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REVIEWER'S REPORT

Manuscript No.: IJAR- 59785

Title: *Social Innovations and Collective Management of Fall Armyworm (Spodoptera frugiperda) in Maize Production in Northern Benin: From Collective Learning to Collective Action?.*

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 examines the role of social innovations in the collective management of fall armyworm (FAW), *Spodoptera frugiperda*, among maize farmers in N'Dali, northern Benin. The study focuses on three dimensions of social innovation—learning, relational and regulatory—and evaluates their sustainability following the withdrawal of external project support. The topic is relevant to agricultural development, integrated pest management, rural sociology and sustainable farming practices.

The manuscript has a clear research focus and uses a combination of questionnaire surveys, interviews and statistical analyses. The application of Ostrom's principles of collective action alongside diffusion of innovations theory provides a useful conceptual foundation. The comparison between learning-oriented arrangements and farmer-led relational arrangements is particularly interesting. The finding that farmer groups are associated with better access to information, while learning activities are more likely to be discontinued, offers useful insights for the design of agricultural development programmes.

However, several methodological and analytical issues require attention before the manuscript can be considered for publication. The purposive selection of farmers, the relatively small sample size, the classification and calculation of social innovation categories, and the interpretation of statistical associations need further clarification. Some conclusions also extend beyond what can be firmly established from the cross-sectional, self-reported data. The manuscript would benefit from a more transparent presentation of the analytical procedures, improved consistency in tables and percentages, and a clearer discussion of study limitations.

2. Content and Originality

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1. **Research contribution:** The study addresses an important research gap by examining whether social innovations introduced through agricultural development projects continue after external support ends. The distinction between learning-oriented and relational arrangements is valuable. However, the authors should state more explicitly what new theoretical or empirical contribution this study makes compared with previous research on farmer field schools, farmer organisations and collective pest management.
2. **Representativeness of the sample:** The study includes 76 farmers who had participated in at least one social innovation, selected from 94 maize farmers monitored by the DigiCLA project. Consequently, the sample does not represent all maize farmers in N'Dali. Farmers who had no involvement in social innovation were excluded. The authors should clearly acknowledge this selection limitation and avoid generalising the findings to the wider farming population.
3. **Selection bias:** Since participation in a social innovation was an inclusion criterion, the study cannot adequately establish how farmers who were never involved in such arrangements differ from participants. The authors should explain how this selection may influence the reported levels of information access, adoption of agroecological practices and perceived effectiveness.
4. **Classification of social innovations:** The manuscript identifies nine forms of social innovation under learning, relational and regulatory dimensions. However, some arrangements, particularly farmer groups and village meetings, may perform multiple functions, including knowledge dissemination, mutual assistance and collective decision-making. The authors should explain more clearly how the primary function was determined and how overlapping functions were handled during classification.
5. **Meaning of collective action:** The study appropriately distinguishes collective learning from collective regulation. However, the authors should explain more precisely what level of cooperation is necessary to qualify as collective pest management. Participation in training or information-sharing does not necessarily establish coordinated pest control across neighbouring farms.
6. **Assessment of sustainability:** The comparison between discontinued learning arrangements and continuing relational arrangements is one of the strongest aspects of the manuscript. Nevertheless, the study relies mainly on farmers' retrospective reports. The authors should clarify how discontinuation and continuation were defined, whether an arrangement was considered discontinued when formal project activities stopped but farmers continued using the knowledge, and how the persistence of an arrangement was verified.
7. **Project influence and potential bias:** The authors acknowledge that they are affiliated with the institution responsible for the DigiCLA project. This is an important disclosure. However, because the research evaluates activities associated with the same project, the possibility of respondent and researcher bias should be discussed more fully. The authors should explain what measures were taken to minimise socially desirable responses and ensure independent interpretation of the findings.
8. **Practical implications:** The recommendations concerning farmer-led facilitators, local monitoring committees, early-warning systems and collective rules are relevant. However, these recommendations should be connected more directly to the study findings, including the reported lack of financial resources, limited participation and insufficient technical support.

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3. Technical Quality

1. **Sampling procedure:** The authors should provide a more detailed explanation of the purposive sampling procedure. It should be stated whether all 76 eligible farmers were interviewed, whether any eligible farmers declined participation, and how the five villages were selected. The selection of only farmers involved in social innovations should also be clearly justified.
2. **Sample size and statistical power:** The sample consists of 76 farmers, while the second logistic regression model uses 110 innovation mentions. The authors should explain the adequacy of these sample sizes for the statistical analyses performed. The relatively small sample may result in unstable estimates, particularly where some categories contain very few observations.
3. **Unit of analysis:** The manuscript uses farmers as the unit of analysis in Model 1 and individual innovation mentions in Model 2. Since a farmer may report several innovations, the authors should explain how repeated observations were handled and whether the clustering of standard errors at farmer level adequately addresses the dependence among observations.
4. **Table 2 – Percentage calculations:** The presentation of Table 2 requires clarification. The percentages for the nine innovation types appear to represent their share of the 111 total mentions, whereas the member and non-member columns appear to represent participation within each group. The table heading and footnote do not make this distinction sufficiently clear. The authors should provide the actual frequencies alongside the percentages and clearly identify the denominator used for each column.
5. **Interpretation of innovation categories:** The learning, relational and regulatory percentages are calculated from the 111 reported mentions. These percentages should not be interpreted as the proportion of farmers participating in each dimension. The authors should consistently distinguish between the percentage of total innovation mentions and the percentage of farmers reporting participation in a particular arrangement.
6. **Origin of innovations:** The manuscript reports that the DigiCLA project was identified as the origin of 64.0% of mentions, while farmers themselves were identified as the origin in 41.4% of mentions. These percentages exceed 100% when combined, suggesting that multiple origins could be reported. The authors should explicitly explain whether categories were non-exclusive and how mixed-origin arrangements were recorded. The relationship between these figures and the later classification of project-specific, farmer-led and mixed-origin innovations should also be clarified.
7. **Regression Model 1:** Membership in a farmer group is associated with access to information, with an odds ratio of 8.51 and a 95% confidence interval of 2.33–31.05. Although this is an important finding, the confidence interval is relatively wide. The authors should discuss the uncertainty of the estimate and avoid interpreting the association as proof that membership directly causes improved information access.
8. **Regression Model 2:** The odds of discontinuation are reported to be approximately eight times higher for learning-oriented arrangements than for relational arrangements. This is an important result. However, the authors should provide the number of discontinued and continuing observations in each category, clarify the handling of missing information, and explain whether the model's assumptions and adequacy were assessed.

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9. **Crop-loss estimation:** The authors state that crop losses were estimated using the pebble method, with a mean estimated loss of 32.6%. The method needs a more detailed explanation, including the procedure followed, the reference used for estimating losses, and how farmers were guided to provide their estimates. Since the reported losses are self-reported rather than experimentally measured, this limitation should be emphasised.
10. **Perceived effectiveness:** The manuscript reports that all farmers perceived a reduction in caterpillar damage after becoming involved in collective pest management. Such uniformly positive responses require cautious interpretation. The authors should explain the question format, response options and reference period used. The possibility of recall bias and socially desirable responses should also be discussed.
11. **Statistical reporting:** The authors should provide complete statistical information wherever possible, including exact p-values, sample sizes, test statistics and confidence intervals. The reporting of permutation-based chi-square tests should include sufficient information about the procedure. The methods should also explain how missing observations were handled in each analysis.
12. **Multiple-response data:** Several results are based on multiple responses, including challenges, communication channels and pest-management practices. The authors should clearly state the denominator for each percentage and indicate that percentages may exceed 100% where multiple responses were allowed.

4. Language and Presentation

The manuscript is generally understandable and follows an appropriate academic style. However, several language and formatting issues should be corrected.
1. Some sentences are lengthy and contain multiple ideas. They should be shortened to improve readability, particularly in the Introduction and Discussion.
2. The manuscript contains several formatting and spacing problems, including missing spaces between words, inconsistent spacing around punctuation and irregular presentation of mathematical expressions.
3. The scientific name *Spodoptera frugiperda* should be italicised consistently throughout the manuscript. Scientific names of other organisms, where used, should follow the same convention.
4. Abbreviations such as FAW, FFS, DigiCLA and ATDA should be defined at their first occurrence and used consistently thereafter.
5. The phrase "Key words:-" should be corrected to "Keywords:" and the formatting of the keyword list should be standardised.
6. The interview quotations are useful and provide practical insight into farmers' experiences. However, the authors should ensure that quotations are presented consistently and that participant identification follows a uniform format.
7. Some expressions in the Discussion are too definitive considering the observational nature of the study. Words suggesting direct causation should be replaced with more cautious expressions such as "was associated with," "suggests," or "may indicate," where appropriate.
8. A careful English-language editing process is recommended to correct grammatical errors, improve sentence construction and ensure consistency in terminology.

5. Structure and Organization

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The manuscript follows a logical structure, with sections covering the Introduction, Analytical Framework, Materials and Methods, Results, Discussion and Conclusion. The overall organisation is appropriate, but some improvements are necessary.

1. **Introduction:** The research gap is reasonably explained. However, the objectives and research questions should be stated explicitly at the end of the Introduction. This would help readers understand the specific purpose of the study.
2. **Analytical Framework:** The discussion of social innovation, Ostrom's principles and diffusion theory is relevant. However, the authors should provide a clearer explanation of how these theoretical concepts were translated into measurable variables and analytical categories.
3. **Materials and Methods:** This section requires further detail concerning the sampling procedure, questionnaire design, interview process, classification of social innovations and measurement of perceived effectiveness. The authors should also provide information about questionnaire pre-testing, if conducted.
4. **Results:** The results are comprehensive but could be organised more systematically. The authors should ensure that each table and figure is introduced in the text and that the accompanying explanations do not simply repeat all numerical information.
5. **Discussion:** The Discussion provides useful comparisons with earlier research. However, it should distinguish more clearly between findings directly supported by the data and interpretations based on theoretical frameworks. The limitations of the study should be discussed in a separate paragraph or subsection.
6. **Conclusion:** The conclusion appropriately highlights the importance of farmer-owned organisational arrangements. However, it should be more concise and should avoid presenting recommendations as established outcomes of the study. The limitations associated with the selected sample and self-reported data should be acknowledged.
7. **Tables and Figures:** All tables and figures should be checked for consistency in numbering, titles, legends, units, denominators and source information. In particular, Table 2 needs revision to make the percentage calculations transparent. Figures should be sufficiently clear and readable.

6. References and Citations

The manuscript includes relevant references on social innovation, collective action, farmer field schools, fall armyworm management and agricultural development. The reference list is generally appropriate to the subject, but several improvements are required.

1. The authors should verify that every in-text citation appears in the reference list and that every listed reference is cited in the manuscript.
2. The formatting of references should be standardised according to the journal's prescribed referencing style.
3. Several references contain spacing and typographical problems, particularly in author names, article titles and journal names. These should be corrected throughout the reference list.
4. DOI information should be checked for accuracy and completeness wherever applicable. References without DOIs should include other relevant publication details or accessible source information.

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5. Government and institutional sources, including DSA, FAO and INSAE, should be presented with complete institutional names, publication titles and publication details.
6. The authors should verify the bibliographic details of recently published references, particularly those dated 2025 and 2026, and ensure that the cited publications are available and accurately represented.
7. The manuscript would benefit from additional recent literature on collective pest management, area-wide management of fall armyworm, farmer-led extension systems and the long-term sustainability of development-project interventions.
8. The use of references should be strengthened in the Discussion, particularly when comparing the findings from N'Dali with studies conducted in other African countries.

7. Overall Recommendation

The manuscript addresses a relevant and valuable research topic and provides useful insights into the relationship between social innovation, farmer organisations and collective management of fall armyworm. The combination of questionnaire data, interviews and statistical analysis is a positive feature. The distinction between learning-oriented arrangements and relational arrangements offers a meaningful contribution to understanding why some project-supported activities disappear while farmer-led organisational structures continue.
However, the manuscript requires substantial improvement in methodological transparency, statistical reporting, interpretation of percentages, and discussion of sampling limitations. The authors should also strengthen the explanation of how social innovations were classified, clarify the denominators used in the tables, and moderate conclusions based on self-reported observations.
The study has publication potential, but the methodological and presentation issues should be addressed before acceptance.
Minor Revision

8. Final Decision

Minor Revision

The manuscript is relevant and has potential for publication after substantial revision. The authors are strongly encouraged to address all methodological and statistical concerns, clarify the classification and percentage calculations of social innovations, improve the presentation of tables and figures, and strengthen the discussion of study limitations. Particular attention should be given to the purposive sampling procedure, the interpretation of regression results, and the distinction between perceived improvements and objectively measured pest-management outcomes.