ISSN: 2320-5407

International Journal of Advanced Research

Publisher's Name: Jana Publication and Research LLP

www.journalijar.com

REVIEWER'S REPORT

Manuscript No.: IJAR-53458 Date:21/08/25

Title: Application of K-Means Algorithm for Classification of Beninese Municipalities According to Their Digital Development Profile

Recommendation:
Accept as it is .....
Accept after minor revision...yes.....
Accept after major revision .....
Do not accept (*Reasons below*) .....

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

Reviewer Name:Dr.Shaweta Sachdeva **Date:** 21/08/25

Reviewer's Comment for Publication.Accepted with Minor Revisions in Manuscript

(*To be published with the manuscript in the journal*)

The reviewer is requested to provide a brief comment (3-4 lines) highlighting the significance, strengths, or key insights of the manuscript. This comment will be Displayed in the journal publication alongside with the reviewers name.

Significance

- The study addresses a **critical policy challenge** in developing countries: understanding and managing the **digital divide** across municipalities.
- By applying **machine learning (K-Means clustering)** to municipal data, the work provides a **novel, data-driven classification system** that goes beyond traditional demographic or economic categorizations.
- The research directly supports **evidence-based governance**, offering a practical tool for policymakers to allocate resources more efficiently and design **differentiated digital development strategies**.

Strengths

- Covers all 77 municipalities in Benin with **45 indicators** and over **20,000 data points**, ensuring robust analysis.

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- Identifies three distinct categories: *digitally advanced*, *moderate development*, and *limited development*, which are directly actionable for planning.
- The results are not just technical but provide a **clear roadmap** for targeted interventions (e.g., advanced municipalities as models, limited municipalities as priority areas).
- Incorporates **preprocessing (normalization, outlier detection, imputation)** and **validation (silhouette analysis, expert review)**, ensuring reliability of clustering outcomes.
- The framework can be easily expanded to other countries or domains, demonstrating **scalability and transferability**.

Key Insights

- The majority of municipalities (65/77) are at a *moderate* level, while only a few are at the extremes, highlighting the **centralized nature of digital development in major urban centers**.
- Digitally advanced municipalities correspond to **major cities** (Cotonou, Porto-Novo, Parakou), while limited development clusters capture municipalities facing **systemic challenges** such as poor infrastructure and limited institutional capacity.
- The framework suggests differentiated strategies:
  - *Advanced*: Focus on innovation and best practices.
  - *Moderate*: Capacity building and incremental improvements.
  - *Limited*: Priority support and infrastructure investment.
- Establishes a **baseline typology** that can be combined with **longitudinal data and predictive modeling** (as in companion studies) to track development trajectories.

Detailed Reviewer's Report

• While clear, the abstract could be more concise by emphasizing the *main contribution* (three-cluster typology and its policy relevance) instead of methodological details.

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- Figures (e.g., Figure 1, Figure 2) should include more descriptive captions to help readers understand their purpose without referring back to the text.

- Ensure consistent use of terms like "digital maturity," "digital profile," and "digital development" throughout the manuscript.

- The reported silhouette score (0.058) is relatively low. The authors should explain why this is acceptable in the context of municipal data and real-world clustering.

- Briefly compare K-Means with alternative clustering approaches (e.g., hierarchical clustering, DBSCAN) to strengthen methodological justification.

- Provide a stronger rationale for choosing mean imputation over more advanced methods (e.g., multiple imputation or regression-based techniques).

- Expand the discussion on why specific municipalities (e.g., Cotonou, Porto-Novo) fall into the "digitally advanced" cluster, linking this to socioeconomic or infrastructural factors.

- Since geography is mentioned, a **map visualization** of cluster membership would make the findings more intuitive.

- With 65 municipalities in the "moderate" cluster and only 6 in each extreme cluster, the paper could discuss whether this imbalance limits policy differentiation.