ISSN: 2320-5407

# International Journal of Advanced Research

Publisher's Name: Jana Publication and Research LLP

www.journalijar.com

ISSN NO. 2320-5407

## REVIEWER'S REPORT

Manuscript No.: IJAR- 58807

**Title:** ***Évaluation des risques hydrologiques et hydrogéologiques par analyse multicritère SIG : cas du projet de centrale solaire photovoltaïque de 30 MWc de Nigouni (Nord de la Côte d'Ivoire).***

**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: **ANAPANA GOPAL**

**Reviewer's Comment for Publication.**

### General Comments

The manuscript addresses a relevant and practical topic: hydrological and hydrogeological risk assessment for the proposed 30 MWp photovoltaic power plant at Nigouni, northern Côte d'Ivoire. The study combines rainfall analysis, GIS-based multicriteria flood-risk mapping, geological/hydrogeological investigations, and estimation of flood discharge. The study site and objectives are clearly defined, and the manuscript provides potentially useful information for infrastructure planning. The reported mean annual rainfall is 1418.28 mm, and the authors classify the site's flood risk as low to moderate while identifying fractured granite as a potentially exploitable groundwater resource.
However, **Minor methodological and quantitative issues need to be resolved before the manuscript can be considered for publication**. In particular, the calculation of peak flood discharge appears inconsistent with the stated rational-method equation and input parameters. The GIS multicriteria methodology also lacks sufficient detail concerning weighting, classification and validation. In addition, several conclusions appear stronger than what can be demonstrated from the presented data.

### Minor Comments

**1. Minor concern regarding the rational-method discharge calculations**

This is the most important issue in the manuscript.
The authors state that peak discharge was calculated using:
$Qp = (C \times i \times A) / 360$
with **A in km²** and **i in mm/h**.
For the 100-year return period, the manuscript reports:

- $A = 12.5$ km²
- $C = 0.35–0.55$
- $i = 31.1$ mm/h

ISSN: 2320-5407

International Journal of Advanced Research

Publisher's Name: Jana Publication and Research LLP

www.journalijar.com

**REVIEWER'S REPORT**

- Qp = 2.93 $m^3/s$.

These values do not appear internally consistent with the equation provided.
Using the equation exactly as written and the reported **mean C = 0.42**, the result would not be 2.93 $m^3/s$. The same problem appears to occur for the other return periods.
Therefore, the authors must **recalculate the entire flood-discharge table from the original rainfall/intensity, runoff coefficient, basin area and concentration-time calculations**.
The authors should explicitly provide:

- the exact rational-method equation and unit convention;
- the value of C used for each return period;
- the source of rainfall intensity;
- the method used to derive rainfall intensity from 24-hour rainfall;
- the calculation of time of concentration;
- the complete calculation for at least one return period.

This issue is sufficiently important that the reported flood-discharge and water-depth conclusions cannot currently be accepted without verification.

**2. The 100-year return-period estimates require stronger justification**

The rainfall dataset covers **2011–2025**, i.e. approximately 15 years. The manuscript nevertheless makes 50- and 100-year design-event statements. The study reports an extreme monthly rainfall of 623.7 mm in August 2019 and subsequently recommends consideration of 50–100-year return periods.
A 15-year observational series is relatively short for directly estimating a 100-year event.
The authors should explain:

- which frequency-distribution model was used;
- whether annual maxima or partial-duration series were analysed;
- which probability distribution was selected;
- how parameters were estimated;
- whether goodness-of-fit was tested;
- whether regional frequency analysis or longer historical records were used;
- how the reported 100-year rainfall value was obtained.

If the 100-year value is derived from another source, that source must be explicitly identified.

**3. GIS multicriteria analysis is insufficiently described**

The manuscript states that drainage density, slope and land use were combined using a weighted multicriteria GIS approach to produce hazard, vulnerability and risk maps.
However, the manuscript does not adequately report:

- the weight assigned to each criterion;
- the basis for those weights;
- the classification intervals;
- the scoring system;
- the normalization procedure;
- whether AHP or another weighting technique was used;
- sensitivity analysis;
- validation against observed flood locations.

ISSN: 2320-5407

International Journal of Advanced Research

Publisher's Name: Jana Publication and Research LLP

www.journalijar.com

**REVIEWER'S REPORT**

Without these details, the analysis is difficult to reproduce.
**Recommendation:** Include a table such as:

| Criterion | Classes | Score | Weight (%) | Basis |
|---|---|---|---|---|
| Slope | ... | ... | ... | ... |
| Drainage density | ... | ... | ... | ... |
| Land use | ... | ... | ... | ... |

The authors should also explain how the final risk classes—low, medium, high, very high—were defined.

**4. Flood-risk mapping requires validation**
The manuscript concludes that the site has low-to-moderate flood risk and that there is no significant prolonged water stagnation affecting the proposed infrastructure.
However, the manuscript does not demonstrate independent validation of the GIS-derived risk map.
The authors should consider validating the result using:

- field observations;
- historical flood observations;
- satellite-derived flood extent, if available;
- local stakeholder observations;
- observed drainage channels;
- topographic verification.

This is particularly important because the GIS model uses only three principal thematic variables.

**5. The relationship between the 2–3 ha accumulation zone and the conclusion needs clarification**
The manuscript identifies a central accumulation zone of approximately **2–3 ha**, where runoff converges before being discharged toward the Tengréla lake.
At the same time, the conclusion states that no prolonged stagnation zone capable of flooding project infrastructure was identified.
These statements are not necessarily contradictory, but the manuscript needs to explain the distinction between:

- temporary runoff accumulation;
- standing water;
- flood inundation;
- prolonged waterlogging;
- direct exposure of photovoltaic infrastructure.

A clear map showing the proposed plant boundary relative to the accumulation zone would be valuable.

**6. Groundwater-resource conclusions are stronger than the presented evidence**
The manuscript identifies fractured granite as potentially exploitable aquifers and recommends **3–5 boreholes** along identified fracture directions.
However, the presented investigation appears primarily based on geological observations, manual drilling/boring, pressiometric investigations and fracture interpretation. The manuscript itself acknowledges the need for complementary geophysical investigation.

ISSN: 2320-5407
International Journal of Advanced Research
Publisher's Name: Jana Publication and Research LLP
*www.journalijar.com*

**REVIEWER'S REPORT**

Therefore, the recommendation for 3–5 boreholes should be presented as a **preliminary recommendation**, not a confirmed groundwater-development plan.
The authors should provide, if available:

- existing borehole locations;
- static water levels;
- pumping-test results;
- transmissivity;
- hydraulic conductivity measurements;
- specific capacity;
- groundwater quality;
- estimated sustainable yield.

Without pumping-test data, the actual sustainable groundwater yield remains uncertain.

**7. Water-demand assessment needs reconciliation**
The manuscript estimates construction water requirements for a 30 MWp plant at approximately **500–2000 $m^3$/day**, while expected borehole yields are reported as **1–10 $m^3$/h**.
The authors should demonstrate quantitatively how the proposed 3–5 boreholes would meet the projected demand.
For example, at 1–10 $m^3$/h, one borehole theoretically provides approximately 24–240 $m^3$/day under continuous pumping. Therefore, the feasibility of meeting 500–2000 $m^3$/day depends strongly on the actual sustainable pumping rate and operating duration.
The manuscript should provide a water-balance calculation rather than simply concluding that 3–5 boreholes will be adequate.

**8. The method for estimating water depth in natural channels is not described adequately**
Table 1 reports water depths of:

- 0.45 m for 10 years;
- 0.55 m for 20 years;
- 0.68 m for 50 years;
- 0.78 m for 100 years.

However, the methodology for converting peak discharge into channel water depth is not adequately described.
The authors should specify whether they used:

- Manning's equation;
- cross-sectional survey;
- hydraulic modelling;
- empirical channel relationships;
- field measurements.

If Manning's equation was used, the manuscript should provide channel geometry, slope, roughness coefficient and boundary conditions.

**9. The study should distinguish hydrological risk from hydraulic modelling**
The GIS multicriteria model identifies spatial flood susceptibility/risk, while the rational method estimates peak runoff. These are different analytical components.

ISSN: 2320-5407

International Journal of Advanced Research

Publisher's Name: Jana Publication and Research LLP

www.journalijar.com

**REVIEWER'S REPORT**

The manuscript should clearly distinguish:
**Flood susceptibility/risk mapping**
from
**Hydrological peak-flow estimation**
from
**Hydraulic inundation/depth modelling**.
At present, these components are sometimes discussed as though they provide equivalent evidence.

**10. The SRTM 30 m DEM may be insufficient for detailed site-scale drainage assessment**
The study uses SRTM data with 30 m spatial resolution to derive drainage and terrain characteristics.
For a solar plant site, where small drainage channels and local depressions can influence infrastructure, 30 m DEM resolution may not adequately capture microtopography.
The authors should discuss this limitation and, if available, incorporate:

- high-resolution topographic survey;
- drone-derived DEM;
- detailed total-station/GNSS survey;
- higher-resolution DEM.

This is particularly important because the manuscript identifies small temporary channels with widths of approximately 0.5–2 m.

**Minor Comments**
**11. Figure-reference errors must be corrected**
Several places contain:
"Figure Error! Reference source not found."
This occurs in the description of the study location, climate and hydrographic network.
All broken cross-references must be corrected before publication.

**12. Figure quality and presentation need improvement**
Figures 5–10 contain multiple maps, but some labels and legends are relatively small.
The authors should ensure:

- readable legends;
- consistent coordinate systems;
- north arrows;
- scale bars;
- clear site boundaries;
- consistent symbology;
- high-resolution export.

The maps should also clearly identify the proposed solar-plant footprint.

**13. Figure 11 provides useful field evidence but requires additional information**
The photograph showing temporary drainage channels is useful supporting evidence.
The authors should provide:

- date of observation;

ISSN: 2320-5407
International Journal of Advanced Research
Publisher's Name: Jana Publication and Research LLP
www.journalijar.com

**REVIEWER'S REPORT**

- approximate location;
- direction of flow;
- whether the channel was observed during or after rainfall;
- relationship to the proposed infrastructure.

**14. Terminology should be standardized**
The manuscript uses both **"lac de Tengréla"** and **"Tengréla dam"** in different sections. The authors should verify whether this feature is correctly classified as a lake, reservoir, dam or lake/reservoir system and use one technically appropriate term consistently.

**15. The manuscript should avoid unsupported statements**
For example, the manuscript describes the multicriteria GIS approach as a "reliable" tool with "satisfactory accuracy" for infrastructure feasibility studies.
Unless the present study includes quantitative validation, this statement should be moderated.
A more appropriate formulation would be that the approach provides a **preliminary or screening-level assessment**, unless validation demonstrates otherwise.

**16. The morphometric interpretation needs further support**
The conclusion states that the 12.5 km² basin, with **Kc = 1.46** and drainage density of **1.84 km/km²**, has characteristics that are "little favorable to sudden floods."
This interpretation should be supported by appropriate references and preferably linked quantitatively to the calculated time of concentration and runoff response.

**17. The abstract should be revised after correction of the calculations**
The abstract currently reports the principal conclusions before the quantitative methodology has been sufficiently demonstrated.
After revising the hydrological calculations, the authors should update:
- flood-risk classification;
- peak discharge;
- flood depth;
- groundwater-resource estimates;
- engineering recommendations.

**Strengths of the Manuscript**
1. **Strong practical relevance** for renewable-energy infrastructure planning.
2. Clearly identified study area and project objective.
3. Integration of **hydrology, GIS, geology and hydrogeology**.
4. Use of a 2011–2025 rainfall dataset.
5. Field investigations complement the remote-sensing/GIS analysis.
6. Useful maps showing drainage density, slope, land use, hazard, vulnerability and risk.
7. The study attempts to translate scientific findings into practical engineering recommendations.
8. The manuscript identifies groundwater fractures as potentially important resources and recommends additional geophysical investigation.

ISSN: 2320-5407
International Journal of Advanced Research
Publisher's Name: Jana Publication and Research LLP
www.journalijar.com

**REVIEWER'S REPORT**

**Recommended Revised Structure**
I recommend restructuring the manuscript as follows:

1. **Introduction**
2. **Study Area**
3. **Materials and Methods**
    - Rainfall data
    - DEM and GIS processing
    - Land-use classification
    - Multicriteria analysis
    - Flood-frequency analysis
    - Rational method
    - Hydraulic depth estimation
    - Hydrogeological investigations
    - Groundwater assessment
4. **Results**
    - Climate and rainfall variability
    - GIS flood-risk assessment
    - Flood-frequency analysis
    - Peak discharge
    - Hydraulic depth
    - Geological/hydrogeological findings
    - Groundwater potential
5. **Discussion**
6. **Engineering Implications for the Solar Plant**
7. **Limitations and Uncertainties**
8. **Conclusion**

**Final Recommendation**
**Decision: MINOR REVISION**
The manuscript has a worthwhile applied objective and potentially useful site-specific findings. However, I would **not recommend acceptance in its current form**, primarily because the reported rational-method flood-discharge values need to be independently recalculated and verified. The GIS weighting/validation methodology and 100-year design-event estimation also require substantial clarification.