

REVIEWER'S REPORT

Manuscript No.: **IJAR- 59151**

Title: Rethinking agricultural mechanisation for the agroecological transition: Benin's national strategy measured against an ideal type.

Recommendation:

Accept as it is

Accept after Major revision.....

Accept after Minor 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.

General Comments

This manuscript examines whether Benin's **National Agricultural Mechanisation Strategy (SNMA) 2022–2026** is consistent with an agroecological transition. The authors construct a seven-dimension ideal type from the FAO's ten elements of agroecology and the HLPE's thirteen principles, then compare the national mechanisation policy with this benchmark using documentary analysis and semi-structured interviews with implementation actors.

The topic is timely and relevant to sustainable agricultural development, mechanisation policy, soil conservation, farmer participation and agroecological transition in West Africa. The manuscript has a potentially valuable conceptual contribution because it combines an **ideal-type framework, policy-mix analysis, institutional lock-in and actor appropriation** rather than relying exclusively on policy-document analysis.

The manuscript reports that the SNMA scores **6/14 on documentary evidence and 2/14 according to implementing actors**, with shared use of machinery being the strongest dimension while input reduction, soil conservation and diversified production systems remain weakly operationalised.

The study is potentially publishable, but **minor revision is required**, particularly concerning the transparency and reproducibility of the qualitative sampling, scoring procedure, evidence supporting interview-based conclusions, potential researcher positionality, and the distinction between empirical findings and normative interpretation.

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1. Originality and Scientific Contribution

The manuscript presents a relatively distinctive analytical approach by translating broad agroecological principles into **seven operational dimensions of mechanisation policy**:

1. Input reduction and recycling
2. Diversity and economic diversification
3. Knowledge co-creation
4. Equity and participation
5. Responsible governance of resources
6. Connectivity and circular economy/shared use
7. Resilience and synergies/diversified systems.

This framework is potentially one of the strongest contributions of the paper.

However, the authors should explain more explicitly what is genuinely novel:

- Is the principal novelty the seven-dimensional ideal type?
- Is it the application of this framework to Benin?
- Is it the combination of documentary scoring and implementation-actor perceptions?
- Is it the identification of institutional lock-in mechanisms?

The Introduction should state the novelty in a more concise and explicit manner.

2. Minor Concern: Construction of the Ideal Type

The ideal type is central to the entire study because all subsequent scoring depends on it.

The manuscript explains Weberian ideal-type construction and then translates FAO and HLPE agroecological frameworks into seven dimensions.

However, the process by which the original ten FAO elements and thirteen HLPE principles were **selected, merged and translated into exactly seven dimensions** requires greater methodological justification.

The authors should explain:

- Why were some principles combined?
- Why were seven dimensions selected?
- Were any principles excluded?
- Were all seven dimensions considered equally important?
- Was the seven-dimension framework reviewed or validated by independent experts?
- Could another researcher reasonably construct a different seven-dimension grid from the same frameworks?

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A short methodological subsection explaining the **framework-development procedure** would strengthen the study considerably.

3. Scoring System Requires Stronger Justification

The manuscript assigns scores from **0 to 2**.

For documentary analysis:

- 0 = dimension absent;
- 1 = mentioned but without operational instrument/budget/criterion/indicator;
- 2 = supported by an identifiable instrument with budget or indicator.

For interviews:

- 0 = absence or contrary practice;
- 1 = partial consideration;
- 2 = effective consideration according to actors.

This is clear and relatively simple.

However, the scoring system introduces substantial researcher judgement.

The authors should explain:

- how borderline cases were handled;
- whether two researchers independently coded the material;
- whether disagreements were discussed and resolved;
- whether an intercoder agreement procedure was used;
- whether coding was performed manually or with qualitative-analysis software;
- how interview evidence was aggregated into one score per dimension.

Without such information, reproducibility of the 6/14 and 2/14 scores is limited.

4. Minor Concern: Interview Sample Is Not Reported Clearly Enough

The Methods state that interviews were conducted with officials from MAEP, DDAEP, ATDA, municipal units, SoNaMA, advisory and training organisations, financial services, farmers, mechanisation service providers and local manufacturers. Sampling was purposive and guided by information saturation.

However, the manuscript does not clearly report the **number of interviews conducted**.

This is a minor methodological omission.

The authors should provide:

- total number of interviews;

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- number of participants by stakeholder category;
- geographic distribution;
- gender distribution where relevant;
- approximate interview duration;
- dates/period of interviews;
- selection criteria;
- number of interviews considered sufficient for saturation.

A table such as the following would be useful:

Stakeholder category Number interviewed Location Role

National government

DDAEP/ATDA

SoNaMA

Farmers

CUMA

Service providers

Manufacturers/artisans

Financial institutions

5. Saturation Needs Demonstration

The authors state that purposive sampling was guided by information saturation.

However, merely stating “saturation” does not demonstrate that saturation was achieved.

The authors should briefly explain:

- how saturation was assessed;
- whether saturation was evaluated separately for different stakeholder groups;
- at what point no new themes were emerging;
- whether the final interviews confirmed existing themes.

This is especially important because the interview findings form a minor part of the manuscript's conclusions.

6. Full Interview Corpus Should Be Used Before Strong Conclusions

The manuscript itself acknowledges an important limitation: the perceived scoring is based on a small number of in-depth interviews and should be consolidated through coding of the **full interview corpus**.

This is a significant issue.

If the full corpus has not yet been coded, the authors should either:

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1. complete the coding before publication, or
2. substantially moderate claims based on actor perceptions.

This is particularly relevant to the reported **2/14 actor score**.

The manuscript should make clear whether the 2/14 score represents the complete interview dataset or an analytical subset.

7. Researcher Positionality and Potential Bias

The authors openly acknowledge that one author serves as secretary of the PDA 2 innovation platform, which facilitated access to actors but may not be neutral toward the research object.

This is commendable transparency.

However, the manuscript should explain more clearly how this potential positionality was managed.

For example:

- Were interviewees informed of the researcher's institutional role?
- Were interview responses independently coded?
- Were contradictory views actively sought?
- Were negative cases retained?
- Did another researcher verify the scoring?

The authors should expand the reflexivity statement rather than simply mentioning the limitation.

8. Documentary Corpus Requires More Systematic Description

The manuscript identifies sixteen policy and legal texts, including the SNMA 2022–2026, agricultural legislation, mechanisation decrees, investment plans and agroecological strategy.

This is a useful corpus.

However, the authors should clarify:

- why these documents were included;
- whether this was an exhaustive corpus;
- whether documents were selected according to predefined inclusion criteria;
- whether implementation guidelines, budget documents and annual reports were included;
- whether any relevant documents were excluded because they were unavailable.

A short statement on **document-search and inclusion procedures** would improve methodological rigour.

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9. Important Issue: Programme Budget Versus Actual Expenditure

The manuscript correctly notes that the reported amounts represent **programmed budgets rather than executed expenditure**. The authors also state that the FNDA subsidy and credit envelope could not be examined.

This is important because the paper makes several conclusions from the distribution of the programmed budget.

Table 3 reports a total programme cost of **22.085 billion CFA francs**, with 31.3% allocated to shared-use models and 29.4% to techniques adapted to the local context.

The authors should consistently use wording such as:

“programmed budget allocation”

rather than implying that these amounts were actually spent.

10. Budget Interpretation Needs Greater Caution

The manuscript states that credit and subsidies account for only 1.4% of the costed budget because the main envelope is referred to the FNDA and is not budgeted within the strategy.

This is an interesting finding, but the authors should be careful not to interpret an uncoded component as equivalent to a negligible policy instrument.

The paper should distinguish:

- **budget explicitly costed in the SNMA;**
- **financial resources referenced but managed elsewhere;**
- **actual expenditure.**

Otherwise, the 1.4% figure may be misleading when interpreted as the complete financial importance of credit/subsidy instruments.

11. Strongest Result: Documentary Score of 6/14

The scoring indicates:

- D1 = 1
- D2 = 0
- D3 = 1
- D4 = 1
- D5 = 1
- D6 = 2
- D7 = 0

giving a total of **6/14**.

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This is a useful synthesis.

However, the manuscript should avoid presenting the 6/14 score as if it were a conventional quantitative index with statistical properties.

The authors appropriately describe the ideal type as a heuristic construct.

That distinction should be maintained throughout the manuscript.

I recommend replacing expressions such as:

“the strategy performs poorly”

with more precise formulations such as:

“the strategy contains fewer operational instruments corresponding to the defined agroecological dimensions.”

This keeps the interpretation directly linked to the analytical framework.

12. Documentary Evidence Should Be Linked More Explicitly to Scores

Table 4 provides evidence supporting each score. This is a major strength.

Nevertheless, the authors should provide **specific document page/section references** wherever possible.

For example:

- SNMA page number;
- specific action number;
- budget annex;
- indicator number;
- eligibility criterion.

This would make the scoring independently verifiable.

13. Actor Score of 2/14 Requires Greater Transparency

The actor assessment gives only D2 and D6 partial recognition, with a total of **2/14**.

This is an important result, but readers need to know how many participants expressed each view.

For example, instead of only stating:

“actors perceive...”

the authors could report:

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“X of Y interviewees...”

or:

“This theme emerged across X stakeholder categories.”

This would strengthen the evidence while retaining the qualitative character of the research.

14. Interview Quotations Need Context

The manuscript includes useful direct quotations from officials, farmers and other actors. For example, the paper reports an interview describing the strategy as “intellectualised” and gives an example involving unsuitable ploughs.

The quotations are valuable, but each should ideally be accompanied by:

- stakeholder category;
- institutional affiliation or anonymised role;
- location;
- interview date;
- whether the quotation was translated from French.

The manuscript already notes that quotations were translated from French by the authors.

This should be retained consistently.

15. Potential Overgeneralisation From Individual Testimonies

Some conclusions about implementation appear to rely heavily on individual testimonies.

For example, the paper states that implementation is oriented toward individual farmer satisfaction and that shared services sometimes originate from local initiatives rather than strategy instruments.

These findings are potentially important, but the authors should indicate whether these were:

- isolated statements;
- recurring themes;
- views shared across several stakeholder groups.

This distinction is essential in qualitative research.

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16. Institutional Lock-In Analysis Is Interesting but Should Be More Explicitly Grounded

The manuscript identifies three mechanisms:

1. lineage of the national operator;
2. import-based supply chain;
3. distribution-oriented indicators.

The discussion then connects these mechanisms to path dependency.

This is potentially a strong theoretical contribution.

However, the authors should distinguish more clearly between:

empirically observed mechanisms

and

theoretical interpretation through the lock-in/path-dependency literature.

A useful approach would be to show, for each mechanism:

Evidence → observed institutional behaviour → theoretical interpretation → affected dimension.

This would make the causal argument more transparent.

17. Causal Language Should Be Moderated

The paper states that the three lock-in mechanisms “explain” persistence of the model.

Given the qualitative case-study design, “help explain” or “are identified as mechanisms contributing to” would be methodologically safer.

The study demonstrates associations and plausible institutional mechanisms; it does not establish causal effects in the statistical sense.

18. Need Stronger Discussion of Alternative Explanations

The discussion focuses heavily on institutional lock-in.

However, alternative explanations should also be considered, including:

- high capital costs of alternative machinery;
- availability of imported machinery;
- limited domestic manufacturing capacity;
- farmer demand for tractors;

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- landholding structure;
- maintenance and spare-parts availability;
- financing constraints;
- government objectives related to rapid mechanisation.

Some of these factors appear indirectly in the manuscript, but they should be integrated more explicitly into the discussion.

19. The Concept of “Agroecology-Compatible Mechanisation” Needs Operational Boundaries

The manuscript appropriately recognises that sustainable mechanisation does not necessarily mean rejecting motorised equipment.

However, the operational definition could be strengthened.

For example, clarify whether agroecology-compatible mechanisation necessarily requires:

- reduced tillage;
- direct seeding;
- diversified cropping;
- shared ownership;
- local manufacturing;
- lower fossil-fuel use;
- reduced soil disturbance.

The seven dimensions imply these elements, but their relative importance is not discussed.

20. Shared Mechanisation Is Correctly Identified as a Strong Policy Dimension

The paper reports that shared use receives **FCFA 6.905 billion, or 31.3% of the programme budget**, through CUMA strengthening and organisation of hire-service providers.

This is a strong empirical result.

However, the manuscript should distinguish between:

- resources allocated to creating shared-service structures;
- actual utilisation of those services;
- number of functioning CUMA;
- number of farmers actually served;
- machinery utilisation rates.

The paper itself points out that implementation monitoring focuses on distribution and hectares worked, rather than unused machinery.

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This distinction could become an important analytical strength.

21. Monitoring Indicators Need More Quantitative Evidence

The paper argues that monitoring indicators emphasise:

- beneficiaries;
- budget consumption;
- demand for equipment;
- tractors delivered;
- hectares worked.

It notes that these indicators do not measure unused equipment or soil effects.

This is an interesting finding.

However, the authors should provide a complete list of the relevant indicators from the SNMA, perhaps in a supplementary table, and classify them according to:

- access;
- distribution;
- utilisation;
- environmental effects;
- social inclusion;
- productivity;
- sustainability.

This would strengthen the argument substantially.

22. Need More Evidence on Soil Impacts

The manuscript repeatedly identifies soil conservation as an underdeveloped dimension.

However, the study does not directly measure:

- soil compaction;
- erosion;
- organic carbon;
- aggregate stability;
- soil disturbance;
- changes in soil fertility.

The argument is therefore based primarily on policy provisions and actor perceptions.

This is acceptable for a policy study, but the wording should make this clear. The paper should not imply that the SNMA has demonstrably caused soil degradation unless supported by empirical evidence.

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23. Historical Analysis Is Useful but Needs Source Attribution

The historical trajectory from human energy and animal traction toward motorised mechanisation is informative. The manuscript reports that the SNMA indicates 76% manual tillage, 23% animal traction and 1% motorised equipment, while later describing the expansion of public intervention and CUMA.

Because these are historical figures, the exact source and year should be consistently specified.

The paper should also avoid presenting figures from different years as though they are directly comparable without noting the time difference.

24. Figure 1 Is Conceptually Useful

The analytical framework shown in Figure 1 effectively illustrates the relationship between:

normative agroecology frameworks → seven-dimensional ideal type → policy mix → coherence gap → institutional lock-in and actor appropriation.

This is one of the manuscript's strongest visual elements.

However, the figure should be checked for:

- font size;
- readability when printed;
- consistency of terminology with the main text;
- distinction between empirical components and theoretical components.

25. Figure 2 Requires Better Explanation

Figure 2 compares the ideal type with the SNMA in the texts and the SNMA as perceived by actors. The figure clearly illustrates the difference between the documentary and actor scores.

However, the text should explain why a radar chart is appropriate and remind readers that the values are **qualitative ordinal scores**, not continuous quantitative measurements.

A simple grouped bar chart could potentially be easier to interpret.

26. Figure 3 and Institutional Architecture

Figure 3 provides an overview of the organisational framework involving MAEP/DGR/DDAEP, SoNaMA, ATDA, FNDA, financial institutions, INRAB/universities, private sector, FOs/CUMA and farmers.

This is useful, but the authors should clearly indicate which relationships are:

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- formal institutional relationships;
- financial relationships;
- service relationships;
- inferred relationships from interviews.

The legend should make these distinctions unambiguous.

27. Limitations Are Appreciated but Could Be Expanded

The authors acknowledge:

- limited interview corpus;
- lack of budget-execution data;
- inability to examine the FNDA envelope;
- researcher positionality.

This is good practice.

Additional limitations should include:

- potential selection bias in purposive interviews;
- translation of interviews from French;
- subjectivity of ordinal scoring;
- absence of independent coder validation, if applicable;
- limited ability to generalise from one national case;
- possible temporal mismatch among policy documents;
- inability to establish actual environmental outcomes.

28. Recommendations Should Be Linked Directly to Findings

The conclusion proposes three major policy implications:

1. environmental and agronomic eligibility criteria for credit and subsidies;
2. indicators of actual equipment use, farmer-category access and soil effects;
3. formal participation of artisans, mechanics, CUMA and farmers in equipment-kit design.

These recommendations are logically connected to the analysis.

However, the authors could improve them by presenting a concise table:

Identified problem	Evidence	Proposed response	policy Responsible actor	Suggested indicator
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This would make the policy relevance more concrete.

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29. References and Citations

The reference list is extensive and includes relevant literature on:

- agricultural mechanisation;
- sustainable mechanisation;
- agroecology;
- policy mixes;
- institutional lock-in;
- qualitative methodology;
- Beninese agricultural policy.

The authors should nevertheless perform a complete reference audit.

Particular attention should be given to:

- consistency of journal titles;
- DOI formatting;
- URLs;
- French/English translated titles;
- government-document citations;
- date and version of policy documents;
- consistency between in-text references and the bibliography.

The principal policy document, the **SNMA 2022–2026**, is clearly identified as the August 2021 final version.

The paper should consistently distinguish the **strategy document** from the **National Agricultural Mechanisation Development Programme** derived from it.

30. Title and Abstract

The title is informative but somewhat long:

“Rethinking agricultural mechanisation for the agroecological transition: Benin’s national strategy measured against an ideal type.”

It is acceptable, although “assessed against” may be more conventional than “measured against,” because the methodology is primarily qualitative.

The abstract is generally strong because it clearly identifies:

- the policy problem;
- the analytical framework;
- data sources;
- major findings;
- policy implications.

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However, the abstract should explicitly state the number of interviews and the qualitative nature of the scoring if this information is available.

31. Language and Editorial Quality

The manuscript is generally readable and professionally written, but a detailed language edit is recommended.

Specific issues include:

- occasional overly long sentences;
- inconsistent use of terminology;
- occasional awkward English resulting from translation;
- inconsistent use of hyphenation;
- formatting of French titles;
- inconsistent quotation marks;
- some typographical artefacts in the manuscript.

The phrase “**Key words:-**” should be changed to simply “**Keywords:**”.

The journal header also contains placeholders such as “**XX-XX**”, which must be corrected before publication.

Strengths of the Manuscript

The manuscript has several important strengths:

- Strongly relevant topic for sustainable agricultural development in West Africa.
- Clear research question.
- Well-defined conceptual framework.
- Innovative translation of agroecological principles into seven mechanisation-policy dimensions.
- Combination of documentary and actor-level evidence.
- Explicit scoring rules.
- Good use of policy documents and institutional literature.
- Useful analysis of the SNMA budget structure.
- Identification of three institutional lock-in mechanisms.
- Transparent acknowledgement of methodological limitations.
- Practical policy recommendations.
- Useful analytical framework that could potentially be applied to other countries.

Overall Recommendation

This manuscript presents a **potentially valuable and original policy-analysis framework** for examining the compatibility of agricultural mechanisation with agroecological transition. The combination of a Weberian ideal type, policy-mix analysis, documentary evidence and implementation-actor perspectives provides a useful analytical structure. The reported contrast between the **6/14 documentary**

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score and 2/14 actor-perception score is particularly interesting and deserves further methodological substantiation.

The main weakness is not the research question or conceptual ambition, but the **transparency and reproducibility of the qualitative empirical analysis**. In particular, the interview sample, saturation process, coding procedure and basis for the actor-level scores need to be reported much more rigorously. The normative nature of the seven-dimension ideal type and the ordinal scoring system also need clearer methodological justification.

The manuscript can become a useful contribution after substantial revision, provided that the authors strengthen the methodological reporting and moderate conclusions where the available qualitative evidence does not support stronger causal claims.

Final Decision: Minor Revision