CALCULATING THE VALUE OF NATURE & THE COST OF HURRICANE HARVEY

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Introduction

ECOSYSTEM-BASED ADAPTATION (EbA):

Strategy that "uses biodiversity & ecosystem services…to help people adapt to the adverse effects of climate change" by taking "into account the multiple social, economic & cultural co-benefits for local communities." (SCBD, 2009)

EbA VALUATION:

Holistic process - **calculates cost, benefits, & impacts** of ecosystems & their adaptation services.

GOALS

a) Show proactive adaptation is more cost-effective than reactive mitigation in resilience projects (i.e. EbA is more beneficial than grey infrastructure).

b) Provide guidelines for understanding EbA valuation process & recommendations for communicating EbA to decision-makers & communities.

APPROACH

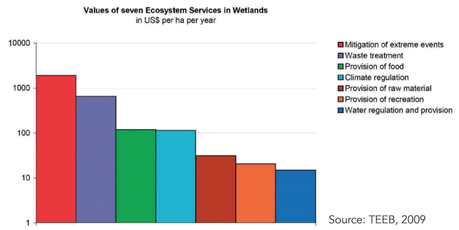
- Texas & Hurricane Harvey case study - example of problems.
- Lone Star National Recreation Area (LSCNRA), Texas - example of EbA & valuation solutions.

PURPOSE

- Recommendations can be used to leverage EbA policies or mainstream EbA valuation in American resilience practice.
- Objective: alleviate increasing cost burden of storm surge impacts.

Analysis & Results

VALUATION



Source: TEEB, 2009

EVENT	DATES (RANGE, YEAR)	COST* (IN BILLIONS)	DEATHS
Hurricane Katrina *August 2005*	08/25 – 08/30, 2005	$161.3	1,833
Hurricane Harvey *August 2017*	08/25 – 08/31, 2017	$125.0	89
Hurricane Maria *September 2017*	09/19 – 09/21, 2017	$90.0	65
Hurricane Sandy *October 2012*	10/30 – 10/31, 2012	$70.9	159
Hurricane Irma *September 2017*	09/06 – 09/12, 2017	$50.0	97

* (CPI-adjusted estimated cost)

Source: NOAA, 2018

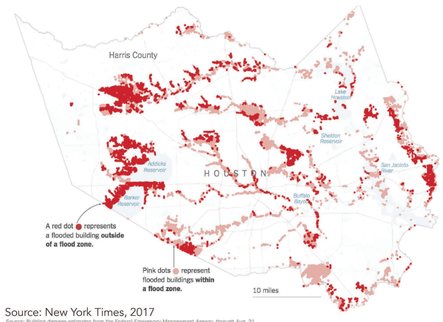
Distribution of Costs and Benefits for Sand City (using High Sea Level Rise projection)

Year	Nourish as Needed	Allow Erosion	Shoreline Armoring
Public Benefits (recreational and ecological value)			
2030	$73,879,019	$55,517,865	$46,714,719
2060	$156,974,550	$128,161,523	$88,872,613
2100	$258,312,180	$215,278,285	$105,318,207
Property Losses/Damages (infrastructure, MRWPCA, public and private property)			
2030	-$22,317,371	-$22,405,393	-$7,307,244
2060	-$22,656,590	-$25,107,555	-$7,768,865
2100	-$57,879,464	-$70,474,388	-$8,435,046
Adaptation Costs (nourishment, groins, revetments)			
2030	-$42,040,402	$0	-$79,876,764
2060	-$42,040,402	$0	-$187,707,339
2100	-$136,692,248	$0	-$260,132,083

Source: The Nature Conservancy, 2016

TEXAS

CALENDAR YEARS	TIME-SPAN (YEARS)	ENCOUNTERS WITH BILLION-DOLLAR DISASTERS (EVENTS)	AVERAGE FREQUENCY (EVENTS PER YEAR)
1980 - 2000	20	31	1.55
2000 - 2017	17	65	3.82
2010 - 2017	7	43	6.14
2013 - 2017	4	27	6.75
OVERALL			
1980 - 2017	37	95	



Source: New York Times, 2017

Source: Building damage estimates from the Federal Emergency Management Agency, through Aug. 31

TEXAS DISASTER CAPITAL OF AMERICA

WHY? TEXAS HOLDS THE NATIONAL RECORD FOR:

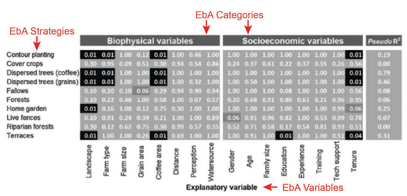
LARGEST CITY WITH NO ZONING LAWS	Houston is the largest U.S. city to have no zoning laws.
HEAVIEST RAINFALL (HURRICANE HARVEY)	Heavist rainfall from a U.S. storm at 52 inches (over 4 feet).
HIGHEST FREQUENCY OF BILLION-DOLLAR DISASTERS	Since 1980, 95 billion-dollar disaster events
LEAST ABSORBENT SOIL	Texas soil is among the least absorbent in the nation.
MOST EXPENSIVE NATURAL DISASTER	Harvey caused damages worth $125 billion (and counting).
LEADING FUEL PRODUCER	Produces > 30% of U.S. crude oil. Oil-production also means more land degredation & soil erosion. Harvey rose gas prices.

BEST PRACTICES

Environmental Communication Best Practices:

1. Connect with the community
2. Impart "action-based knowledge"
3. Show immediate benefits of action
4. "A picture is worth 1,000 words"
5. Adapt language & avoid controversial terms to simplify a complex issue
6. Interdisciplinary expert collaboration is necessary

Adapted from: Schultz et al, 2018



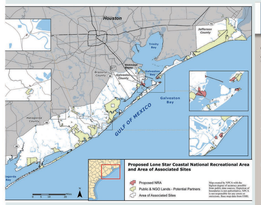
5 EbA Impact Categories

Valuation Category	Valuation Methods	Examples
Biophysical effects	1. Ecological 2. Biological 3. Hydrological 4. Hydraulic 5. Morphodynamic 6. Meteorological 7. Epidemiological 8. Nutrition 9. Agronomic	Habitat composition, flora and fauna, catchment runoff, groundwater recharge, water flow/quality, flood dynamics, erosion, sedimentation, topography, tides, water-borne disease incidence, food intake, vitamin deficiencies, crop yields, etc. (tend to yield more **quantitative** measures)
Risk exposure & vulnerability	1. Allocation of weights 2. Probability analysis 3. Monte Carlo simulation 4. Risk-benefit analysis 5. Decision analysis 6. Real option analysis 7. Acceptable risks 8. Robust decision-making 9. Delphi method 10. Sensitivity analysis 11. Scenario analysis	Via disease, drought, floods, rainfall, temperatures, fires, etc. (tend to yield more **quantitative** measures)
Economic costs & benefits	1. Cost-benefit analysis 2. Cost-effectiveness analysis 3. Least cost analysis 4. Value for money approaches 5. Input-output analysis 6. General/partial equilibrium models 7. National income/ecosystem accounting 8. Ecosystem services valuation (NPV)	National, household, corporate, or individual purchases, sales, production, consumption, savings, investment, trade, income, employment, etc. (tend to yield more **quantitative** measures)
Quality of life impacts	1. Sustainable livelihood analysis 2. Household livelihood security assessment 3. Participatory risk & vulnerability assessment 4. Participatory ecosystem valuation 5. Stakeholder-focused or locally-driven cost-benefit analysis 6. Participatroy rural appraisal (PRA)	Food, fuel, shelter, money, health, education, happiness, prosperity, employment, safety, freedom, etc. (tend to yield more **qualitative** measures)
Social & institutional outcomes	1. Participatory techniques 2. Agent-based models 3. Stakeholder mapping & assessment 4. Social network analysis 5. Institutional and context analysis 6. Knowledge-attitude-practices surveys 7. Contingent valuation (WTP & WTA)	Power, status, roles, responsibilities, relationships, participation, governance, sanctions, etc. (tend to yield more **qualitative** measures)

Adapted from: Emerton,

Discussion

- EbA more beneficial than grey infrastructure but overlooked. But strengthening evidence does not = more well-informed decisions
- Need better communication - simplify process, use real-world examples through disaster lens, account for community values.
- Example: Lone Star Coastal National Recreation Area (LSCNRA) - "coalition along Texas Gulf coast partnering with National Park Service
- LSCNRA Goal: enhancing Texas-led stewardship/conservation, coastal economy compatible with flooding, expanding/promoting tourism/ recreation." (LSCA, 2017).
- Challenges/Uncertainties - EbA can be subjective, has limits, varying spatial and temporal distributions.



Source: LSC, 2017

Total Economic Impact of the Proposed LSCNRA Could Double in Ten Years

Growing visitation is expected to double the economic impact of the Lone Star Coastal National Recreation Area in its first ten years of operation.

PRIOR to Designation	YEAR TEN of Operation
Attract	Attract
2.6 million annual visitors	3.8 million annual visitors
Support	Support
$263 million local sales	$535 million local sales
6,240 local jobs*	13,325 local jobs*
$109 million personal income	$234 million personal income

* full-time and part-time jobs

Source: LSC, 2017

Conclusions

Decision-makers should:

1. Use Texas as an EbA example
2. Utilize simple, value-based communication
3. Implement EbA Valuation

This research aims to aid in mainstreaming EbA and can be used to develop further research in the future.

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