Beyond Policy Drift

Hydrodynamic Benchmarks for Saemangeum’s Trust Deficit

IAIA26
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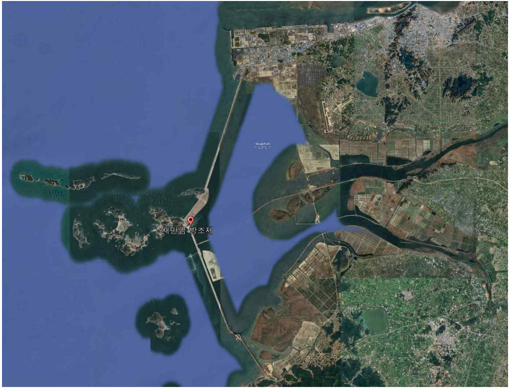
Saemangeum
: 35 Years of Drifting Governance

Site at a glance

- Seawall: 33.9 km
- Basin: 291 km²
- Sluice cross-section: 7,000 m²
- 2 openings/day since 2020
- Tidal range: 2m below Shihwa

Saemangeum Development and Investment Agency [SDIA]. (2024)



Google Earth image of Saemangeum Seawall, South Korea. Image © 2026 Airbus

Saemangeum
: 35 Years of Drifting Governance

Sediment in a state of long-term anaerobic decay.
Adapted from *2억 톤 수질 개선용 '방류' 아닌 '해수 상시 유통'이 새만금 살리는 길*, by S. Moon, 2024, *Jeonbuk Sori.*

35 years, no recovery

- US$ 1.4 B spent on water quality
- Bottom Dissolved Oxygen(DO) < 1 mg/L below 8 m
- Plan reversed every admin cycle
- NOW: 224 MW tidal, no baseline

Saemangeum Master Plan; JoongAng Ilbo. (2025, May);
Ryu, J. (2025, October). [Conference presentation].
Saemangeum Sustainable Development Policy Forum; Saemangeum Citizens' Ecological Survey Group. (2024).
Eleven-station DO and salinity survey; Kyunghyang Shinmun. (2026, January 1)

A Precedent We Cannot Afford to Repeat

Garorim Bay (2014)

- Tidal barrage proposed
- No scientific baseline
- Years of resident conflict
- Cancelled by court

→ same script, larger scale

Saemangeum (2026)

- Tidal power feasibility: B/C 0.465
- Hypoxia worsening
- Government trust already eroded

Inform the next decision — do not ratify it.

Korea Rural Community Corporation [KRC]. (2024).Saemangeum tidal power feasibility study.

Research Questions & Objective

Q1	What Minimum Tidal Prism(P_min) meets target DO?
Q2	Can any feasible operation reach it?

Why P_min works as a shared baseline

Testable
a physics test, not opinion

Technology-neutral
any solution can be scored

Pre-disclosed
before negotiation, not from it

Methodology: Two-Layer Box Model with Energy Closure

Answers Q1: What P-min meets target DO?

Answers Q2: Can any operation reach it?

Step 1	Step 2	Step 3	Step 4	Step 5
Field-data Parameters incl. dynamic z_pyc extraction	$Q_{mix,min}$ reverse-calc.	P_min derivation	Gap analysis	Governance framework

Governing equations

Eq.1 Minimum vertical mixing = $\dfrac{bottom\ O_2\ demand\ \times\ lake\ surface\ area}{(top - bottom\ DO\ gap)\ \times\ seconds/day}$

Eq.2 Minimum tidal prism = (gate area × half tidal cycle) × ∛(mixing power required ÷ gate energy transfer capacity)

Multi-year (2021–2025) summer means; KHOA + KRC cross-validation.

Chapra, S. C. (1997).Surface water-quality modeling.
McGraw-Hill; Williams, B. K., Szaro, R. C., & Shapiro, C. D. (2009).Adaptive management:
The U.S. Department of the Interior technical guide.
Adaptive Management Working Group, U.S. Department of the Interior

Empirically Confirmed Parameters

9.56
mg/L
C_{sur}
(surface DO saturation)

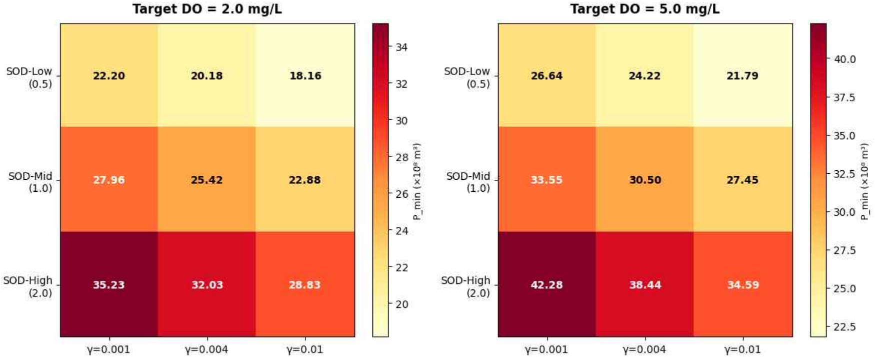
11.52
kg/m^3
$\Delta\rho$ (density gradient)

291
$\times 10^6\ m^2$
A_{basin} (basin area)

7,000
m^2
A_{cross}
(sluice gate cross-section)

Source: KHOA + NIER, summer 2021–2025; KRC cross-validation.

Sensitivity Matrix:
γ × SOD × Target DO (18 cases)



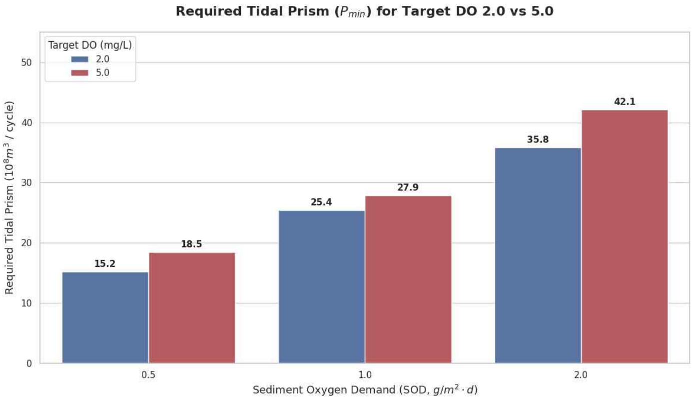
Key insight: asymmetric sensitivity

Linear in SOD, cube-root in 1/γ. 10× γ change → only 1.22× P_min.

P_min Range: DO 2 mg/L vs 5 mg/L

Interpretation

- DO 2 mg/L: floor target
- DO 5 mg/L: ~1.1 × P_min
- Same physical law



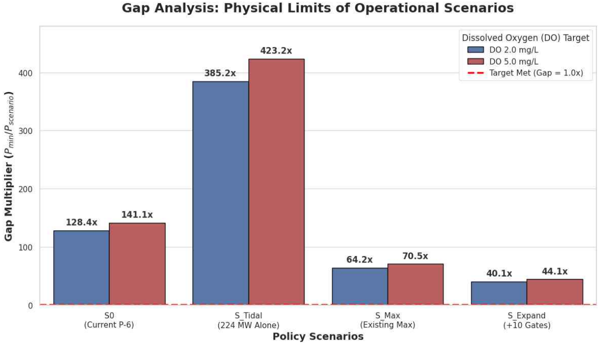
Three-Stage Energy Collapse

Gate efficiency = P_actual / P_upper

Natural tides		Sluice maximum		Actual
13.1 $\times 10^8$ m³	Seawall ↓ 76%	3.09 $\times 10^8$ m³	Summer ↓ 94%	0.20 $\times 10^8$ m³
P_upper		P_gate_max		P_actual
unrestricted exchange ceiling		continuous open case		

Gate efficiency 1.5% → P_actual = 1/128 of P_min

Gap Analysis: Every Scenario Falls Short



Tidal power alone makes it 3× worse than today.
Maximum structural expansion still falls 40× short.

Why Shihwa Does Not Generalize

Source: Dec 2025 inter-agency MoU (4 agencies)

Parameter	Shihwa	Saemangeum
Seawall length	11.2 km	33.9 km
Basin storage	0.28×10^9 m³	0.93×10^9 m³
Max tidal range	7.80 m	5.71 m
Daily exchange	147 Mm³ (52%)	135 Mm³ (15%)*
Tidal capacity	254 MW	224 MW*
Annual generation	552 GWh	477 GWh*

**Dec 2025 government plan*

Physics gap

3.3× basin volume

0.73× tidal range

0.29× exchange ratio

Energy density ≈ 1/5 Shihwa

Same template — different physics

International Precedents: Pathways for Saemangeum Governance

Strangford Lough (UK)

Adaptive management

- Pre-installation baseline
- Science + Liaison Groups
- Mandatory Shut-down Protocol
- Mitigation reduced over time

Long-horizon hybrid retrofit — not all-or-nothing

Savidge, G., Elsaesser, B., Pritchard, D. W., Whittaker, T. J. T.,
Fortune, F., Inger, R., Kennedy, R., McRobert, A., Plummer, K. E., & Sparling, C. E. (2014).
Strangford Lough and the SeaGen tidal turbine. In M. A. Shields & A. I. L. Payne (Eds.),
Marine renewable energy technology and environmental interactions(Chapter 12, pp. 153–172).
Springer; Royal Haskoning. (2012).
SeaGen environmental monitoring programme final report(Ref. 9S8562/R/303719/Edin)

Tourism Ireland. (2025, May 21). *Stone tower and woodland overlooking tranquil waters and golden fields near Strangford in County Down* [Photograph]. Ireland.com. vhttps://www.ireland.com/en-us/magazine/touring-holidays/strangford-unrushed/

International Precedents: Pathways for Saemangeum Governance

Oosterschelde (Netherlands)

Permeable redesign

- Originally closed-dam plan
- Citizen coalition + cost-benefit reversal
- 62 movable gates: open daily,

closed in storms

- ≈75% natural tidal exchange preserved
- Fisheries, ecology, tidal power all maintained (Limited Tide zone)

Long-horizon hybrid retrofit — not all-or-nothing

Saeijs, H. L. F. (1991). Eastern Scheldt: A living estuary. Rijkswaterstaat.
Disco, C. (2002). Remaking "nature": The ecological turn in Dutch water management. Theory, Culture & Society, 19(5–6), 145–172.
Commissie Oosterschelde [Klaasesz Commission]. (1974). Rapport van de Commissie Oosterschelde. Ministerie van Verkeer en Waterstaat.
Rijkswaterstaat. (n.d.). Oosterscheldekering: Storm surge barrier operations and closure records (1986–present). Ministry of Infrastructure and Water Management.

The Saemangeum Conflict Map

Water level	−1.5 m (development)	↔	0 m (ecology)	core
Method	Tidal power	↔	Gate opening	
Trust	RE100 industry	↔	Water quality	
Governance	Central	↔	Stakeholders	

No common baseline → axes cycle forever

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Seoul Shinmun. (2026, February).Shihwa tidal power as Samsung's RE100 solution;
Energy Economy Daily. (2025, July).Tidal power outperforms solar as RE100 source;
Saemangeum Continuous Seawater Exchange Headquarters. (2025, July). [Statement on the 9th Saemangeum Committee];
Financial Review. (2025, October).The 3rd Saemangeum Master Plan amendment must be disclosed.

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PLANMalaysia. (2023). Panduan perlaksanaan penilaian impak sosial bagi projek pembangunan[PPSIA guideline]
Mohd Shahwahid, H. O., Kuppusamy, S., Jahara, H. Y., & Abdul Rahim, A. S. (Eds.). (2022). Improving Social Impact Managemen Plan (SIMP) from the perspectives of SIA Review Panel members(MSIA Reading Series No. 1). Malaysian Association of Socia Impact Assessment
Malaysian Association of Social Impact Assessment [MSIA]. (2022). SIMP implementation and monitoring — Grievance Managemen Plan, Consultative Community Committee, High Level Committee(Reading Series No. 7)
Mohd Shahwahid, H. O. (2026). Valuing social impacts of development projects: Weighing the economic costs and benefits(MSIA Reading Series No. 30)
Saemangeum Special Act, Article 11 (Republic of Korea); Jeonbuk Special Self-Governing Province Act (Republic of Korea)

Proposed Two-Stage Governance Framework

Why P-min as the baseline? Testable · technology-neutral · pre-disclosed

1

Set scientific baseline

Declare P-min publicly — the physical floor.

2

Pre-verify operations

gap ≤1× → execute
gap 1–3× → enhance
gap >3× → restructure

Process pillar

Oosterschelde Model + Strangford anchor

- Full information disclosure
- Unanimous on baseline
- Civil society leads
- Conservation-revenue separation

(Strangford Mandatory Shut-down Protocol)

Substance pillar

Malaysia SIMP — raise SIA to EIA equivalence

- Independent SIA report + review panel
- Weighted-average significance scores
- Common monetary yardstick
- Compensation neutralises net losses

Physics fixes the floor · Process opens the room · Substance scores the trade-offs

Limitations & Future Research

01 Spatial homogeneity

Spatial γ variation not modeled

02 SOD variability

In-situ measurements needed

03 Flood-season conflict

Freshwater vs seawater trade-off

04 Governance feasibility

Follow-up empirical study needed

Conclusions

1. P-min ≫ P-actual: recovery currently impossible
2. Every single-tool scenario fails the P_min test
3. Raise water level to 0 m: precondition
4. No new infrastructure approvals without P_min compliance

Let’s continue the conversation!

Message me your questions or comments in the IAIA26 app.

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