

REVIEWER'S REPORT

Manuscript No.: IJAR- 59468

Title: Assessment of the Physicochemical and Bacteriological Quality of Drinking Water from Cemented Wells and Mini Drinking-Water Supply Systems in Awaridi Village, Diffa, Niger.

Recommendation:

Accept as it is

Accept after Minor 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

The manuscript assesses the physicochemical and bacteriological quality of drinking water from five water-supply facilities in Awaridi village, Diffa, Niger. The study evaluates two cemented wells, two boreholes, and one mini drinking-water supply system (Mini-AEP), with reference to WHO and Nigerien drinking-water standards. The authors also employ Spearman correlation analysis, principal component analysis (PCA), and hierarchical cluster analysis to investigate relationships among the measured water-quality parameters.

The topic is relevant to environmental science, groundwater management, drinking-water safety, and public health. The manuscript's main strength is its attempt to evaluate chemical and microbiological water quality together rather than relying solely on physicochemical measurements.

According to Table 2, the reported pH ranges from 6.65 to 7.88, while electrical conductivity ranges from 316 to 449 $\mu\text{S}/\text{cm}$. The authors report that the measured physicochemical parameters generally comply with the standards used in the study. In contrast, Table 3 reports mean total coliform and fecal coliform counts of 94 CFU/mL and 98 CFU/mL, respectively. The authors identify microbiological contamination as the principal concern and emphasize the need for improved protection and monitoring of drinking-water sources.

The manuscript also uses multivariate statistical methods to explore patterns in water quality. The first two PCA axes are reported to explain 72.56% of the total variance, while hierarchical cluster analysis identifies three groups of parameters. These analyses could add value to the study if their suitability, interpretation, and limitations are adequately addressed.

However, several methodological and reporting concerns need to be resolved before the findings can be considered sufficiently robust. The study examines only five water-

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supply facilities, and the manuscript does not adequately clarify whether the statistical analyses use independent observations, repeated measurements, or facility-level averages. This is particularly important for interpreting correlation coefficients, PCA, and hierarchical clustering.

There are also inconsistencies in the reporting of bacteriological results, uncertainty concerning units and microbiological standards, and several interpretations that suggest causal mechanisms without direct supporting evidence. The analytical methods, sampling procedures, and quality-control measures require further detail. In addition, the reference list contains incomplete bibliographic entries, and the manuscript needs substantial language and formatting improvements.

Overall, the manuscript addresses an important public-health problem and contains potentially useful local observations. Nevertheless, minor revision is required, particularly to clarify the sampling and analytical procedures, verify the bacteriological results and units, reassess the statistical analyses, and ensure that the conclusions remain within the limits of the available evidence.

Minor Comments

1. Title and Scope of the Study

The title appropriately identifies the main water-quality parameters, source types, and study location. However, the manuscript should ensure that the stated scope matches the actual sampling design.

Only five water-supply facilities were sampled. The authors should therefore clarify whether the findings represent these specific facilities or can reasonably be generalized to the drinking-water supply of the entire village.

The title may be retained, but the abstract and conclusion should avoid implying comprehensive village-wide assessment beyond the sampled sources.

2. Abstract Requires Revision

The abstract provides the objective, sampling categories, analytical methods, major physicochemical results, bacteriological findings, and multivariate analysis results.

However, some details require clarification:

- The reported total and fecal coliform concentrations should be accompanied by clearly defined units and sampling denominators.
- The statement that physicochemical quality is satisfactory should be distinguished from the finding of substantial bacteriological contamination.
- The compliance claims should be checked against the standards and units actually applied.
- The PCA and dendrogram findings should be summarized without implying that they establish specific pollution sources or causal relationships.

The abstract should be revised after the analytical and reporting issues have been resolved.

3. Introduction and Research Gap

The introduction provides a broad discussion of drinking-water safety, groundwater resources, microbial contamination, and water-quality challenges in the Sahel and Niger.

However, the specific research gap concerning Awaridi village could be articulated more clearly. The authors should explain what information was previously unavailable for this locality and how the present assessment contributes to existing knowledge.

The final paragraph should state the research objectives explicitly and ensure that each objective is addressed in the methods and results.

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4. Description of the Study Area

The study-area section describes the location of Diffa and its administrative boundaries. Figure 1 provides a geographical map locating the study area.

The authors should expand the description where relevant to include local hydrogeological characteristics, groundwater dependence, and the sanitary conditions surrounding the sampled water points. These details would help readers understand the potential environmental influences on water quality.

Any additional geographical or hydrogeological information should be supported by appropriate sources rather than inferred from the water-quality results alone.

5. Sampling Design and Representativeness

Section 2.2 states that five facilities were selected because they represent the main water-supply sources used by the population. However, the procedure used to establish representativeness is not described in sufficient detail.

The authors should explain the selection criteria for each facility and clarify whether sampling was conducted once or on multiple occasions.

The manuscript should also report the sampling dates, season, number of samples collected per facility, and whether samples were taken directly from the source or from points of public access.

Because only five facilities were included, the limitations associated with the small number of sampling locations should be acknowledged.

6. Sampling and Laboratory Procedures

Table 1 lists the analytical methods and materials used for physicochemical and bacteriological measurements, including membrane filtration and incubation.

However, the manuscript should provide more detailed information about sample collection, preservation, transport, storage time, and laboratory handling.

For microbiological analysis, the authors should clarify how sterile sampling bottles were used, how contamination during collection was prevented, and how samples were transported to the laboratory.

The analytical procedures should be described sufficiently for another researcher to reproduce the study.

7. Physicochemical Analytical Methods

The manuscript refers to Rodier's methodology and spectrophotometric procedures for the measurement of several parameters.

The authors should specify the exact procedures used for each parameter, including the relevant analytical method, instrument model where appropriate, calibration procedure, detection limits, and units.

Table 1 includes several reagents and measurement wavelengths, but the presentation is difficult to follow. The table should be reorganized to link each parameter clearly with its analytical technique and reference method.

The authors should also verify the listed wavelengths and reagent names against the procedures actually used in the laboratory.

8. Bacteriological Analysis Needs Greater Detail

The manuscript describes membrane filtration and incubation for total, fecal, and atypical coliforms. However, the microbiological procedures are not sufficiently detailed to assess the reliability of the reported results.

The authors should specify the culture medium or media used, the precise incubation conditions, the procedure for identifying each group of organisms, and the method used to calculate colony-forming units.

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The reported incubation conditions should be checked against the actual analytical protocol. The manuscript should also clarify whether the organisms were identified through selective culture, confirmatory tests, or another method.

The use of the term "atypical coliforms" requires a clear operational definition and an explanation of how these organisms were distinguished from total and fecal coliforms.

9. The Sample Size Is a Minor Limitation for Statistical Analysis

The study includes five water-supply facilities and reports measurements for numerous physicochemical and bacteriological variables.

The manuscript should clarify the actual number of independent observations used in each statistical analysis. If each facility contributed only one observation per parameter, the sample size would be extremely small relative to the number of variables.

The authors should reconsider whether the correlation matrix, PCA, and hierarchical cluster analysis can provide stable and meaningful results with the available data. If repeated measurements or additional samples were collected, their number and structure should be reported explicitly.

The analyses should not treat multiple measurements from the same facility as independent observations without appropriate justification.

10. Table 2 Requires Numerical and Terminological Verification

Table 2 presents minimum, maximum, median, and mean values for the physicochemical parameters, together with WHO and Nigerien standard values.

The authors should verify the calculations and ensure that the table agrees with the accompanying text. Particular attention should be given to the reporting of nitrite concentrations, total iron, calcium, magnesium, and total hardness.

The table contains both French and English terminology, including "Moyenne," and uses inconsistent symbols and formatting for some chemical parameters.

All parameter names, abbreviations, units, decimal places, and standard values should be standardized. The authors should also explain the meaning of the slash entries in the non-compliance row.

11. The Interpretation of Physicochemical Quality Should Be More Cautious

The authors conclude that the physicochemical quality of the sampled water is generally satisfactory because the measured parameters fall within the standards applied in the study.

However, compliance with the selected parameters alone does not establish the overall safety of drinking water, particularly when bacteriological contamination is reported.

The authors should distinguish between compliance with the measured physicochemical parameters and overall drinking-water safety. They should also avoid concluding that domestic or agricultural pollution is absent solely because nitrate and nitrite concentrations are low.

The interpretation should be restricted to the parameters measured and the limitations of the sampling design.

12. Temperature and Guideline Comparisons Need Clarification

The manuscript reports a mean water temperature of 26.8 °C and describes it as slightly above a WHO guideline value of 25 °C.

The authors should verify the source and status of this reference value and clarify whether it is a health-based drinking-water limit, an operational recommendation, or a contextual comparison.

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The discussion should distinguish water temperature from parameters for which a formal health-based compliance limit is applicable. Any comparison with a standard should be supported by an accurate and traceable reference.

13. Bacteriological Units and Standards Must Be Checked Carefully

Table 3 reports total, atypical, and fecal coliforms in CFU/mL. It lists a total coliform range of 0–200 CFU/mL, a mean of 94 CFU/mL, and a fecal coliform mean of 98 CFU/mL.

The authors should verify the units against the original laboratory records and the analytical method described in Table 1. The reference limits must use compatible units and the same measurement basis as the reported results.

The manuscript should also identify the exact WHO and Nigerien standards applied, including the relevant organism or indicator, measurement unit, and applicable criterion. The standards should not be presented as interchangeable if they refer to different indicators or testing procedures.

This verification is essential because the study's principal conclusion depends on the interpretation of the bacteriological results.

14. The Non-Compliance Percentages Need Recalculation or Explanation

Table 3 reports non-compliance rates of 80% for total coliforms and 100% for fecal coliforms, based on five observations.

The authors should explain how these percentages were calculated and identify the number of samples exceeding each applicable standard.

The percentages should be verified against the individual sample results, the correct compliance thresholds, and the units used. Where five facilities constitute the complete dataset, the manuscript should make clear that the percentages describe those sampled facilities and do not automatically represent the entire village.

15. The Bacteriological Results Should Be Presented at Facility Level

The manuscript reports summary statistics for total, atypical, and fecal coliforms and discusses differences among the sampled facilities.

However, the individual values for each facility are not presented clearly alongside the summary statistics.

The authors should include a table showing the measured bacteriological concentrations for PC1, PC2, F1, F2, and the Mini-AEP, together with the relevant units and compliance interpretation.

This would allow readers to verify the reported means and understand the differences between facilities.

16. Figures 2–4 Require Consistent Interpretation

The manuscript uses maps to describe the distribution of total coliforms, atypical coliforms, and fecal coliforms among the five facilities.

These figures could help readers understand the spatial variation in the reported results. However, the percentages displayed or discussed should be traceable to the original measurements and the method used to calculate them.

The authors should clarify whether the percentages represent relative contributions, normalized concentrations, proportions of total counts, or another quantity.

The discussion should not infer the presence of a technical failure, wastewater infiltration, or a specific pollution source solely from a higher percentage unless the relevant evidence was collected.

17. Potential Pollution Sources Are Not Directly Established

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The discussion attributes microbial contamination to factors such as nearby latrines, domestic wastewater infiltration, and inadequate sanitary protection.

These are plausible explanations, but the manuscript does not describe direct measurements of distances to sanitation facilities, wastewater pathways, groundwater flow, or sanitary inspection scores.

The authors should distinguish between observed contamination and hypothesized sources. If sanitary inspections or environmental observations were conducted, the corresponding methods and results should be presented.

Otherwise, the proposed contamination pathways should be described as possible explanations requiring further investigation.

18. The Correlation Matrix Requires Statistical Clarification

Table 4 presents Spearman correlation coefficients among physicochemical and bacteriological parameters. The discussion describes several relationships as significant or very strong.

However, the table does not provide p-values, confidence intervals, or another indication of statistical significance.

The authors should clarify whether statistical significance was formally tested and, if so, report the results and the number of observations used for each coefficient.

The strength of a correlation coefficient alone does not establish statistical significance. Given the small number of facilities, the reported associations should be interpreted cautiously.

The authors should also verify the numerical values in the matrix and ensure that the narrative accurately reflects the table.

19. Correlation Does Not Establish Causation

The discussion suggests that higher temperature favors the development of atypical coliforms, slightly alkaline pH supports fecal coliform survival, and iron may limit bacterial proliferation.

The reported correlation matrix can identify associations, but it cannot independently establish these causal mechanisms.

The authors should revise statements that imply direct cause-and-effect relationships. Explanations involving temperature, pH, iron, or nitrate should be framed as hypotheses and supported by relevant literature or additional experimental evidence.

In particular, the proposed inhibitory effect of iron on bacterial proliferation requires stronger evidence than a negative correlation coefficient.

20. The PCA Requires Reassessment

The manuscript reports that the first two principal components explain 72.56% of the total variance, comprising 49.80% for F1 and 22.76% for F2.

Although this percentage is reported in the text and illustrated in the PCA figures, the manuscript does not adequately demonstrate that the analysis is reliable given the number of facilities sampled relative to the number of variables.

The authors should report the data matrix used for PCA, the number of observations, the scaling or standardization procedure, the variable loadings, and the criteria used to interpret the components.

If PCA was conducted on only five facility-level observations with many variables, the resulting component structure may be unstable. The authors should consider obtaining additional independent observations or limiting the analysis and interpretation to what the existing dataset can reasonably support.

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The percentage of explained variance should not, by itself, be treated as proof that the PCA reliably distinguishes pollution processes.

21. The Interpretation of PCA Loadings Needs Greater Precision

The manuscript interprets F1 as representing mineralization-related variables and F2 as distinguishing bacteriological contamination from selected chemical parameters.

These interpretations should be supported by a clearly presented loading matrix and an explanation of the contribution of each variable to each axis.

The authors should also distinguish the relationships among variables from the positions of individual facilities on the PCA biplot.

The statement that certain water conditions favor bacterial survival, or that higher iron and nitrate levels reduce bacterial loads, should not be presented as a demonstrated causal mechanism based on the PCA alone.

22. Hierarchical Cluster Analysis Needs Additional Methodological Detail

The manuscript reports the use of Ward's method and a distance based on the absolute correlation coefficient to classify the parameters into three groups.

The authors should explain how the distance matrix was constructed and why this combination of distance measure and clustering method was selected.

They should also specify whether the data were standardized before analysis and how the number of clusters was determined.

Because the study includes numerous parameters but very few sampled facilities, the stability of the dendrogram should be examined before the three clusters are interpreted as meaningful environmental groupings.

The authors should avoid presenting the clusters as proof of common pollution sources unless additional evidence supports that interpretation.

23. Figure Numbering and Cross-References Are Inconsistent

The manuscript contains several figures relating to the spatial distribution of bacterial indicators, PCA, and hierarchical clustering.

However, the figure numbering and references in the text are inconsistent. The caption for the fecal coliform map uses Figure 4, while the PCA correlation circle is also labelled Figure 4. Subsequent references to the PCA biplot and dendrogram do not consistently match their displayed figure numbers.

The authors should renumber every figure sequentially and verify all in-text references. Each figure should have a concise, informative caption and should be cited in the appropriate results subsection.

24. The PCA Figures Need Improved Labelling

The PCA correlation circle and biplot contain numerous abbreviations, chemical symbols, and axis labels.

The authors should define all abbreviations in the figure captions or accompanying text and ensure that labels remain legible when the figures are viewed at normal publication size.

The figures should use consistent notation for electrical conductivity, total hardness, calcium, magnesium, total coliforms, atypical coliforms, and fecal coliforms.

The authors should also check that the facility labels and variable directions agree with the accompanying interpretation.

25. The Dendrogram Interpretation Should Avoid Overstatement

The hierarchical cluster analysis identifies three groups of parameters and interprets these groupings in terms of mineralization and contamination.

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The authors should explain that clustering demonstrates similarity under the selected analytical method rather than establishing a shared source or mechanism.

The proposed grouping of nitrate, nitrite, and coliform indicators should be interpreted cautiously, particularly because the manuscript does not present direct source-tracking evidence.

The cluster analysis should be retained only if its methodological basis and limitations can be adequately justified.

26. The Discussion Needs a Clearer Structure

The discussion combines physicochemical results, bacteriological findings, correlations, PCA, and hierarchical clustering. Some interpretations are repeated across different subsections.

The authors should organize the discussion around the major findings:

- Physicochemical characteristics and compliance.
- Bacteriological quality and implications for drinking-water safety.
- Differences among the five sampled facilities.
- Statistical relationships and multivariate patterns, if adequately supported.
- Implications for monitoring and source protection.

Each subsection should distinguish the findings of the present study from comparisons with previous research.

27. Comparisons with Previous Studies Should Be More Specific

The manuscript cites studies from Niger, Benin, Cameroon, and Ghana to contextualize its findings.

However, the discussion often compares results without adequately considering differences in sampling design, analytical methods, indicator organisms, or units.

The authors should ensure that comparisons are scientifically appropriate and that reported concentrations are expressed on compatible measurement bases.

References should be used to explain similarities and differences, rather than simply to confirm that water contamination has been reported elsewhere.

28. The Conclusion Should Be More Closely Linked to the Evidence

The conclusion states that physicochemical quality is generally satisfactory but that bacteriological contamination remains a concern. This is consistent with the principal findings presented in Tables 2 and 3.

However, the conclusion also attributes contamination to specific anthropogenic sources and characterizes the Mini-AEP as having better overall quality.

The authors should ensure that these statements are supported by the individual facility results and direct observations, where available. They should also clarify that the assessment covers five selected facilities and that the results do not necessarily represent all water sources in Awaridi village.

The conclusion should focus on the verified findings and avoid extrapolating beyond the study design.

29. Recommendations Should Be Linked to the Results

The manuscript recommends continued monitoring, community awareness, and technical improvements to drinking-water facilities.

These recommendations are relevant to the reported bacteriological concerns. However, the authors should provide a more explicit link between each recommendation and the observed findings.

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For example, recommendations for sanitary protection, treatment, or maintenance should be related to documented contamination and the condition of the relevant facilities.

The recommendations should also distinguish immediate measures to address microbiological risks from longer-term improvements in water-supply management.

30. Ethical Statements Need Consistency and Context

The manuscript states that ethical approval was not required because the study was non-interventional and did not involve clinical or experimental procedures. It also states that informed consent was obtained from participating traders.

The reference to “traders” appears inconsistent with the study population of drinking-water supply facilities and should be checked.

The authors should clarify whether the research involved human participants, facility operators, or only water samples. The ethical statement and consent description should accurately reflect the activities conducted and any applicable institutional requirements.

31. Acknowledgments, Funding, and Conflict of Interest

The manuscript includes acknowledgments, a funding statement, and a declaration of no conflict of interest.

These sections are appropriate, but the authors should verify the institutional name and ensure that the acknowledgments accurately describe the support received.

The funding and conflict-of-interest declarations should follow the journal's required format.

32. References Require Substantial Verification

The reference list includes several relevant publications on drinking-water quality, groundwater resources, microbiological contamination, and water-quality assessment. However, some entries appear incomplete or inconsistently formatted. For example, certain references lack full article titles, journal details, page ranges, or sufficient publication information.

The authors should verify every reference against the original publication and ensure that all in-text citations correspond to complete entries in the reference list.

Particular attention should be paid to incomplete entries, inconsistent author names, capitalization, DOI formatting, and references cited to support drinking-water standards or specific analytical procedures.

33. English Language and Formatting Require Comprehensive Editing

The manuscript contains spacing errors, inconsistent capitalization, inconsistent use of abbreviations, grammatical problems, and formatting issues in tables and figure captions.

Examples include inconsistent use of “physicochemical,” “bacteriological,” and “drinking-water,” as well as the mixture of French and English terms in the tables.

The authors should undertake comprehensive language editing and standardize chemical notation, units, decimal separators, abbreviations, and heading formats throughout the manuscript.

The tables and figures should be formatted consistently and remain legible in the final journal layout.

Overall Assessment

The manuscript addresses an important environmental and public-health issue by examining physicochemical and bacteriological drinking-water quality in Awaridi village, Diffa, Niger. Its combined assessment of chemical parameters, microbial

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indicators, and statistical relationships could provide useful preliminary information for local water-resource management.

The principal finding is that the sampled water sources generally show acceptable values for the physicochemical parameters assessed, while the reported coliform results indicate substantial bacteriological contamination. This contrast is important and should remain central to the revised manuscript.

However, several issues currently limit the strength of the conclusions. The small number of sampled facilities raises concerns about the reliability of the multivariate analyses. The bacteriological units and standards require verification, and the statistical methods and interpretations need further justification. In addition, some proposed contamination pathways and causal explanations are not directly established by the reported data.

The authors should prioritize the following revisions:

1. Verify the original laboratory results, bacteriological units, and compliance criteria.
2. Clarify the sampling design, number of observations, and laboratory quality-control procedures.
3. Reassess the suitability of the correlation analysis, PCA, and hierarchical clustering.
4. Correct figure numbering, table presentation, and numerical inconsistencies.
5. Revise the discussion and conclusion to distinguish measured findings from hypotheses.
6. Verify references and undertake comprehensive language editing.

The manuscript has potential, but its scientific reliability depends on resolving these methodological and reporting concerns.

Final Decision

MINOR REVISION

The manuscript should be reconsidered after substantial revision. The authors must verify the bacteriological measurements and standards, clarify the sampling and analytical procedures, reassess the multivariate statistical analyses, and ensure that all interpretations are supported by the available data.

Particular attention should be given to the small sample size, the use of CFU/mL, the interpretation of correlation coefficients, and the distinction between observed contamination and hypothesized pollution sources.