What-If Scenario Analysis and Decision Support Algorithm for Offshore Wind Farm Installation

Synthetic Data Analysis Results

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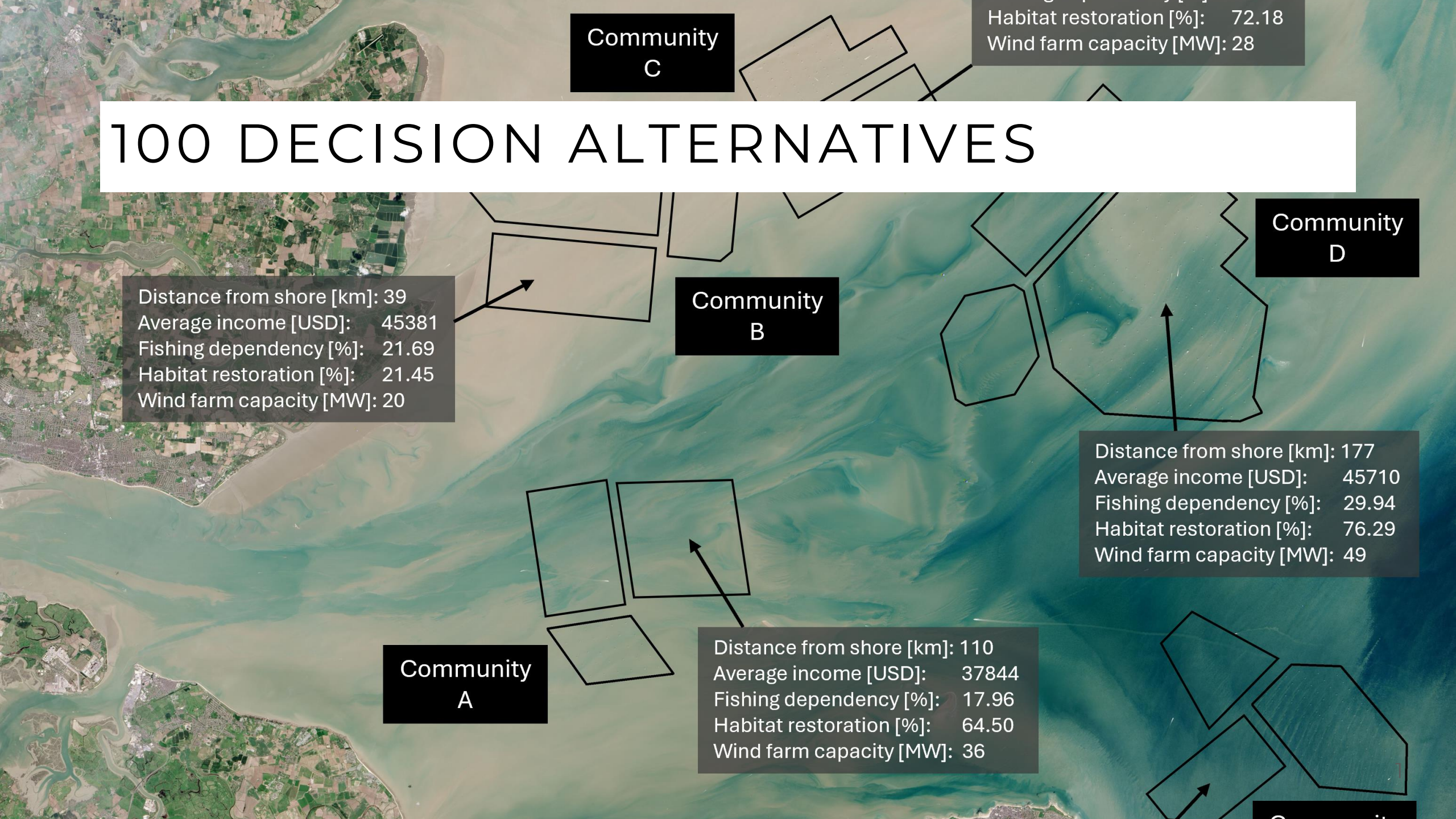
Data overview


Community C
Habitat restoration [%]: 72.18
Wind farm capacity [MW]: 28
100 DECISION ALTERNATIVES
Community D
Distance from shore [km]: 39
Average income [USD]: 45381
Fishing dependency [%]: 21.69
Habitat restoration [%]: 21.45
Wind farm capacity [MW]: 20
Community B
Distance from shore [km]: 177
Average income [USD]: 45710
Fishing dependency [%]: 29.94
Habitat restoration [%]: 76.29
Wind farm capacity [MW]: 49
Community A
Distance from shore [km]: 110
Average income [USD]: 37844
Fishing dependency [%]: 17.96
Habitat restoration [%]: 64.50
Wind farm capacity [MW]: 36

12 EVALUATION CRITERIA

No.	Criterion	Group of criteria	Description	Preference direction
C1	Average income	Socio-economic	Average income of the community [USD]	Max
C2	Fishing dependency		Proportion of the community dependent on fisheries [%]	Min
C3	Unemployment rate		Unemployment rate of the community [%]	Min
C4	Tourism revenue		Annual tourism revenue [USD]	Max
C5	Fish stock health	Spatial/Economic	Health of local fish stocks [%]	Max
C6	Marine habitat restoration		The potential for habitat restoration in the area [%]	Max
C7	Marine biodiversity	Environmental	A biodiversity index for the marine environment (0-100)	Max
C8	Carbon sequestration potential		Estimated potential for carbon sequestration in the area [T]	Max
C9	Marine protected Area		Whether the area is marine protected [True/False]	Min
C10	Current offshore wind farms	Technical/Spatial	Number of existing offshore wind farms in the area [#]	Min
C11	Distance from shore		Distance of wind farm from shore [km]	Min
C12	Wind farm capacity		Potential capacity of wind farms in the area [MW]	Max

1 ENVIRONMENTAL CONSTRAINT

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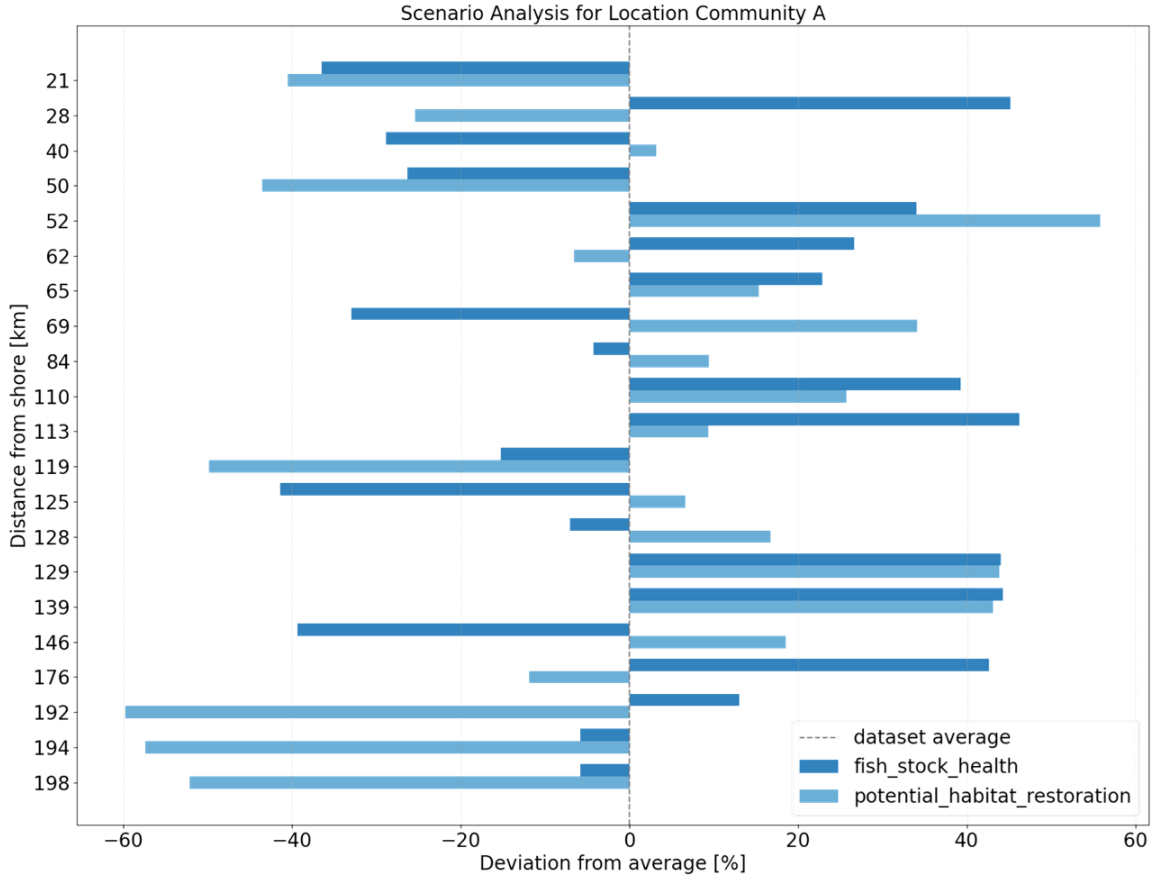
C11	Distance from shore		Distance of wind farm from shore [km]	Min
C12	Wind farm capacity		Potential capacity of wind farms in the area [MW]	Max

What-If Scenario Analysis

Decision Support for Offshore Wind Farm Installation
Synthetic Data Analysis Results

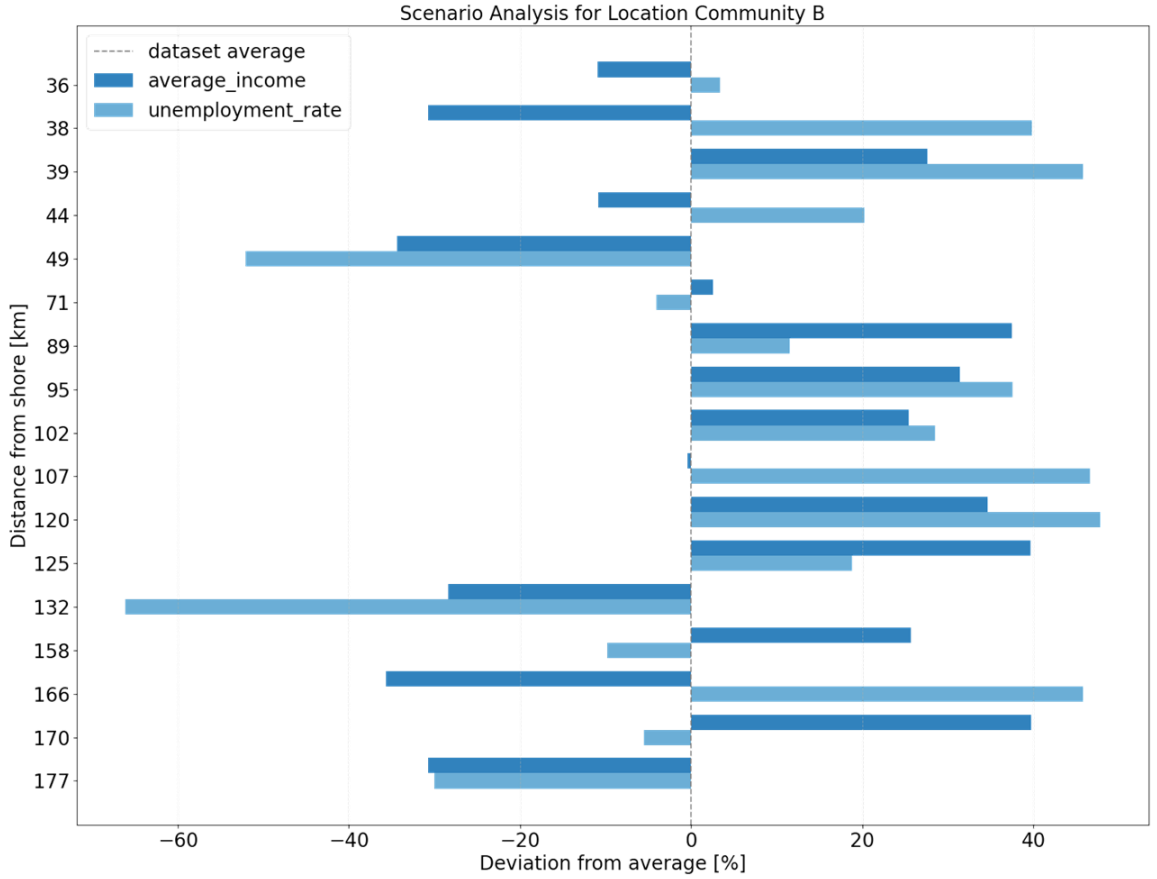
IMPACT ON LOCAL FISHERIES

- What would happen with the marine habitats and fish stocks if a location in community A was chosen?
- If the objective was to maximize both criteria, optimal location for a wind farm would be 52 km from shore.



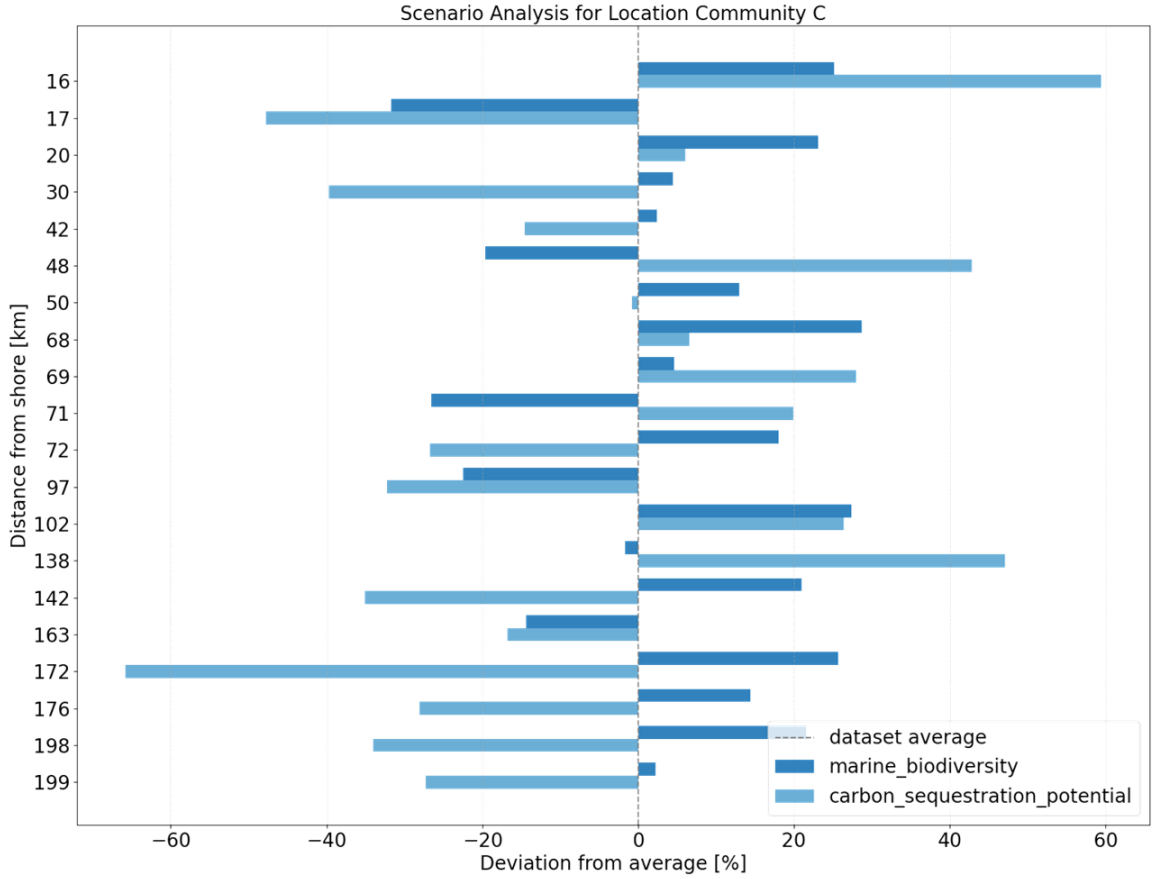
IMPACT ON LOCAL ECONOMY

- What would happen with the unemployment rates and average income if a location in community B was chosen?
- If the objective was to minimize unemployment rate and maximize average income, optimal location for a wind farm would be 170 km from shore.



IMPACT ON THE ENVIRONMENT

- What would happen with marine biodiversity and carbon sequestration potential if a location in community C was chosen?
- If the objective was to maximize both criteria, optimal location for a wind farm would be 16 km from shore.



Ranking of alternatives

EQUALLY WEIGHTED CRITERIA

- Which location would be optimal for the offshore wind farm installation if all criteria were equally weighted?
- Best ranked location would be in community **E**, **117 km** from shore.

Criterion	Value
Average income	48117.0 USD
Fishing dependency	13.07 %
Unemployment rate	2.09 %
Tourism revenue	456168.0 USD
Fish stock health	59.94 %
Potential habitat restoration	70.94 %
Marine biodiversity	85.60
Carbon sequestration potential	0.35 T
Current offshore wind farms	0
Potential wind farm capacity	21.0 MW

ENVIRONMENT CRITERIA PRIORITIZED

- Which location would be optimal for the offshore wind farm installation if environmental factors had advantage?
- Best ranked location would be in community **D**, **122 km** from shore.

Criterion	Value
Average income	48720.0 USD
Fishing dependency	25.36 %
Unemployment rate	5.42 %
Tourism revenue	448680.0 USD
Fish stock health	62.17 %
Potential habitat restoration	67.61 %
Marine biodiversity	75.29
Carbon sequestration potential	0.50 T
Current offshore wind farms	2
Potential wind farm capacity	37.0 MW

TECHNICAL CRITERIA PRIORITIZED

- Which location would be optimal for the offshore wind farm installation if technical factors were prioritized?
- Best ranked location would be in community **A**, **28 km** from shore.

Criterion	Value
Average income	34548.0 USD
Fishing dependency	10.37 %
Unemployment rate	8.39 %
Tourism revenue	125206.0 USD
Fish stock health	85.13 %
Potential habitat restoration	38.25 %
Marine biodiversity	79.95
Carbon sequestration potential	0.10 T
Current offshore wind farms	0
Potential wind farm capacity	46.0 MW

UNCERTAIN DECISION MAKING

- Which location would be optimal for the offshore wind farm installation if stakeholder uncertainty in decision making was considered?
- Best ranked location would be in community **D**, **33 km** from shore.

Criterion	Value
Average income	47528.0 USD
Fishing dependency	10.53 %
Unemployment rate	3.40 %
Tourism revenue	372965.0 USD
Fish stock health	77.38 %
Potential habitat restoration	45.58 %
Marine biodiversity	52.69
Carbon sequestration potential	0.23 T
Current offshore wind farms	0
Potential wind farm capacity	10.0 MW

Sensitivity analysis

BEST RANKED ALTERNATIVE

- If socio-economic factors had become more important, location in community **E**, **117 km** from shore would continue to be an optimal choice
- If technical factors such as wind farm capacity or distance from shore were prioritized, this location would severely underperform
- In case of prioritization of environmental factors, this location would still prove to be a good alternative