

NATURE AND INSURANCE – COULD A NATURE INSURANCE BE CREATED?

Analysis of Insurance Viability for Mangrove Protection in Bali, Indonesia



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INTRODUCTION



The Threat

Climate change increases coastal flooding & erosion, threatening global tourism destination.



The Alternative

Mangrove restoration offers a cost-effective Nature-Based Solution (NbS) that reduces annual flood damage while providing ecological benefits.



The Problem

Traditional "grey infrastructure" (seawalls) is costly, unsustainable, and damages natural aesthetics.



The Gap

Quantify the financial benefits of mangrove protection & assess the potential for nature-linked insurance solution.



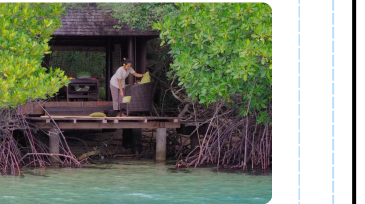
A beachfront hotel in Sanur, Bali, representative of coastal tourism assets exposed to flood risk



Bruguiera spp. (Bakau mangrove), a common mangrove species found along Bali's coastline

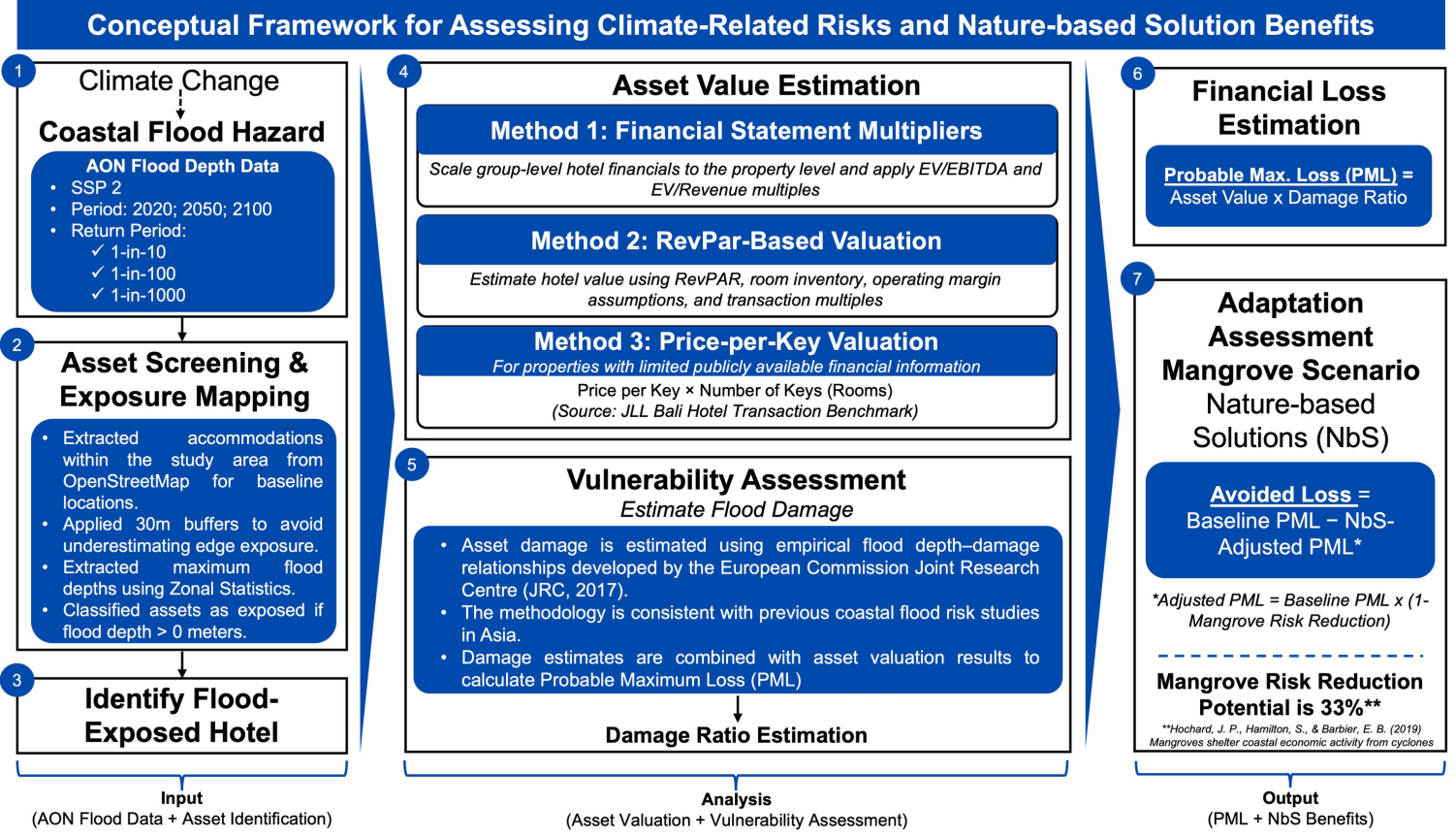


Coastal flooding in Bali, following heavy rainfall (October 2025)



A coastal resort adjacent to mangrove forests in Menjangan, Bali,

METHODOLOGY



ASSET VALUATION METHODS

InterContinental Bali Sanur	Laguna Reef Huts*	
FINANCIAL STATEMENT MULTIPLIER - Scale IHG EMEAA segment revenue ÷ hotel count = per-property revenue - Apply EV/EBITDA multiple from IHG listed equity BEST USED: No property data exists	REVPAR-BASED VALUATION - ADR = USD 254.09 × 69.1% = RevPAR +35% room revenue uplift (F&B, wellness) - Apply EV/EBITDA 15× (CDL Hospitality Trusts 22.3× stripped of REIT premium) BEST USED: Room metrics known	PRICE-PER-KEY VALUATION - JLL Bali midscale median: - USD 146,942/key 12 rooms × USD 146,942 BEST USED: Income data unavailable
USD 20.96M	USD 113.9M	USD 1.76M

**Flood-exposed property in dataset*

*Flood-exposed property in dataset

MANGROVE REDUCTION FACTOR

- Generated **417 valid permutations via a Monte Carlo simulation**. The simulation varied local environmental inputs to isolate the protective variance between scenarios with and without mangroves. The baseline parameters for storm-induced economic damage were derived from Hochard et al. (2019), which uses seaward-to-inland mangrove width to model reductions in permanent months-lost of economic activity.

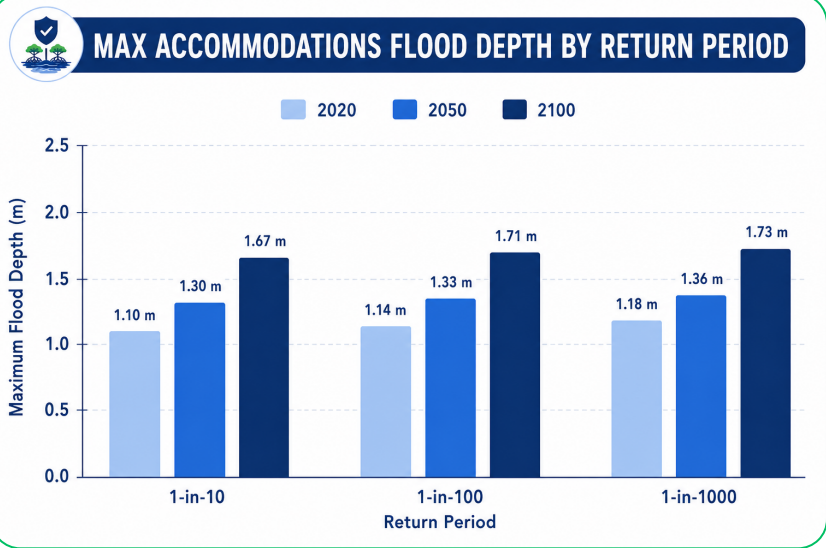
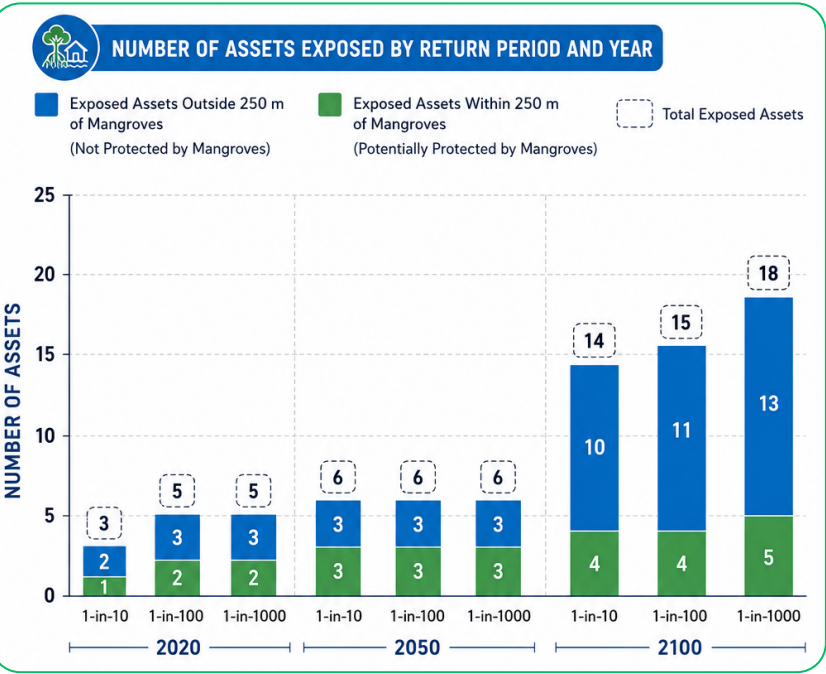
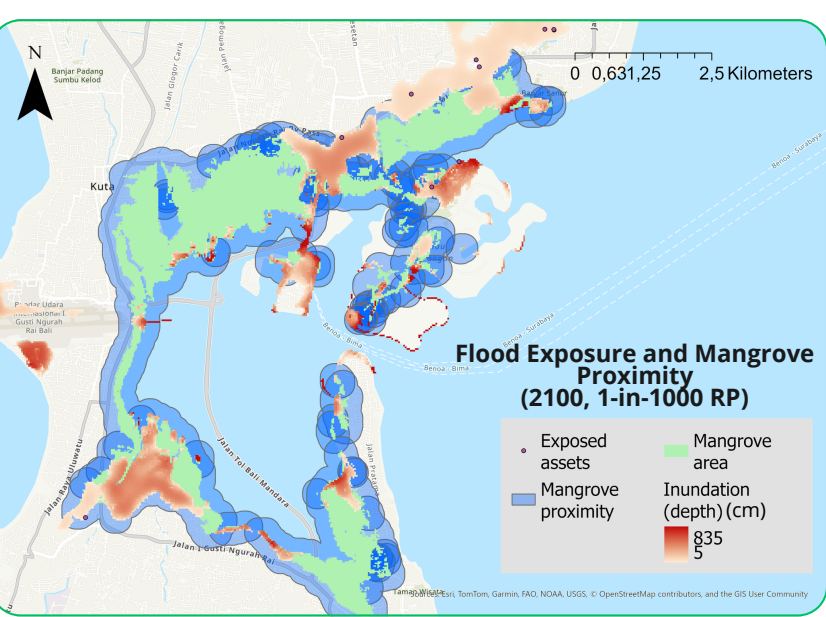
Estimated risk reduction ranged from **1.8% to 61.2%**

Mean **33.0%**

Median **33.3%**

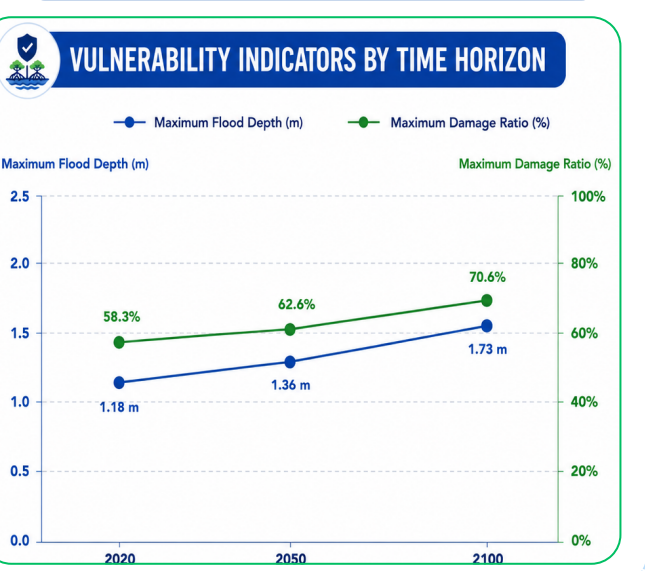
- Distribution is centred around ~33% (representative estimate)
- Baseline adaptation scenario: **adopts a 33% flood-risk reduction factor to quantify the protective benefits of mangrove ecosystems**

HAZARD, EXPOSURE, AND VULNERABILITIES

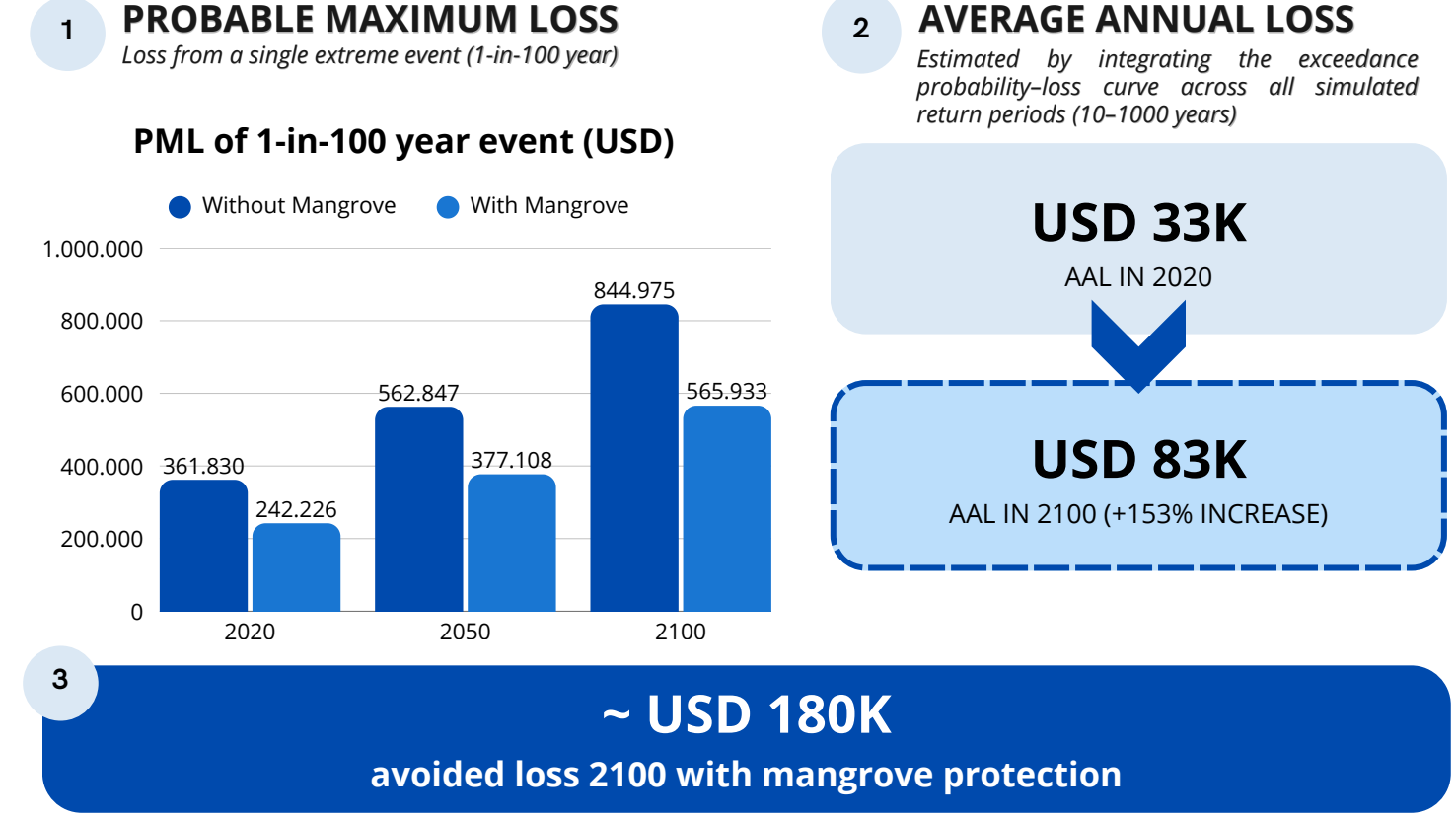


- The combined layers provide a **spatial assessment** of the relationship between flood hazard, asset exposure and vulnerability, and mangrove proximity
- The number of Bali's tourism **assets** that are **exposed** to inundation **increase** over time and with longer return periods.
- Flood-exposed assets are concentrated along **southern corridor**, particularly **Kuta, Benoa, Serangan, Sanur, and Nusa Dua**, where flood depths are also among the highest
- Assets within mangrove proximity** also increase, but exposure growth **exceeds** mangrove coverage, creating a **protection gap** by 2100
- Maximum flood depth** increases from **1.18 m** in 2020 to **1.73 m** in 2100
- Maximum damage ratio** rises from **58.3%** in 2020 to **70.6%** in 2100

"The increasing hazard intensity and potential damage indicating growing risk and vulnerability."



PML, AAL & MANGROVE-AVOIDED LOSS



MEXICO VS BALI



Mexico

- Sufficient premium base
- Institutional aggregator
- Free-rider-proof financing



Bali

- Limited asset set; many properties may not sit directly on the coastline.
- Exposed set skews to **smaller, lower-tier hotels** with constrained budgets

QUINTANA ROO CASE STUDY

- Parametric insurance product covering 100 miles of Mexico's Yucatan coastline
- Pays out immediately once hurricane wind speeds cross a set threshold
- Funded by the Coastal Management Zone Trust via tourism fees, coastal property owner contributions, and government support

CONCLUSION

- Exposure is limited now but will **expand sharply**
- Avoided losses due to nature based solutions are substantial (mangrove protection generates **~USD 180k-200k in avoided flood losses by 2100**)
- Mangrove reduction potential varies** depending on other factors such as forest structure, species composition, water depth, coastal morphology and forest width