Reproducible Research Repository

Mapping the Risk Posed to Groundwater-Dependent Ecosystems by Uncontrolled Access to Photovoltaic Water Pumping in Sub-Saharan Africa

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Maria Reyes Retana
reproducibility@worldbank.org
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This review verifies the reproducibility of the exhibits included in the paper " *Mapping the Risk Posed to Groundwater-Dependent Ecosystems by Uncontrolled Access to Photovoltaic Water Pumping in Sub-Saharan Africa*".

Contents in this review:

Main findings

- The code was successfully executed on a new computer by following the instructions in the README file, skipping the `Map_construction` step. In particular:
  1. Run `get_ghi` in Matlab.
  2. Skip the `Map_construction` step.
  3. Run `Main_AHP` in Matlab.
  4. Open the `Plot_results` QGIS file and follow the point-and-click instructions specified in the README file.
- The output demonstrates consistent stability across multiple runs. Specifically, executing the code two times consecutively yielded identical results.
- The code takes approximately 40 minutes to run.
- We conducted our reproducibility analysis based on the paper shared by the authors on December 23rd.
- Each exhibit has been accurately reproduced. However, the results for some figures were reproduced only by using the intermediate dataset provided by the authors. When running the full QGIS model (`Map_construction`) with QGIS version 3.38, the results did not match exactly. The replicators used a different version of QGIS, which explains the discrepancies. The replicators confirmed that the results using the intermediate dataset generated with QGIS version 3.26.3 by the authors, are consistent with the exhibits presented in the publication. For further details, see List of exhibits and reproducibility status.

- **Reproducibility Summary**:
  - **Data**: All data sources are publicly available and included in the reproducibility package.
  - **Code**: All code files (from cleaning to analysis) are included in the reproducibility package.
  - **Outputs**: Some outputs are not generated by code (created manually in Excel, ArcGIS, etc) but instructions for producing these outputs are included in the README file.
  - **Reproducibility verification**: Reviewers used data provided directly by the authors to conduct the reproducibility verification, and this is included in the public reproducibility package. The reviewers did not verify if publicly available data matches the data provided by the authors.
  - **Dependencies environment**: The reviewers reproduced an existing environment for dependencies using dependency files or an environment metadata file provided by the authors.

List of exhibits and reproducibility status

Results in the Main Section of the Paper

- **Figure 1** Reproduced, but includes manual changes. The figure was reproduced following the instructions in the README file. This involves some point and click approach, as well as mofidying the colors to match the figure shown in the paper.
- **Figure 2 a,b** Reproduced, but includes manual changes. The figure was reproduced using the `Plot_results` QGIS file. The plot is displayed in the QGIS console and needs to be manually saved.[1]
- **Figure 3 a,b** Reproduced, but includes manual changes. The figure was reproduced using the `Plot_results` QGIS file. The plot is displayed in the QGIS console and needs to be manually saved.
- **Figure 4a,c** Reproduced, but includes manual changes. The figure was reproduced using the `Plot_results` QGIS file. The plot is displayed in the QGIS console and needs to be manually saved.
- **Figure 4b** Reproduced.
- **Figure 4d** Reproduced.
- **Table 1** Does not show analysis results.
- **Table 2** Reproduced, but includes manual changes. The results are shown on the Matlab command window after runnin Main_AHP.m
- **Table 3** Reproduced, but includes manual changes. The results are shown on the Matlab command window after runnin Main_AHP.m
- **Table 4** Reproduced, but includes manual changes. The results are shown on the Matlab command window after runnin Main_AHP.m.

1. Note: For Figures 2, 3, 4, and Table 4, the results were only reproducible using the intermediate data provided by the authors, as it was generated with QGIS version 3.26.3. If replicators use this version, the results should match; for later versions, use the provided intermediate data and skip the map construction step.

Reproduction Environment

- Paper exhibits were reproduced in a computer with the following specifications:
  - OS: Windows 11 Enterprise
  - Processor: Intel(R) Core(TM) i5-1145G7 CPU @ 2.60GHz
  - Memory available: 15.7 GB
  - Software version: Matlab 2024a, QGIS 3.38 (replicators), QGIS 2.26.3 (authors).