

REVIEWER'S REPORT

Manuscript No.: IJAR- 58558

Title: A Time-Series Framework for Estimating the Lagged Impact of Crop-Residue Burning on PM_{2.5} Pollution in Delhi-NCR.

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: **ANAPANA GOPAL**

Reviewer's Comment for Publication.

General Comments

This manuscript investigates the temporal relationship between crop-residue burning in Punjab and PM_{2.5} concentrations in Delhi-NCR using a nine-year (2015–2024) time-series dataset integrating NASA FIRMS fire counts and CPCB air quality observations. The topic is timely and highly relevant for environmental management and public health. The manuscript is generally well organized and includes several informative visualizations. However, there are substantial concerns regarding methodological rigor, statistical interpretation, causal inference, novelty, and overstatement of conclusions. These issues should be addressed before the manuscript is suitable for publication.

Minor Comments

1. Causality is overstated

The manuscript frequently implies that crop-residue burning directly causes PM_{2.5} increases in Delhi-NCR.

However, the analyses are based primarily on correlations and distributed lag regressions.

Since multiple pollution sources simultaneously contribute to Delhi air quality (vehicular emissions, industries, dust, biomass burning, meteorology, and boundary layer dynamics), the conclusions should be carefully rewritten to indicate **association rather than causation**.

Statements such as:

"Our findings establish..."

should be softened to

"Our findings suggest..."

or

"Our results indicate an association..."

throughout the manuscript.

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2. Meteorological variables are missing

The largest limitation of this study is the absence of important meteorological predictors.

Variables such as:

- wind speed
- wind direction
- boundary layer height
- humidity
- rainfall
- temperature
- atmospheric pressure

strongly influence PM_{2.5} transport.

Without incorporating these covariates into the regression models, it is difficult to isolate the contribution of crop-residue burning.

The authors should either:

- include these variables in the statistical model, or
- clearly acknowledge this limitation.

3. Weak correlation coefficients

The strongest reported Pearson correlation is only:

$r = 0.289$

Although statistically significant because of the sample size, this represents only a weak-to-moderate relationship.

The manuscript repeatedly describes the relationship as "strong" or "dominant," which is not statistically justified.

The discussion should emphasize the modest effect size rather than overstate its importance.

4. Novelty requires clarification

Distributed lag analysis and cross-correlation between crop burning and PM_{2.5} have already been reported in previous studies.

The Introduction should explicitly explain:

- what methodological innovation this study provides,
- how it differs from previous research,
- why this framework is superior to existing approaches,
- whether this represents a new analytical method or merely an application of existing techniques.

5. Early-warning framework requires validation

The manuscript proposes a three-tier early-warning system.

However,

this framework has **not been validated** using independent datasets.

No prediction accuracy,

no sensitivity,

no specificity,

no forecasting performance,

and no external validation are presented.

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Therefore, the framework should be described as **conceptual** rather than operational until validated.

6. Distributed lag regression requires additional information

The manuscript mentions distributed lag regression but does not adequately report:

- regression coefficients,
- confidence intervals,
- adjusted R^2 ,
- residual diagnostics,
- multicollinearity assessment,
- autocorrelation testing,
- model assumptions.

These should be included.

Specific Comments

Title

The title is informative.

However,

it is rather long.

A shorter alternative could be:

Lagged Association Between Punjab Crop-Residue Burning and PM_{2.5} Pollution in Delhi-NCR: A Nine-Year Time-Series Analysis

Abstract

The abstract is generally well written.

However,

avoid claiming

"same-day dominant lagged signal"

without explaining the relatively low correlation coefficient.

Mention the minor limitation of missing meteorological adjustment.

Introduction

The Introduction is comprehensive.

However,

it is excessively long.

Several background paragraphs could be condensed.

Recent references from 2024–2025 should be incorporated where available.

Materials and Methods

The methods should clearly describe:

- quality control procedures,
- handling of missing data,
- assumptions of regression,
- justification for selecting 24-, 48-, and 72-hour lag periods,
- sensitivity analyses.

The exclusion of 2017 data should also be better justified.

Results

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The figures are attractive and easy to interpret.

However,

Figures 5 and 6 mainly repeat information already shown in earlier figures.

Some figures could be moved to supplementary material.

The Results section should focus on objective findings rather than interpretation.

Discussion

The Discussion contains several speculative statements.

Examples include:

- policy effectiveness,
- transport time,
- aerosol persistence,
- warning system performance.

These interpretations should be better supported with references or clearly identified as hypotheses.

The discussion should also compare results with similar studies from China, Europe, and other biomass-burning regions.

Statistical Interpretation

The manuscript reports numerous statistically significant p-values.

However,

greater emphasis should be placed on:

- effect sizes,
- practical significance,
- uncertainty,
- confidence intervals,

rather than statistical significance alone.

Conclusion

The conclusion should avoid overgeneralization.

The manuscript should conclude that crop burning is **one important contributor** to Delhi pollution rather than implying it is the dominant cause.

Recommendations for future multivariable forecasting models should also be included.

Language and Editorial Comments

The manuscript is generally written in good English.

Nevertheless, several improvements are recommended:

- Reduce repetitive wording.
- Simplify overly long sentences.
- Avoid excessive use of technical adjectives.
- Maintain consistent formatting of statistical symbols (p , r , R^2).
- Italicize statistical variables consistently.
- Standardize figure captions.
- Check reference formatting for journal compliance.

Strengths

- Highly relevant environmental issue.

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- Long-term dataset (2015–2024).
- Integration of satellite and ground-based observations.
- Clear graphical presentation.
- Appropriate use of time-series concepts.
- Useful policy implications.
- Practical relevance for air-quality management.

Weaknesses

- Weak correlation coefficients.
- Lack of meteorological adjustment.
- Causal claims exceed the statistical evidence.
- Novelty not sufficiently demonstrated.
- Early-warning framework lacks validation.
- Limited reporting of regression diagnostics.
- Discussion contains speculative interpretations.
- Some figures are redundant.

Editorial Recommendation

The manuscript addresses an important environmental health problem and provides a useful long-term analysis of the relationship between crop-residue burning and PM_{2.5} concentrations in Delhi-NCR. However, the current version requires substantial revisions to strengthen the statistical methodology, temper causal claims, incorporate meteorological considerations, clarify the study's novelty, and improve interpretation of the findings.

Final Recommendation: Minor Revision.