

README

1. Overview

This repository contains the code to reproduce the analysis and figures presented in the World Bank Policy Research Working Paper titled:

“An exploration of system-wide flood protection standards for coastal polders in Bangladesh”

For any questions related to the code, please contact: Jasper Verschuur – j.verschuur@tudelft.nl

2. Data Availability

2.1 Data Sources

Risk Data (Risk_summary_polder.csv)

The raw input data is collected from two unpublished datasets:

1. Polder-level present and future risk estimates per impact category from Verschuur et al. (2023): <https://openknowledge.worldbank.org/entities/publication/8b15a7c3-f25d-42a2-bdc1-4524ca52f58a>
2. The ‘Cost of Coastal Adaptation Tool’ (TU Delft, 2020)

Access to these datasets is restricted. Interested readers may contact: - Swarna Kazi – skazi1@worldbank.org - Bramka Arga Jafino – bjafino@worldbank.org - Jasper Verschuur – j.verschuur@tudelft.nl

Variable formatting: D_{hazard}_{RP}_USD_{cat}_{CC} - hazard: flood (no hazard), wind (extreme wind speed) - RP: return period (10, 25, 50, 100) - cat: category (housing, agri, aqua, infrastructure) - CC: climate change status (CC = sea-level rise for 2050 included)

Geospatial Data

Required files for plotting:

1. coastalzone.gpkg – geopackage of the Bangladesh coastal zone (ADM2 level)
Source: https://geodata.ucdavis.edu/gadm/gadm4.1/gpkg/gadm41_BGD.gpkg

The authors manually retained the following coastal districts using QGIS: Bagerhat, Barguna, Barisal, Bhola, Chandpur, Chittagong, Cox’s Bazar, Feni, Gopalganj, Jessore, Jhalokati, Khulna, Lakshmipur, Narail, Noakhali, Patuakhali, Pirojpur, Satkhira, Shariatpur

2. `polders_file.gpkg` – geopackage containing coastal polder information Original polder shapes:
<https://gis.bwdb.gov.bd/arcgis/apps/webappviewer/index.html?id=38d89295444d46578cbce6d534b0d17f>

Additional variables were merged from the Cost of Coastal Adaptation Tool: T, 10, 25, 100, Dec. Height [m], b-value, Average elevation (mPWD), a-value, h0-value, embankment_height

Final variables (e.g., coastaldyke, riverdyke, slope protection coastal, etc.) were added via expert inference by Jasper Verschuur and Kasper Lendering.

Access to the merged dataset requires contacting the same authors listed above.

Output Data

File	Description
<code>optimal_polder_results.csv</code>	Optimal polder heights and construction costs
<code>sensitivity_analysis.csv</code>	Monte Carlo sensitivity results

2.2 Rights Statement

I certify that the author(s) of the manuscript have legitimate access to and permission to use all data used in this manuscript.

3. Instructions for Replicators

The full workflow (data processing, analysis, and figure generation) is implemented in:

`Optimal_polder_protection_clean.ipynb`

Required Input Files:

- `coastalzone.gpkg`
- `polders_file.gpkg`
- `Risk_summary_polder.csv`

The format of damage estimates is: `D_{hazard}_{RP}_USD_{cat}_{CC}` (see Section 2.1 for definitions)

4. List of Exhibits

All figures and tables included in the manuscript are generated within the notebook.

5. Requirements

Computational Requirements

- Tested on: MacBook Pro (2021)
- Expected runtime:
 - Main analysis: approximately 10–20 seconds
 - Sensitivity analysis: several hours (Monte Carlo loop with 1000+ iterations)

Software Requirements

Software	Version
Python	3.9.12
geopandas	0.10.2
pandas	2.2.3
numpy	1.26.4
matplotlib	3.9.4
scipy	1.12.0

6. Code Description

All required steps are executed within: `Optimal_polder_protection_clean.ipynb`

This includes: - Data import - Processing - Optimization - Output generation - Figure creation

7. Folder Structure

```
Repository/
├── Optimal_polder_protection_clean.ipynb
├── Input/
│   ├── coastalzone.gpkg
│   ├── polders_file.gpkg
│   └── Risk_summary_polder.csv
└── Output/
    ├── optimal_polder_results.csv
    └── sensitivity_analysis.csv
```