, uses feed efficiently, and yields near-daily egg income. The KUB chicken adds far higher, steadier egg output to the hardiness of local birds, fitting the limited land and capital of urban farming. IAARD Superior Kampung Chickens (KUB) are a strategic alternative to be developed in urban small-scale farming systems because they have higher productivity, have stable production performance, and better feed efficiency than ordinary free-range chickens (Hadrawi *et al*., 2023). KUB chickens are able to produce 160–180 eggs per head per year, much higher than local free-range chickens which generally produce less than 100 eggs per year (Nurhayu *et al*., 2021). The development of KUB chickens aligns with Semarang's urban farming policy under Mayor Regulation No. 24 of 2021, which launched the Perdu Semerbak Program in 2023 to strengthen household food security through integrated crop–livestock cultivation. Officially launched by the Mayor and funded partly through external partnerships (Bank Jateng, PLN, Indonesia Power, Bank Indonesia) across coastal, lowland, and upland pilot sites, the program reflects clear political commitment, though insecure land access still constrains implementation, making group-level sustainability worth assessing.

However, the implementation of KUB chicken cultivation within the program is currently constrained by multifaceted technical and social barriers. Field observations during the early phase of the program indicated several recurring issues among recipient groups, namely unstable egg production, dependence on commercial feed, variable livestock mortality, and limited technical record-keeping. These preliminary feed-technology interventions based on locally processed ingredients represent one potential avenue for reducing this dependence on commercial feed. The administration of fermented agricultural by-products as synbiotic feed additives and low-level inclusion of maggot-based meal in native chickens has been reported to improve growth performance, nutrient digestibility, and feed-cost efficiency compared with conventional rations (Utama *et al*., 2020; Panuntun *et al*., 2025; Utama *et al*., 2026). However, these findings have not yet been applied to layer-type KUB chickens managed by groups within an urban government program. Poorly managed cages in residential areas can also cause social problems, especially related to the smell of waste which can affect the level of community acceptance (Naubert, 2020). The success of a KUB chicken enterprise is shaped by interacting biological, technical, economic, and social factors. Livestock, especially poultry, contribute strongly to household food security in low- and middle-income settings by converting largely non-edible feed into high-quality protein and income (Mottet *et al*., 2017), while sustainability at the farm level depends on integrating technical management, economic efficiency, and group institutional capacity (Nair, 2019). Evaluating this sustainability requires a multidimensional approach; the Business Sustainability Index (BSI), as a composite index, integrates various technical and social indicators into a single representative measure of the production system (OECD, 2008).

Existing Indonesian studies on KUB sustainability are almost entirely rural. In Cianjur, an MDS-RapPoultry assessment rated KUB farming only moderately sustainable, with the institutional dimension weakest (38.91 of 100) (Antikasari *et al*., 2023). Farmer-scale economic analyses report feed as the dominant cost (≈32%) and R/C near 1.3, indicating thin margins (Zunarto *et al*., 2025), and national reviews link smallholder poultry constraints to productivity gaps, weak biosecurity, and feed dependence (Sumiati *et al*., 2025). Reviews of urban livestock further note that city systems face distinct pressures, limited space, disease and waste risks, and weak policy integration, that rural studies do not capture (Abu Hatab *et al*., 2019).

Thus the literature assesses KUB sustainability mainly in rural systems and rarely in urban, group-based government programs where land constraints, communal management, and municipal policy interact. This study addresses that gap by assessing the technical, social, and economic sustainability of KUB farming within an urban farming program (Semerbak) in Semarang City.

Accordingly, this study evaluates the sustainability of Kampung Unggul IAARD (KUB) chicken farming within the Semerbak Plant Program in Semarang City. It pursues three objectives: to assess sustainability across the technical and social dimensions, to determine economic feasibility at the group level, and to identify the indicators that most constrain overall sustainability. The technical and social dimensions were assessed using the Business Sustainability Index (BSI), and the economic dimension using the Revenue–Cost (R/C) ratio.

MATERIALS AND METHODS

Study materials

This research was carried out in Semarang City, Central Java Province, which is an urban area with limited agricultural land and pressure on local food availability. The study subjects comprised cooperative farmer groups (KT) and women farmer groups (KWT) in the Perdu Semerbak Program, a community-based integrated agricultural program developing Kampung Unggul Balitbangtan (KUB) chicken cultivation in residential environments. Although KWT differ in comprising women members, both were treated as equivalent units of analysis because they received the same assistance package, technical guidance, and program targets, operated the KUB enterprise collectively under identical urban conditions, and were assessed against the same indicators. The analysis thus focuses on the group as the operating unit rather than the organization type.

A total of 16 KT/KWT recipients of KUB chicken assistance served as analysis units in this study. The groups represent a system of small-scale poultry farms managed by groups in urban areas (Table 2)

Study design

This study used a descriptive quantitative approach with a survey method to evaluate the level of sustainability of KUB's chicken business. Primary data was collected through structured questionnaires, in-depth interviews, field observations, and recording of business economic data. This study used a total sampling (census) approach: All 16 KT/KWT groups that received KUB chicken assistance under the Perdu Semerbak Program were included as the entire study population. Because every recipient group was enumerated, no probability sampling or sample-size estimation was required, and the findings describe the program in full rather than a sampled subset. The groups are distributed across coastal, lowland, and upland areas of Semarang City, reflecting the range of conditions under which the program operates.

The questionnaire was compiled using a Likert scale of 1–5, where a score of 1 represented the lowest condition and a value of 5 indicates a very high condition. This approach is used to quantitatively measure technical and social indicators (Pescaroli *et al*., 2020).

Observations were carried out to verify the actual conditions in the field, including cage systems, feed management, sanitation, biosecurity, and waste management (Mohammed and El-Sayed, 2016). Economic data such as production costs and receipts were obtained from business records and interviews with respondents.

Before each interview, respondents were informed of the study's purpose and their right to decline or withdraw at any time, and participation was based on their verbal consent. All responses were collected and reported anonymously to protect participants' privacy.

The overall study design, from group selection to sustainability assessment across the three dimensions, is summarized in Figure 1.

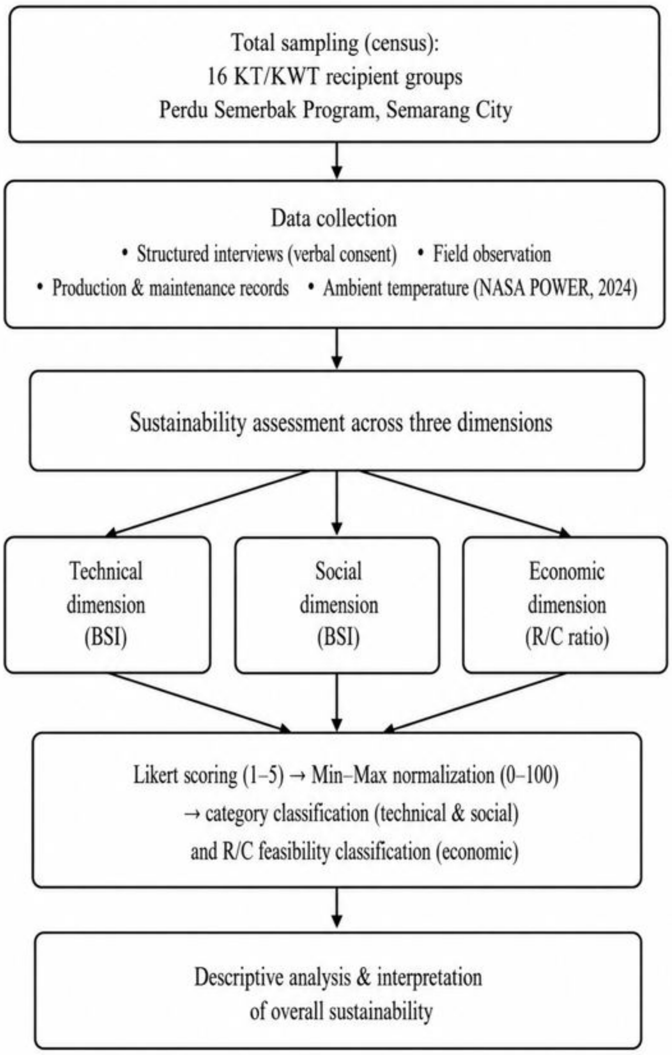

Figure 1: Flowchart of the study design for assessing the sustainability of KUB chicken farming.

Research variables

The sustainability of the KUB chicken business is analyzed based on three main dimensions, namely technical, social, and economic.

The technical dimension includes egg productivity, mortality rate, feed management, cage management, biosecurity implementation, and waste management. The social dimension includes the participation of group members, division of duties, sustainability of business activities, involvement of the younger generation, and the level of community acceptance. Meanwhile, the economic dimension includes production costs, receipts, revenues, and the receipt-to-cost ratio (R/C ratio) (Akbar *et al*., 2024). To support transparency and replicability, the indicators assessed in each dimension and their measurement basis are summarized in Table 1.

Table 1: Sustainability indicators and their measurement basis.

Dimensions	Indicator	Skor 1 (lowest)	Skor 5 (highest)
Technical	Egg productivity	Very low egg yield per hen, well below KUB potential	Consistently high yield, at or near KUB potential
	Mortality rate	Very high mortality, frequent uncontrolled losses	Very low mortality, well controlled
	Feed management	No feeding schedule; feed quality/quantity poorly managed	Regular, well-measured feeding with quality control
	Cage management	Cages poorly maintained, overcrowded, unsanitary	Clean, well-maintained, adequately spaced cages
	Biosecurity implementation	No biosecurity measures applied	Comprehensive biosecurity routinely applied
	Waste management	Waste untreated and unmanaged	Waste fully managed/utilized (e.g., composted)
Social	Member participation	Very few members active	Nearly all members actively involved
	Division of duties	No clear task allocation	Clear, well-functioning task allocation
	Sustainability of business activities	Activities frequently stalled or inactive	Activities run continuously and reliably
	Involvement of the younger generation	No youth involvement	Strong, regular youth involvement
	Community acceptance	Strong community objection (e.g., odor complaints)	Full community acceptance and support

Each technical and social indicator was rated on a 1–5 Likert scale, then normalized to 0–100 (Min–Max) for the BSI. The economic dimension was assessed separately through the Revenue–Cost (R/C) ratio rather than the Likert scale, using production costs, receipts, revenues, and the resulting R/C value.

Ambient temperature data were obtained from the NASA Power database (2024). As these are regional estimates, they approximate general thermal conditions rather than the exact microclimate of each coop; local cage temperatures may differ owing to urban and housing factors. They are therefore used as indicative context, and direct on-site measurement is recommended for future work.

Business sustainability index (BSI) analysis

Sustainability analysis on the technical and social dimensions was carried out using the Business Sustainability Index (BSI). The BSI value is compiled based on the principle of the OECD Composite Index (2008) which is widely used to assess the sustainability of agricultural and livestock systems. Each indicator is scored on the 1–5 Likert scale and then normalized to a 0–100 scale using the Min–Max method with the following formula:

$$BSI = \frac{X - X_{min}}{X_{max} - X_{min}} \times 100$$

Where X is the indicator score, X_{min} is the minimum value (1), and X_{max} is the maximum value (5). Normalization places all indicators on a common, comparable 0–100 metric, which allows indicators measured on different aspects to be aggregated and reported consistently across dimensions. The index value for each dimension is the mean of its constituent normalized indicators; because each dimension comprises several indicators, the resulting dimensional BSI is a continuous composite score rather than a simple recoding of a single Likert item. All indicators were weighted equally, as there is no established empirical basis for assigning differential weights in this context; this assumption is acknowledged as a limitation, and a weighted composite is recommended for future research. The categories of sustainability levels were adapted from Guo *et al.* (2015), as follows:

- 0–25: Unsustainable
- 26–50: less sustainable
- 51–75: Moderately sustainable
- 76–100: sustainable

Equal 25-point intervals were used because the underlying indicators were normalized to a common 0–100 scale and weighted equally; equal-interval classification therefore preserves the proportional spacing of that scale and avoids introducing subjective thresholds. This convention follows established composite sustainability indices that apply equal-width performance bands on a 0–100 scale (e.g., OECD, 2008; Guo *et al.*, 2015). As these thresholds have not been empirically validated for urban poultry specifically, they are treated as an interpretive classification rather than an absolute standard, and this is acknowledged as a limitation.

Economic feasibility analysis

The economic feasibility analysis of the KUB chicken business was carried out using the Revenue–Cost Ratio (R/C), with the formula (Asmara *et al*., 2017):

$$R/C = \frac{TR}{TC}$$

Where; TR is total revenue and TC is total cost (Rp/year). TR comprised all cash income, namely sales of eggs and live or culled chickens, plus the imputed value of household-consumed eggs at prevailing local prices. TC combined variable costs (feed, DOC or replacement stock, vaccines and medicines, and other consumables) and fixed costs (annual depreciation of cages and equipment). Family labor was not monetized, as cultivation is carried out voluntarily by group members; the R/C ratio therefore reflects cash and imputed input costs, excluding the opportunity cost of family labor.

The business feasibility criteria were adapted from Harly *et al*. (2025), then determined as follows:

- R/C > 1 : economically viable business
- R/C = 1 : break-even
- R/C < 1 : unqualified effort

Data analysis

The data were analyzed using descriptive statistics, including means, percentages, and the distribution of sustainability categories across the technical, social, and economic dimensions. The results are presented in tables and interpreted to convey the overall sustainability of the KUB chicken business in the Semerbak Plant Program. As the study describes the entire population of recipient groups, the analysis is intentionally descriptive, focusing on portraying each dimension and identifying the indicators that most constrain sustainability.

RESULTS

Characteristics of farmer groups

This study involved 16 farmer groups and groups of women farmers who received the Perdu Semerbak Program consisting of 14-40 members in Semarang City who managed KUB chicken cultivation collectively on a small business scale. Across the 16 groups, membership averaged 22.6 people, while flock size varied widely: most groups (12 of 16) kept around 20 birds, whereas a few operated at a much larger scale, raising the average flock to 48 birds despite a median of only 20. This larger scale reflects technical progress, as several KT/KWT have begun hatching their own chicks and are therefore able to expand their flocks independently of the initial assistance. Production activities are focused on the utilization of eggs and the sale of live chickens with a semi-intensive maintenance system adapted to the environmental conditions of the settlement. Most of the groups are still in the early stages of business development, with relatively limited experience in livestock farming and managerial capacity still developing. KT Tani Mulyo kept a much larger flock (219 birds) than the others, reflecting its larger membership and its ability to hatch its own chicks rather than a data error, its per-hen egg output (164 eggs/year) was in line with the rest.

Table 2: Institutional profile of KT/KWT recipients of the 2024 Perdu Semerbak program.

Group Name	Year of establishment	Number of members	KUB chickens	
			Male	Female
		(people)	(birds/year)	
KT Jatiwangi	2018	22	36	114
KWT Geber Semanggi	2021	19	4	16
KT Kemijen	2019	19	8	22
KT Tani Mulyo	2019	26	96	123
KT Kusuma	2020	20	31	17
KWT Bina Mandiri	2012	40	4	16
KWT Tunas Bahagia	2019	20	4	16
KT Mureh Mulyo	2010	20	4	16
KT Bhumi Rejo Makmur	2012	14	6	18
KWT Hijau Asri	2014	34	4	16
KT Subur Makmur Sejahtera	2024	16	4	16
KT Dewi Sri	2017	20	64	36
KT Makmur Sejahtera	2022	20	4	16
KWT Berkah Tani	2024	20	4	16
KWT Sendang Makmur	2022	37	4	16
KWT Srikandi Adiwidya	2022	15	4	16
Total		362	281	490
Average		22,6	17,6	30,6

Source: Semarang City Agriculture Office (2024).

Productivity of KUB chickens

The annual egg productivity of KUB chickens varied widely, ranging from 325 to 9,000 eggs/group and an average of around 2,743 eggs per year (Table 3). Based on the analysis of the sustainability index, most of the groups (75%) are in the category of moderately sustainable, while 25% of the groups have reached the sustainable category in terms of productivity. There are no groups that fall into the category of less sustainable or unsustainable, which shows that in general egg production performance has met the minimum sustainability standards even though there are still gaps between groups. Although total egg output varied widely (325–9,000 eggs/year), per-hen productivity

Table 3: Production of KUB chicken eggs in the recipient group of the Semerbak urban farming program.

Groups	Districts	Egg production (eggs/year)	Productive female KUB chickens (Birds)	Eggs/hen/year
KT Jatiwangi	Candisari	3750	23	163
KWT Geber Semanggi	Semarang Selatan	3000	16	188
KT Kemijen	Semarang Timur	2500	15	167
KT Tani Mulyo	Pedurungan	9000	55	164
KT Kusuma	Gayamsari	661	4	165
KWT Bina Mandiri	Semarang Tengah	1330	8	166
KWT Tunas Bahagia	Semarang Utara	2800	16	165
KT Mureh Mulyo	Genuk	3000	16	188
KT Bhumi Rejo Makmur	Gajahmungkur	325	2	163
KWT Hijau Asri	Semarang Barat	3000	16	188
KT Subur Makmur Sejahtera	Tugu	2076	13	160
KT Dewi Sri	Banyumanik	2340	14	167
KT Makmur Sejahtera	Tembalang	2160	13	166
KWT Berkah Tani	Ngaliyan	2112	13	163
KWT Sendang Makmur	Gunungpati	1440	9	160
KWT Srikandi Adiwidya	Mijen	520	3	173
Average		14,8	2,743	169

Source: Primary Data Processed (2025). Eggs/hen/year = annual egg production ÷ number of productive females.

Table 4: Average temperature, flock size, and mortality of KUB chickens (2024).

Districts	Average tempera-ture -(°C)-	Mortality (birds/ year)	Chicken population (birds/year)	Mor-tality (%)
Candisari	28,5	6	150	4
Semarang Selatan	28,7	-	20	-
Semarang Timur	29,0	4	30	13,3
Pedurungan	28,9	3	219	1,4
Gayamsari	28,8	12	48	25
Semarang Tengah	28,9	4	20	20
Semarang Utara	29,2	-	20	-
Genuk	29,1	2	20	10
Gajahmungkur	28,4	8	24	33,3
Semarang Barat	29,0	2	20	10
Tugu	28,8	-	20	-
Banyumanik	28,1	1	100	1
Tembalang	28,0	2	20	10
Ngaliyan	28,5	7	20	35
Gunungpati	27,6	2	20	10
Mijen	27,9	10	20	50
Average (n=13)	28,5			17,5

Source: Primary data processed (2025); Prediction of Worldwide Energy Resources (POWER) Data access viewer of the national aeronautics and space administration (NASA), 2024; Mortality (%) = (dead birds ÷ population) × 100. Mortality counts for Semarang Selatan, Semarang Utara, and Tugu were not recorded during data collection and were excluded from the average; population figures for these groups are available (20 birds each).

was consistent at 160–188 eggs/hen/year (mean 169), close to the KUB potential. The differences in group totals thus stem from flock size, not bird productivity.

Mortality rate and environmental conditions

The mortality rate of KUB chickens showed variation between groups, where 12.50% of the group was in the sustainable category, 62.50% in the moderately sustainable category, 6.25% in the less sustainable category, and 18.75% in the non-sustainable category. Mortality, expressed as a percentage of each flock, ranged from about 1% to 50% (mean 17.5%) (Table 4), well above the rates reported for KUB chickens elsewhere. The highest losses occurred in the early rearing phase, pointing to management and environmental factors rather than ambient temperature alone, since recorded cage temperatures (27.6–29.2°C) were not extreme.

Technical sustainability of KUB chicken farming

The results of the analysis of the Business Sustainability Index (BSI) on the technical dimension show that most of the groups are in the category of moderately sustainable, which reflects that the basic practices of KUB chicken cultivation have been applied in general. Indicators with relatively high values include cage management and feeding, while indicators with lower values are found in the aspects of waste management and production recording (Table 5). Overall, these results show that although the group has been technically able to run the livestock business, several indicators remain below the moderately sustainable threshold in more specific management aspects to achieve a higher level of sustainability. Strikingly, 81.25% of groups fell into category D (not sustainable) for Production and Maintenance Administration, the lowest score of any indicator. This points to a near-universal absence of structured record-keeping among recipient groups, a weakness that also limits the precision of self-reported productivity data and should be interpreted with this caveat in mind.

Table 5: Percentage of technical sustainability index by category.

Sustainability index parameters	Category (%)			
	A	B	C	D
Productivity	25,00	75,00	0,00	0,00
Mortality	12,50	62,50	6,25	18,75
Production and maintenance administration	0,00	0,00	18,75	81,25
Feed availability	25,00	68,75	6,25	0,00
Feed utilization	18,75	75,00	6,25	0,00
Clean water	37,50	62,50	0,00	0,00
Biosecurity	31,25	68,75	0,00	0,00
Waste management	31,25	56,25	12,50	0,00
Overall technical dimension (Aggregate BSI)	31,25	68,75	0,00	0,00

Remarks: A (sustainable), B (Moderately sustainable), C (Less sustainable), D (not sustainable), Business Sustainability Index (BSIs).

Table 6: Percentage of social sustainability index by category.

Sustainability index parameters	Category (%)			
	A	B	C	D
Active member participation in group management	18,75	50,00	31,25	0,00
Continuity of cultivation activities	37,50	56,25	6,25	0,00
Acceptance of the surrounding community	25,00	62,50	12,50	0,00
The Social dimension of the economy	37,50	56,25	6,25	0,00

Remarks: A (sustainable), B (Moderately sustainable), C (Less sustainable), D (not sustainable), Business Sustainability Index (BSIs).

Social sustainability of farmer groups

In the social dimension, most of the groups are in the category of moderately sustainable, which indicates the participation of members in cultivation activities although the level of involvement still varies. The sustainability of business activities shows that 56.25% of the group is in the category of moderately sustainable, 37.50% in the sustainable category, and 6.25% in the less sustainable category (Table 6). In addition, the level of public acceptance of KUB chicken farming activities is relatively good, with 62.50% of the group in the fairly sustainable category and 25% in the sustainable category, which indicates that in general livestock activities can be accepted in residential environments.

Economic feasibility of KUB chicken farming

The economic feasibility analysis showed that there was a variation in the R/C ratio between groups, where some groups had achieved an R/C value of > 1 indicating economic feasibility, while the other group still had an R/C value of < 1 which indicated that business profits had not been achieved. Overall, around 56.25% of the group is not economically feasible, while the rest are in the feasible category with varying levels of efficiency (Table 7). These results show that although the program has had a positive impact on production, the economic aspects of the business still require improvement, especially in cost efficiency and production scale. Because total cost included both variable inputs and fixed costs such as depreciation of cages and equipment, groups classified as Not Eligible (R/C < 1.00) were, in practice, operating at a net loss: Total costs exceeded total revenue, meaning business continuity depended on unpaid family labor and program support rather than economic return in its own right.

Table 7: R/C ratio value of KUB chicken business in the recipient group of the Semerbak urban farming program.

Groups	R/C Ratio	Categories
KT Jatiwangi, Candisari	1,60	Feasible efficient
KWT Geber Semanggi, Semarang Selatan	1,57	Feasible efficient
KT Kemijen, Semarang Timur	0,44	Not eligible
KT Tani Mulyo, Pedurungan	1,35	Low-worth
KT Kusuma, Gayamsari	0,99	Not eligible
KT Bina Mandiri, Semarang Tengah	0,95	Not eligible
KWT Tunas Bahagia, Semarang Utara	1,49	Low-worth
KT Mureh Mulyo, Genuk	1,26	Low-worth
KT Bhumi Rejo Makmur, Gajahmungkur	0,15	Not eligible
KWT Hijau Asri, Semarang Barat	0,91	Not eligible
KT Subur Makmur Sejahtera, Tugu	0,73	Not eligible
KT Dewi Sri, Banyumanik	1,79	Feasible efficient
KT Makmur Sejahtera, Tembalang	1,23	Low-worth
KWT Berkah Tani, Ngaliyan	0,93	Not eligible
KWT Sendang Makmur, Gunungpati	0,50	Not eligible
KWT Srikandi Adiwidya, Mijen	0,30	Not eligible

Source: Primary Data Processed (2025).

The gap between strong technical productivity and low economic feasibility (56.25% not feasible) arises from scale: with most groups keeping only about 20 birds, even good per-hen output yields revenue too small to cover feed and input costs. Feasibility here is limited mainly by flock size and input efficiency, not by bird productivity (Table 8).

Table 8: KUB chicken business feasibility based on R/C ratio.

Categories	Quantity (KT/KWT)	Percentage (%)
Highly efficient	0	0,00
Feasible-efficient	3	18,75
Low-worth	4	25,00
Not eligible	9	56,25
Total	16	100,00

Source: Primary Data Processed (2025). Highly Efficient = R/C ≥ 2.00; Feasible-efficient = 1.50 ≤ R/C < 2.00; Low-worth = 1.00 ≤ R/C < 1.50; Not Eligible = R/C < 1.00. Adapted from Harly *et al*. (2025).

DISCUSSION

The findings reveal an uneven sustainability profile across the three dimensions: technical performance was generally adequate, social participation was mixed, and economic feasibility was the weakest, with 56.25% of groups not yet viable. These patterns suggest that the dimensions do not move together; strong egg productivity, for instance, coexisted with widespread economic infeasibility, indicating that technical success alone did not ensure business viability. Variations in total egg output between groups were associated mainly with flock size rather than per-hen productivity, which was consistent across groups. Where productivity did differ, it may relate to feed, husbandry, or flock-health factors; however, as these were not measured directly, such links remain tentative rather than established. The limited experience of some groups also widens the gap in production performance. This confirms that the genetic potential of KUB chickens needs to be supported with adequate feed management, environmental conditions, and health control (Mano *et al*., 2024). This condition confirms that technical efficiency is the main determinant of productivity in small-scale poultry farms.

These results can be situated within the broader KUB literature. The moderately sustainable technical profile observed here is broadly consistent with findings from Cianjur, where an MDS-RapPoultry assessment similarly rated KUB farming as moderately sustainable, though the institutional dimension scored markedly lower there (38.91/100) than the technical scores reported in the present study (Antikasari *et al*., 2023). Economically, the mean R/C ratio across all groups in this study (~0.95) falls below the 1.3 reported for rural KUB operations (Zunarto *et al*., 2025), a gap attributable to the smaller flock sizes and higher unit fixed costs that characterize urban group settings. The mean mortality rate of 17.5% also exceeds the 5–15% range documented at the farmer level in Central Java, pointing to biosecurity and health-management challenges that are likely compounded by the communal and residential nature of urban farming rather than being inherent to the KUB breed.

The stability of the production system is greatly influenced by the group's ability to control risks, especially those related to livestock health. The high mortality rate in some groups shows that the stability of the maintenance system has not been optimal. The recorded cage temperatures (27.6–29.2°C) were only slightly above the thermoneutral zone and not extreme, so heat stress alone is unlikely to explain the high mortality. The losses, concentrated in the early rearing phase, more plausibly reflect inconsistent biosecurity, incomplete vaccination, and early-adaptation vulnerability (Bhagora, 2025), with mild heat possibly acting as an added stressor (Sailo and Das, 2016) rather than the primary cause. The inconsistent implementation of biosecurity reinforces this condition and shows that health management is not yet a top priority. Previous research confirms that controlling mortality through improved health and environmental management can have a direct impact on increasing productivity and business efficiency (Kennady *et al*., 2023). Mortality thus serves both as a technical indicator as well as a determining factor for the stability of the production system.

Technical performance that is not fully optimal is reflected in the lack of a data-based business management system. Limitations in waste management and production recording show that some business groups are still at the semi-traditional stage. Farmers have not fully applied data-based management principles in decision-making. Livestock waste management in urban areas is a strategic aspect because it is directly related to the quality of the environment and the comfort of the surrounding community. In the literature, poorly managed waste can cause odor and reduce social acceptance (Oluwam and Oligbinde, 2022). In this study, community acceptance was relatively favorable (25% sustainable, 62.5% moderately sustainable), suggesting waste issues were not yet a major source of friction; however, as this relationship was not tested directly, it is presented as contextual rather than a demonstrated link. On the other hand, integrated waste management can provide added value, for example as an organic fertilizer. Previous studies have shown that the integration of waste management in livestock systems has the potential to improve business efficiency and sustainability (Reza *et al*., 2024). This confirms that improving the technical aspect must include a systemic approach, not just an increase in production.

The social aspect in this study shows that business sustainability is greatly influenced by the internal dynamics of the group and interaction with the community. The uneven level of member involvement indicates that the effectiveness of the group organization has not been fully established. In the literature, higher group participation has been associated with better task coordination and activity consistency (Smith, 2022); in this study, the 18.75% of groups classified as sustainable in member participation tended to show higher scores in the continuity-of-activities indicator, though this relationship was not formally tested. Low participation can lead to workload imbalances and lower overall group performance. Relatively good public acceptance shows that livestock businesses can still run in residential environments, but their sustainability still depends on the group's ability to keep environmental impacts under control. Thus, the social aspect is not only supportive, but also a determining factor for the sustainability of business operations.

The implications of these technical and social conditions are reflected in the economic performance of the business which still varies. All groups in this study relied entirely on commercial feed, and disaggregated cost records at the group level were not available; however, prior KUB economic analyses report feed as the dominant variable cost, accounting for approximately 32% of total production costs at the farmer scale (Zunarto *et al*., 2025). Feed use efficiency therefore emerges as a key determinant of the R/C ratio: At the small flock sizes operated by most groups (~20 birds), even modest inefficiencies in feed allocation can shift a group from the low-worth to the not-eligible category. Efficient feed management and maintained productivity were associated with a higher likelihood of business viability, whereas groups experiencing technical issues such as high mortality tended to face compounded income loss through both reduced egg output and unrecovered feed costs. The small scale of the business limits the opportunity to achieve optimal economic efficiency, as fixed costs cannot be significantly reduced. Previous studies have shown that improving input efficiency and business scale such as collaboration with other small businesses is a key strategy in increasing the profitability of smallholder poultry farms (Awogboro *et al*., 2021). This shows that the improvement of economic aspects cannot be separated from technical and managerial improvements. Notably, the nine not-eligible groups tended to show higher mortality rates and lower member participation scores relative to feasible groups, suggesting that technical and social weaknesses compound into economic non-viability. This pattern is consistent across the data, though it is treated as interpretive given that cross-dimensional relationships were not formally tested in this descriptive study.

The urban setting introduced challenges that are largely absent from rural KUB studies. Limited and sometimes insecure land access constrained cage expansion beyond the starter package; residential proximity heightened community sensitivity to odor and noise; the absence of local feed supply networks increased transport costs; and zoning ambiguity in some districts created operational uncertainty. These structural pressures are reflected in the dominance of small (~20-bird) semi-intensive systems across the program and help explain why technical performance, though generally adequate, did not translate into economic viability for the majority of groups. The interconnectedness between these dimensions shows that the sustainability of the KUB chicken business in the urban farming system is multidimensional and interconnected. Weaknesses in one aspect will affect other aspects, so a partial approach will not be effective in improving business performance. High mortality was associated with lower productivity and income in this study, though the cross-sectional design does not allow causal inference. Similarly, poor waste management may be linked to lower social acceptance, and low group participation can weaken the implementation of technical management. Therefore, business development strategies must integrate technical capacity building, social institutional strengthening, and economic efficiency. This approach is in line with the concept of modern farm sustainability, which emphasizes the importance of interdimensional integration in achieving long-term success (Sulewski *et al*., 2018).

These findings have direct policy implications for the implementation of Mayor Regulation No. 24 of 2021 (Semarang City Government, 2021), which underpins the Perdu Semerbak Program. The prevailing assistance model, providing each group with a uniform starter package of approximately 20 birds, appears structurally insufficient to achieve economic viability at the group level, given that scale was the primary constraint on R/C ratio performance. Three adjustments merit consideration by program administrators. First, admission criteria could incorporate a minimum record-keeping standard, as the near-universal absence of production records (81.25% of groups in Category D) not only limits managerial decision-making but also reduces the reliability of program monitoring data. Second, assistance packages could be calibrated to group capacity, measured by membership size, cage availability, and prior husbandry experience, rather than applied uniformly, to enable groups with greater absorptive capacity to reach economically viable flock sizes more rapidly. Third, program continuation criteria could include minimum biosecurity compliance indicators, since early-phase mortality was the most consistent differentiator between feasible and non-feasible groups across the technical and economic dimensions.

As with any study, several boundaries define the scope of these findings and point to opportunities for further work. The study focuses on the complete set of 16 recipient groups, which provides a full picture of the program at this stage while naturally setting the scale for more advanced statistical modeling in future, larger cohorts. Its descriptive, cross-sectional design is well suited to characterizing the current sustainability profile of the groups; building on this baseline, longitudinal and inferential approaches could further trace how the technical, social, and economic dimensions influence one another over time. As the study centers on program participants, comparison with non-participating farmers offers a promising avenue to quantify the program's added value. Finally, the use of self-reported data, common in farm-level research, could be complemented in future studies by direct measurement and records to further strengthen precision. The absence of inferential or correlation analysis in this study is a deliberate methodological choice, because all 16 recipient groups constitute the entire program population rather than a sample, correlation coefficients and significance tests would be mathematically valid but statistically uninterpretable, they would describe the population itself, not estimate parameters for a broader universe. Examining relationships between dimensions, such as the link between mortality rates and R/C ratios or between membership size and participation scores, is therefore recommended as a priority for future research conducted with larger, multi-program cohorts where inferential methods are appropriate. These directions build naturally on the present findings and reinforce their value as a foundation for continued research.

CONCLUSION

The analysis of the sustainability of the KUB chicken business in the Perdu Semerbak Program shows that most of the groups are in the category of moderately sustainable, which indicates that the business system has run but is not optimal. The technical dimension remains constrained by mortality control and farm management limitations and business management, the social dimension shows uneven participation despite good public acceptance, while the economic dimension is not fully feasible due to low input efficiency. This condition confirms that improving sustainability requires strengthening technical capacity, group participation, and managerial efficiency in an integrated manner. Strengthening sustainability therefore requires targeted, sequenced interventions: (1) mandatory farm-record training to address the near-universal record-keeping gap; (2) standardizing vaccination and biosecurity protocols across all groups to reduce early-phase mortality; (3) cooperative feed purchasing to lower input costs; and (4) gradual flock-size expansion, supported by self-hatching programs, to improve economic returns per group.

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NOVELTY STATEMENT

This study contributes novel empirical evidence on the sustainability of KUB chicken farming in an urban farming context, a setting that has received substantially less attention than rural poultry systems in the Indonesian literature. Unlike rural assessments, the present study captures urban-specific pressures including limited and insecure land access, residential proximity effects on waste and noise tolerance, dependence on external feed supply chains, and the operational constraints of communal small-flock management under municipal program structures. By applying an integrated multidimensional framework, the Business Sustainability Index (BSI) for technical and social dimensions and the R/C ratio for economic feasibility, to the complete population of a city-level urban farming program, this study provides a replicable assessment model applicable to similar community-based livestock programs in other Indonesian cities.

AUTHORS CONTRIBUTION

CSU conceived and designed the study, supervised the research process, and critically revised the manuscript. IKD collected and analyzed the data, performed the sustainability assessment, and drafted the manuscript. MH contributed to the survey design, data interpretation, and manuscript review. All authors read and approved the final manuscript.

Generative AI and AI-assisted technology statement

During the preparation of this manuscript, the authors used Claude to support language editing and improve the clarity of the English text. After using this tool, the authors reviewed and edited the content as needed and take full responsibility for the content of the publication. All scientific content, data analysis, interpretation, and conclusions are the authors' own.

Conflict of interest

The authors have declared that there is no conflict of interest regarding the publication of this article.

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