

REVIEWER'S REPORT

Manuscript No.: **IJAR- 59247**

Title: Sustainability Assessment of Poultry Production using Economic and Environmental Indicators: Evidence from Barind Tract, Bangladesh.

Recommendation:

Accept as it is

Accept after Minor revision.....

Accept after Major revision

Do not accept (*Reasons below*)

Rating	Excel.	Good	Fair	Poor
Originality		✓		
Techn. Quality		✓		
Clarity			✓	
Significance			✓	

Reviewer Name: **Dr. ANAPANA GOPAL**

Reviewer's Comment for Publication.

1. General Comments

The manuscript addresses an important and relevant topic by attempting to integrate the **economic, environmental and operational dimensions of poultry-farming sustainability** in the drought-prone Barind Tract of Bangladesh. The study uses primary data from 121 poultry-farming households in Rajshahi and Joypurhat and applies several statistical approaches, including RII, regression analysis, chi-square tests, Friedman tests, Kruskal-Wallis tests and a composite Sustainability Score.

The manuscript has several strengths, particularly the use of primary household-level data, explicit acknowledgement of the cross-sectional nature of the study, and an attempt to develop an integrated sustainability framework. However, **substantial methodological and conceptual issues need to be addressed before publication**. The most important concerns involve the sample-size justification, definition and validation of the composite Sustainability Index, mismatch between the stated objectives and the analyses actually performed, interpretation of the district effect, regression modelling with a relatively small sample, reliance on self-reported environmental indicators, and several conclusions that extend beyond the evidence generated by the study.

Overall Recommendation: Minor Revision

2. Minor Comments

2.1 The stated objectives and actual analyses are not fully aligned

The Introduction states that the study aims to assess:

1. economic performance and factors influencing **productivity and profitability**;
2. environmental impacts and environmental-management practices; and
3. economic, environmental and institutional constraints.

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However, the reported economic analysis primarily examines **total production cost**, rather than profitability, gross margin, benefit-cost ratio, productivity or technical efficiency.

This is an important discrepancy.

The authors should either:

- provide the promised profitability/productivity analyses, such as gross margin, net return, benefit-cost ratio or relevant productivity measures; **or**
- revise the objectives and claims so that they accurately describe the variables actually analysed.

The manuscript itself states that previous literature used gross margin, benefit-cost and stochastic-frontier approaches, but these approaches are not actually applied in the present study.

2.2 The sample-size calculation requires clarification

The authors state that Cochran's formula was used with:

- $Z = 1.96$
- $p = 0.5$
- $e = 0.05$

and that a finite-population correction was applied, followed by approximately 10% inflation for non-response. The final sample was only **121 households**.

The manuscript does not provide:

- the total population of eligible poultry farms used for the finite-population correction;
- the number of farms in the sampling frame;
- the number selected initially;
- the number refusing participation;
- the actual response rate;
- the precise calculation leading to $n = 121$.

Because the conventional Cochran calculation with $p = 0.5$, 95% confidence and 5% precision initially produces a substantially larger sample before finite-population correction, the authors must show the complete calculation.

A reproducible sample-size table or formula should be provided.

2.3 The representativeness of the sample is limited

The sample is heavily dominated by relatively large commercial farms:

- **76.9%** had more than 2,000 birds.
- **95.9%** of respondents were male.
- 88.4% used commercial feeding systems.

The authors acknowledge this limitation later, which is appropriate.

Nevertheless, the manuscript should consistently avoid broad statements about **“poultry production in the Barind Tract”** when the empirical sample disproportionately represents larger commercial operations.

The title, abstract and conclusions should make clear that the findings primarily represent the sampled **commercial and semi-commercial poultry farms**, rather than all poultry producers.

3. The Composite Sustainability Index Requires Stronger Conceptual and Statistical Justification

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This is one of the most important issues in the manuscript.

The authors combine:

- Economic Challenge Index (ECI)
- Environmental Sustainability Index (ESI)
- Challenge Severity Index (CSI)

and then calculate their arithmetic mean to create a composite Sustainability Score. However, several questions remain.

a. Why should these three dimensions receive equal weights?

An arithmetic mean assumes that:

Economic = Environmental = Operational challenges

in their contribution to sustainability.

No theoretical or empirical justification is provided for equal weighting.

The authors should justify this decision or perform a sensitivity analysis using alternative weighting approaches.

b. Cronbach's alpha does not establish construct validity

The manuscript reports Cronbach's α values between approximately 0.709 and 0.750. However, Cronbach's alpha only provides information about **internal consistency**. It does not demonstrate that the items validly measure economic sustainability, environmental sustainability or overall sustainability.

The authors should consider reporting, where appropriate:

- item-total correlations;
- exploratory factor analysis;
- factor loadings;
- construct validity;
- convergent/discriminant validity;
- or a stronger theoretical justification for the index.

At minimum, the authors should explicitly state that reliability does not by itself establish validity.

3.1 The terminology of the Environmental Sustainability Index is confusing

The manuscript calls the measure the **Environmental Sustainability Index**, but Table 4 states:

“higher values indicate poorer environmental performance.”

This is counterintuitive because an index named “Environmental Sustainability” would normally be expected to increase with better sustainability.

The authors should either:

- reverse the direction so higher values indicate better environmental sustainability; or
- rename it as an **Environmental Challenge/Environmental Pressure Index**.

The same directional convention should then be maintained throughout the manuscript.

4. The Sustainability Score May Have a Circular Relationship With Some Predictors

The Sustainability Score is constructed from questionnaire items concerning economic, environmental and operational challenges. Some independent variables, such as training, education and other farmer characteristics, are then used to predict that score.

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This is acceptable in principle, but the authors should clearly demonstrate that none of the predictor variables are themselves components of the index.

More importantly, the conceptual relationship between:

training → environmental index → composite sustainability score

needs careful treatment because training is associated with the questionnaire-based environmental perception measures.

The authors should provide the complete item list for all three indices, preferably as a supplementary table.

5. Environmental Indicators Are Mostly Self-Reported Rather Than Objective Environmental Measurements

The title emphasizes **“Economic and Environmental Indicators.”**

However, the environmental assessment appears to rely substantially on farmer-reported:

- manure-management practices;
- perceived environmental impacts;
- perceived water pollution;
- perceived water scarcity;
- environmental perceptions.

The authors themselves acknowledge that environmental measures are subject to recall and social-desirability bias.

There are apparently no direct measurements of:

- groundwater level;
- groundwater quality;
- poultry wastewater;
- nutrient concentrations;
- ammonia;
- nitrate;
- phosphate;
- microbial contamination;
- greenhouse-gas emissions;
- manure nutrient loading.

Therefore, the manuscript should avoid giving the impression that it has **measured environmental impact directly**.

The title could be revised to emphasize **environmental management practices/perceptions** rather than environmental indicators if no objective environmental measurements are available.

6. The Groundwater Argument Is Stronger Than the Study's Direct Evidence

The manuscript appropriately highlights groundwater depletion in the Barind Tract and cites regional literature.

However, the current study does not appear to measure poultry-related groundwater extraction or actual poultry water consumption.

The manuscript therefore needs to distinguish clearly between:

regional groundwater depletion documented by previous studies

and

water demand attributable to the sampled poultry farms.

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The recommendation to integrate poultry water demand into regional groundwater governance is reasonable as a policy hypothesis, but the present survey does not quantify that demand.

The conclusion should therefore be phrased more cautiously.

7. The “District Effect” Requires More Cautious Interpretation

The composite Sustainability Score regression reports:

- District coefficient $\beta = 0.137$
- $p < 0.001$
- $R^2 = 0.615$

and describes district as the strongest predictor.

However, only **two districts** were studied, and the districts were purposively selected. Consequently, the district coefficient may capture many unmeasured differences, including:

- market access;
- veterinary services;
- extension services;
- infrastructure;
- farm density;
- land availability;
- groundwater conditions;
- input prices;
- poultry value chains;
- local institutions.

It should not be interpreted as evidence that **“district location” itself causes sustainability differences**.

The manuscript should state that the district variable is likely acting as a proxy for a collection of location-specific structural factors.

8. Potential Clustering/Nesting Issue Needs Discussion

Farmers were selected within:

- districts,
- upazilas,
- farm types,
- flock-size categories.

The regression analysis appears to treat the 121 farms as independent observations.

The authors should clarify whether farms are clustered within upazilas or other sampling units and whether clustering was accounted for statistically.

If many farms come from the same upazila, standard errors may be underestimated if intra-cluster correlation exists.

At minimum, the authors should provide:

- number of upazilas sampled;
- number of farms per upazila;
- sampling-frame structure;
- whether cluster-robust standard errors were considered.

9. Logistic Regression Requires More Complete Reporting

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The logistic regression examines formal credit access, with only **27 farms having access and 94 without access**.

The model includes six predictors.

Given the relatively small number of positive credit-access cases, the stability of the logistic regression should be carefully assessed.

Table 3 currently reports:

- standardized β ;
- odds ratios;

but does not provide:

- standard errors;
- 95% confidence intervals;
- p-values;
- model likelihood statistics;
- pseudo- R^2 ;
- classification performance/AUC;
- calibration information.

These should be added.

The authors should also clarify that an OR of 3.64 represents the association with a specified unit of the predictor—in this case, the interpretation depends on the scaling of flock size.

10. The Linear Regression Diagnostics Indicate Model Problems

For the production-cost regression, the authors report:

- $R^2 = 0.306$;
- significant Breusch–Pagan test;
- significant Shapiro–Wilk test for residual normality.

The manuscript acknowledges heteroskedasticity and non-normal residuals, but still presents conventional OLS inference.

The authors should consider:

- heteroskedasticity-robust standard errors;
- transformation/alternative model specification;
- robust regression;
- sensitivity analyses;
- or bootstrap confidence intervals.

The statement that the non-normality is attributable to “a small number of very large commercial farms” should be supported by diagnostic evidence rather than simply asserted.

11. The Sample Size Is Relatively Small for the Number of Analyses Conducted

The study uses 121 observations but performs numerous analyses:

- t-tests;
- ANOVA;
- correlations;
- chi-square tests;
- Friedman test;
- Wilcoxon tests;
- Kruskal–Wallis tests;
- multiple linear regression;

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- logistic regression;
- several composite indices.

The large number of statistical tests increases the possibility of false-positive findings. The authors should explain their analytical hierarchy and distinguish:

- **pre-specified primary outcomes**
- **secondary/exploratory analyses.**

The manuscript should also avoid presenting every statistically significant association as equally important.

12. The Negative Association Between Training and Sustainability Needs More Careful Interpretation

Training is negatively associated with:

- Environmental Sustainability Index;
- Composite Sustainability Score.

The authors appropriately acknowledge several possible explanations, including reverse causation/self-selection and greater awareness among trained farmers.

This is one of the stronger aspects of the Discussion.

However, the Abstract states:

“training showed a significant negative association with sustainability.”

This is statistically accurate but could easily be misinterpreted as evidence that training **reduces sustainability**.

The abstract should explicitly state that this is an **observational association** and that causal interpretation is not possible.

13. “Credit and Training Systems Currently Reward Scale” Is Too Strong

The Abstract concludes:

“Credit and training systems currently reward scale rather than efficiency or environmental performance.”

The data show that flock size is associated with formal credit access, but the study does not directly examine **credit-allocation criteria** or how training systems allocate resources.

Therefore, “reward” implies a mechanism that has not been directly measured.

A more defensible interpretation would be:

“Formal credit access was strongly associated with flock size, suggesting that existing access patterns may favor larger operations.”

The same caution should be applied throughout the Discussion and Conclusions.

14. Economic Performance Should Include Actual Economic Indicators

If the manuscript is intended as an economic sustainability assessment, the authors should ideally report:

- total revenue;
- variable costs;
- fixed costs;
- gross margin;
- net return;
- benefit-cost ratio;
- cost per bird;
- revenue per bird;

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- profitability by poultry type;
- possibly return on investment.

At present, much of the economic regression focuses on **total production cost**, which is not itself a measure of economic sustainability.

A larger production cost does not necessarily indicate poorer economic performance.

The authors actually acknowledge this appropriately:

the model explains “scale of expenditure rather than cost-efficiency.”

This clarification should be reflected more prominently in the manuscript.

15. Environmental Management Categories Need Clear Definitions

The manuscript defines “improved manure management” as composting or biogas and “unimproved” management otherwise.

However, direct application to cropland may not necessarily be environmentally equivalent to open dumping, and pond application may have different consequences depending on quantity, timing and management.

The authors should provide an operational definition and justify why particular practices were categorized as improved versus unimproved.

16. The RII Methodology Requires Some Clarification

The RII formula is provided, which is useful.

However, the manuscript should state:

- whether all Likert questions had the same direction;
- whether reverse-coded items were used before RII calculation;
- how missing responses were handled;
- whether the RII was calculated on all 121 respondents for every item;
- how ties were treated.

The term should also be consistently written as **Relative Importance Index**, not occasionally “Relative Important Index.”

17. Some Claims in the Discussion Are Speculative

The Discussion proposes that the district effect may reflect:

- extension services;
- market infrastructure;
- institutional support;
- structural conditions.

These are plausible explanations, but they were not directly measured in the regression.

The authors should clearly distinguish:

measured evidence from **possible explanations**.

Phrases such as “may reflect,” “could be associated with,” and “requires further investigation” should be retained.

18. Policy Recommendations Need Better Linkage to the Evidence

The policy section proposes:

- biosecurity;
- vaccination;
- heat-stress mitigation;
- group-based lending;

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- revised credit systems;
- revised training curricula;
- composting/biogas subsidies;
- district-targeted infrastructure;
- integration of poultry water demand into groundwater planning.

These recommendations are potentially useful, but some go beyond what was directly tested.

A table linking **finding** → **evidence** → **policy implication** would improve the manuscript.

For example:

Empirical finding	Evidence	Appropriate implication
Heat stress is a major reported constraint	RII = 0.71	Investigate farm-level heat mitigation
No sampled farm used biogas	0% adoption	Evaluate economic/technical barriers
Flock size associated with credit access	OR = 3.64	Investigate credit eligibility mechanisms
District differences	$\beta = 0.137$	Investigate district-level structural factors

19. Limitations Section Is Good but Should Be Expanded Slightly

The manuscript already provides a useful limitations section covering:

- cross-sectional design;
- sample composition;
- self-reported environmental data;
- purposive district selection;
- low R^2 for environmental regression.

This is a strength.

However, the authors should additionally acknowledge:

- possible clustering within sampling units;
- limited statistical power for the credit-access model;
- equal weighting of composite-index components;
- lack of objective environmental measurements;
- potential measurement error in self-reported economic data;
- lack of direct poultry water-consumption measurements.

20. Future Research Section Is Appropriate

The proposed future work—including longitudinal data, qualitative institutional research, broader sampling, direct water-quality measurements, groundwater monitoring and efficiency analysis—is appropriate.

However, these limitations should also be reflected earlier in the interpretation rather than being confined to the Future Research section.

21. References Require Careful Technical Checking

The reference list needs editorial and bibliographic revision.

Examples include:

- “Akpaeti et al. (n.d.)” without a publication year.
- Several references lack complete bibliographic information.

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- FAO/GLEAM appears in more than one form.
- Some older references are used for broad background claims that could be supported by more recent sources.
- Formatting is inconsistent between references.

Every reference should be checked for:

- author names;
- year;
- journal title;
- volume;
- issue;
- page/article number;
- DOI;
- consistency with the journal's reference style.

22. Some Background Statements Need Better Referencing

The Introduction contains broad claims such as poultry being among the most resource-efficient animal-protein sources and being the fastest-growing agricultural sub-sector.

These should be supported by authoritative and recent literature where possible.

Similarly, claims concerning antimicrobial resistance, zoonotic disease and environmental pollution should be supported by references directly addressing those topics rather than relying on broad sectoral sources.

23. Figure and Table Presentation

The manuscript contains several useful visualizations:

- Figure 1: sample distribution by district and poultry type;
- Figure 2: economic challenges;
- Figure 3: manure management/environmental perception;
- Figure 4: operational constraints;
- Figure 5: district-level Sustainability Score.

The figures are generally clear, but the following should be improved:

1. Standardize figure titles and capitalization.
2. Ensure all axes contain units where applicable.
3. Define all abbreviations in captions.
4. Ensure statistical results in figures correspond exactly to the text.
5. Avoid excessive reliance on color to distinguish categories.
6. Ensure figures remain interpretable in grayscale.
7. Explain the meaning and direction of the Sustainability Score in Figure 5.

24. Language and Editorial Issues

The manuscript is generally readable, but several formatting and grammatical problems require attention.

Examples include:

- “Keywords:Poultry farming” → spacing required.
- “Theeconomic performance” → “The economic performance.”
- “47 metres(Hasan et al., 2018)” → missing space.
- “Table 2:Multiple Linear Regression” → missing space.
- “Table 3:Binary Logistic Regression” → missing space.

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- "Table 4.Linear regression" → punctuation/spacing.
- "3.7 Discussions" should preferably be **"3.7 Discussion."**

The manuscript should undergo professional language editing.

25. Important Conceptual Issue: Sustainability Is More Than the Three Selected Dimensions

The manuscript defines sustainability through:

- economic challenge;
- environmental sustainability;
- operational challenge.

However, sustainability of livestock production is generally multidimensional and may also involve:

- social sustainability;
- animal welfare;
- occupational health;
- food safety;
- antimicrobial use;
- resilience;
- resource efficiency;
- gender inclusion;
- livelihood security.

The authors do not need to include all of these, but they should clearly explain why the present Sustainability Index is limited to the three selected dimensions.

The title and conclusions should not imply that the index represents **overall sustainability in an exhaustive sense**.

26. Suggested Structural Revision

A clearer structure would be:

1. Introduction

- Background
- Barind Tract context
- Research gap
- Objectives/hypotheses

2. Materials and Methods

- Study area
- Sampling
- Questionnaire
- Variables
- Sustainability-index construction
- Statistical analysis
- Ethics

3. Results

- Sample characteristics
- Economic outcomes
- Environmental management
- Operational constraints
- Composite sustainability
- Regression analyses

International Journal of Advanced Research

Publisher's Name: Jana Publication and Research LLP

www.journalijar.com

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4. Discussion

- Economic findings
- Environmental findings
- Training/credit findings
- District/structural differences
- Comparison with previous studies
- Implications

5. Limitations

6. Conclusions and Policy Implications

This would reduce repetition between the current "Results and Discussions" section and the later Discussion section.

27. Overall Strengths

Despite the concerns above, the manuscript has several positive features:

- Relevant and policy-oriented research question.
- Primary data from 121 poultry-farming households.
- Focus on an environmentally vulnerable agro-ecological region.
- Inclusion of economic and environmental dimensions.
- Multiple statistical approaches.
- Explicit reliability assessment of composite measures.
- Appropriate acknowledgement that cross-sectional data cannot establish causality.
- Useful attempt to identify district-level structural differences.
- Clearly presented figures and regression tables.
- Dedicated limitations and future-research sections.

The study therefore has a potentially useful empirical contribution, provided the methodological and interpretive issues are addressed.

28. Final Recommendation

Decision: MINOR REVISION