Modelling and mapping social-ecological system flows generated by the small-scale fishery in Senegal

Whose values, Whose benefits?

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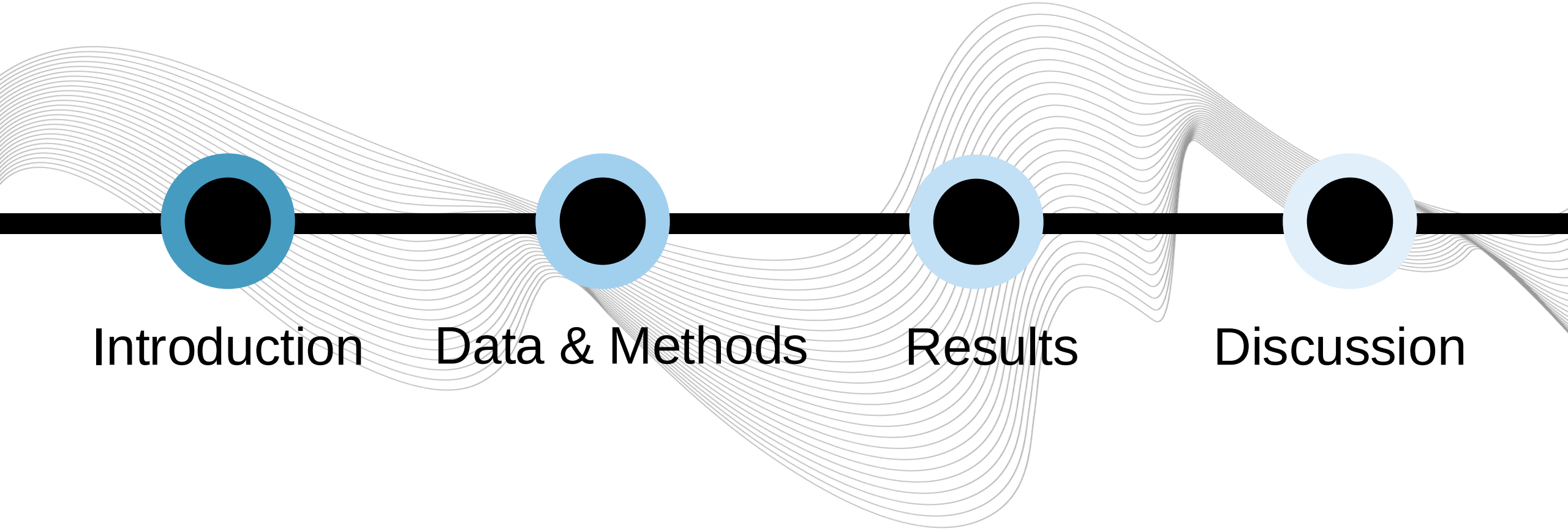
IN THIS PRESENTATION:



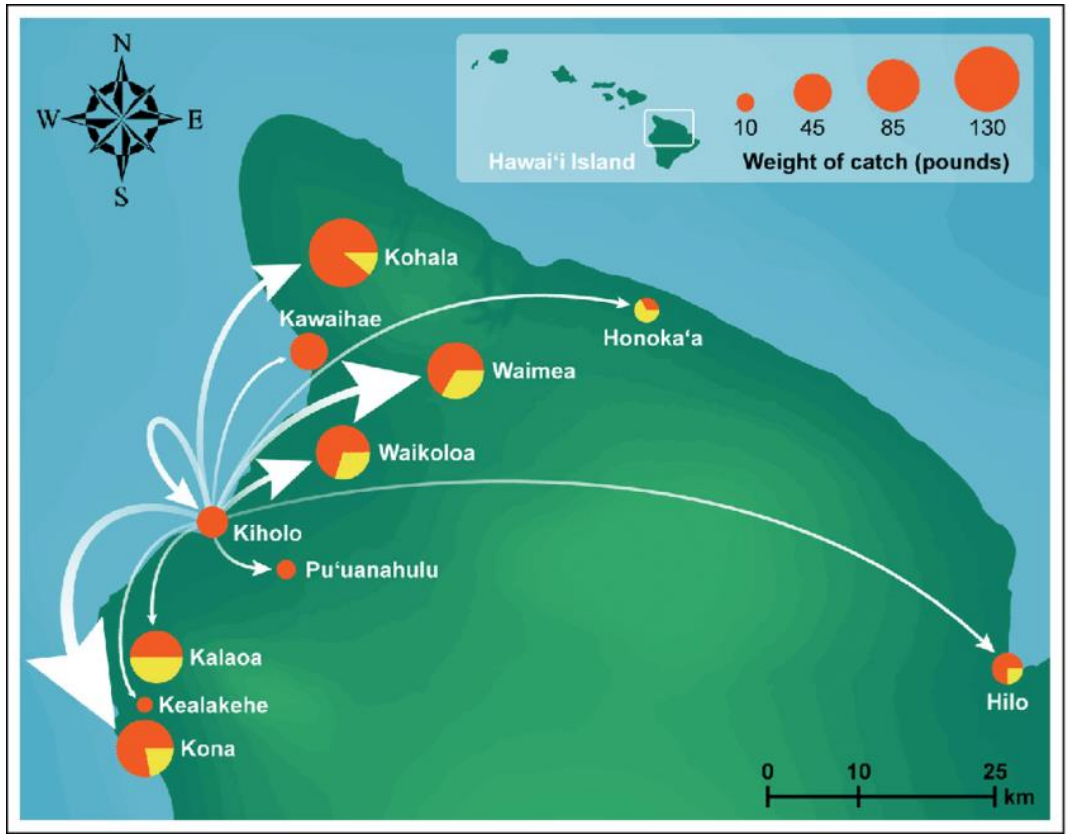
Introduction – Marine ES flows

Interactions between marine ecosystems and beneficiaries are complex:

1. Human activities may occur in the marine environment (e.g., trade, transportation), but beneficiaries are located predominantly on land

2. Information on ES flows in the marine environment is still missing (ecosystem-based management is the common practice)

3. Oceans provide ES flows (such as seafood) that are valuable to people irrelevant to their location



spatial patterns of reef-fish catch distribution among local communities from landings at Kīholo Bay, Hawaii by Hixon et at., (2021)

Introduction – Senegal

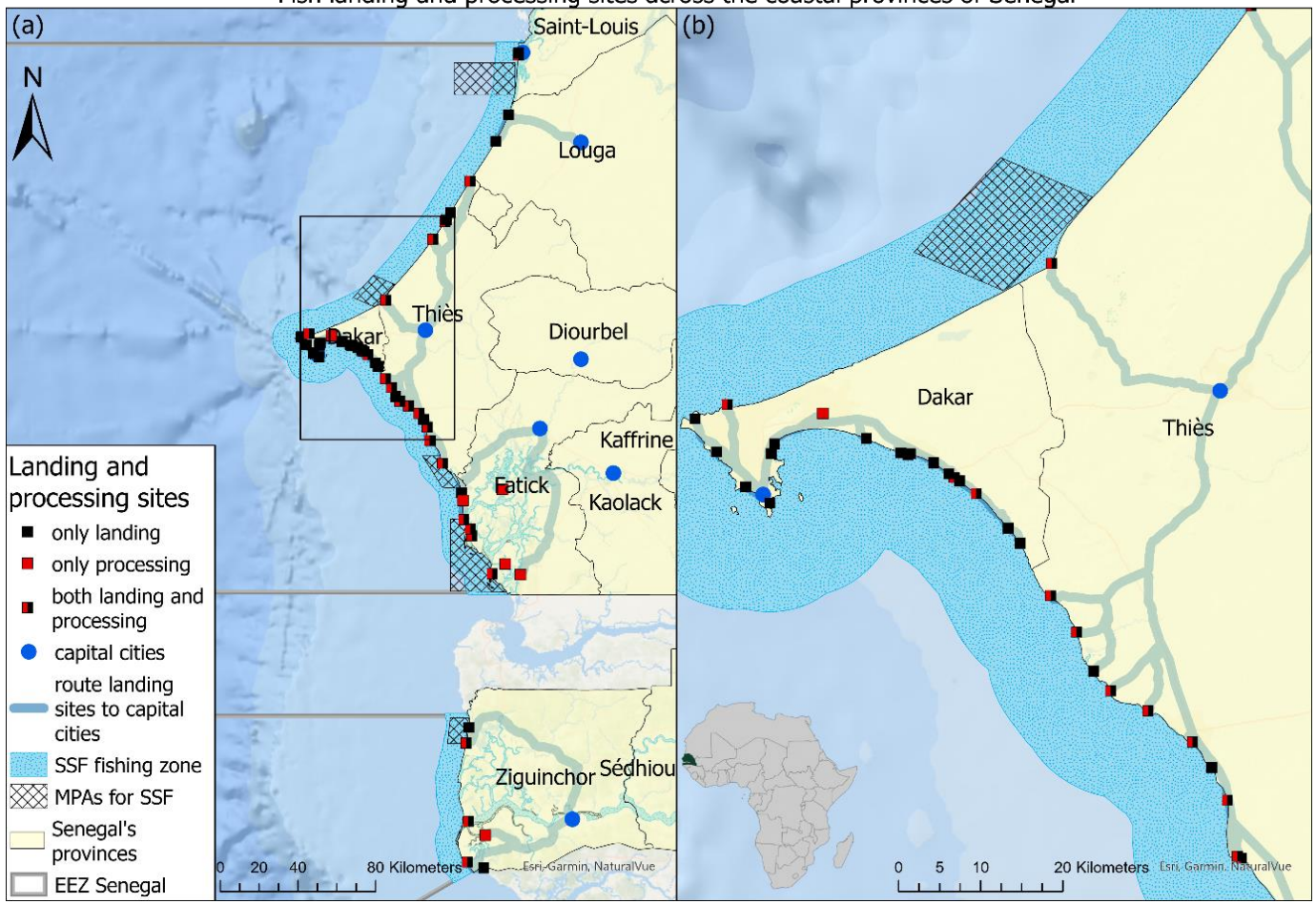
1. Large **maritime and coastal zone** extended to 221,818 km^2

2. Small-scale fishery provides large variety of **marine ecosystem services**:
   - Food provision → seafood landings: 350,000 tons/year
   - Employment in the fisheries sector → 600,000 people

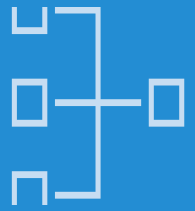
3. Large **dependency on fish** proteins for food intake and livelihoods

4. Poor management in the **distribution of fish proteins**

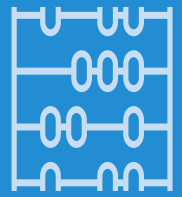
Fish landing and processing sites across the coastal provinces of Senegal



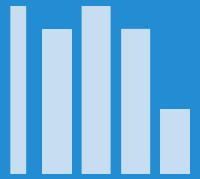
Introduction – Objectives



Quantify and map the direction of ES flows from the ecosystem to adjacent and distant beneficiaries in marine systems

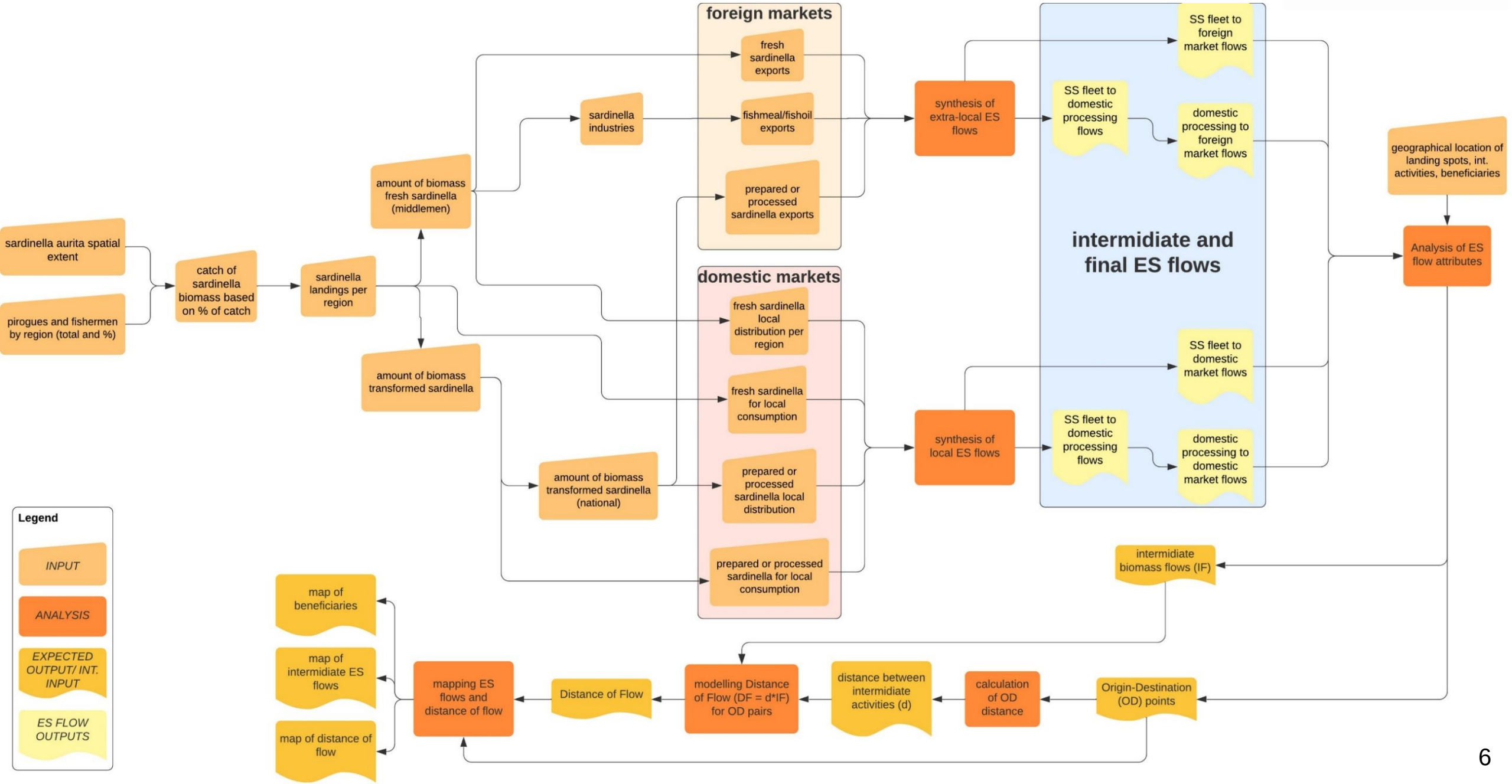


Quantify and map the intermediate flow costs associated with each value chain process

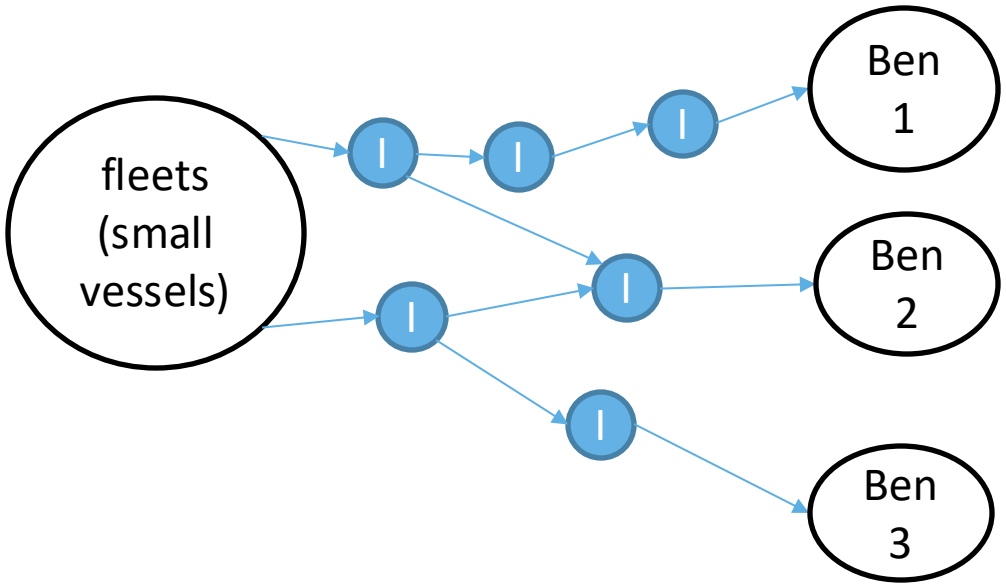


Identify which parts of the value chain we spot mismatches between ES flows and ES demand through an ES flow index

Methods - small–scale fishery supply chain



Methods – modelling interim and final ES flows



I = intermediate activities
Ben = beneficiaries

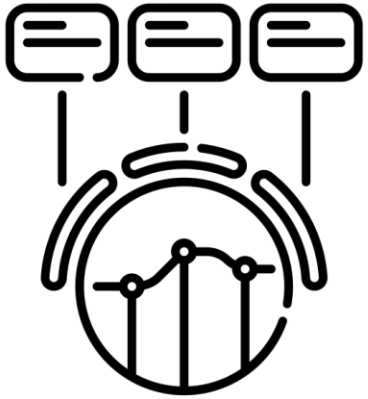
FLOW DIMENSION	DEPENDANCE ON	DESCRIPTION	ASSOCIATED INDICATORS
ACTUAL FLOW (ESF_i)	CURRENT STATE OF ES DISTRIBUTION	CURRENT NET BENEFITS WITH ASSOCIATED COSTS	• BENEFITS (FOOD PROVISION, EMPLOYMENT) • COSTS (ENVIRONMENTAL)
	CURRENT ACCESS	WITH ACCESS RESTRICTIONS RELATED ONLY TO DISTANCE	• GEOGRAPHICAL ACCESSIBILITY (G.A.)
	MET DEMAND	DEMAND BASED ON CURRENT LEVELS OF PROTEIN AND VITAMIN B_{12}	• PROTEIN AND VITAMIN B_{12} DEFICIENCY PER ADMINISTRATIVE REGION

Methods – ES flow index

ES flow index

$$\sum_i^N [ESF_i\ ] = = \ (B_1 - C_1) * A_1 + (B_2 - C_2) * A_2 + \cdots + \ (B_N - C_N) * A_N$$

- B: Benefits for each beneficiary group
- C: Costs for each beneficiary group
- A: Geographical accessibility based on the access (distance-related) of each beneficiary group

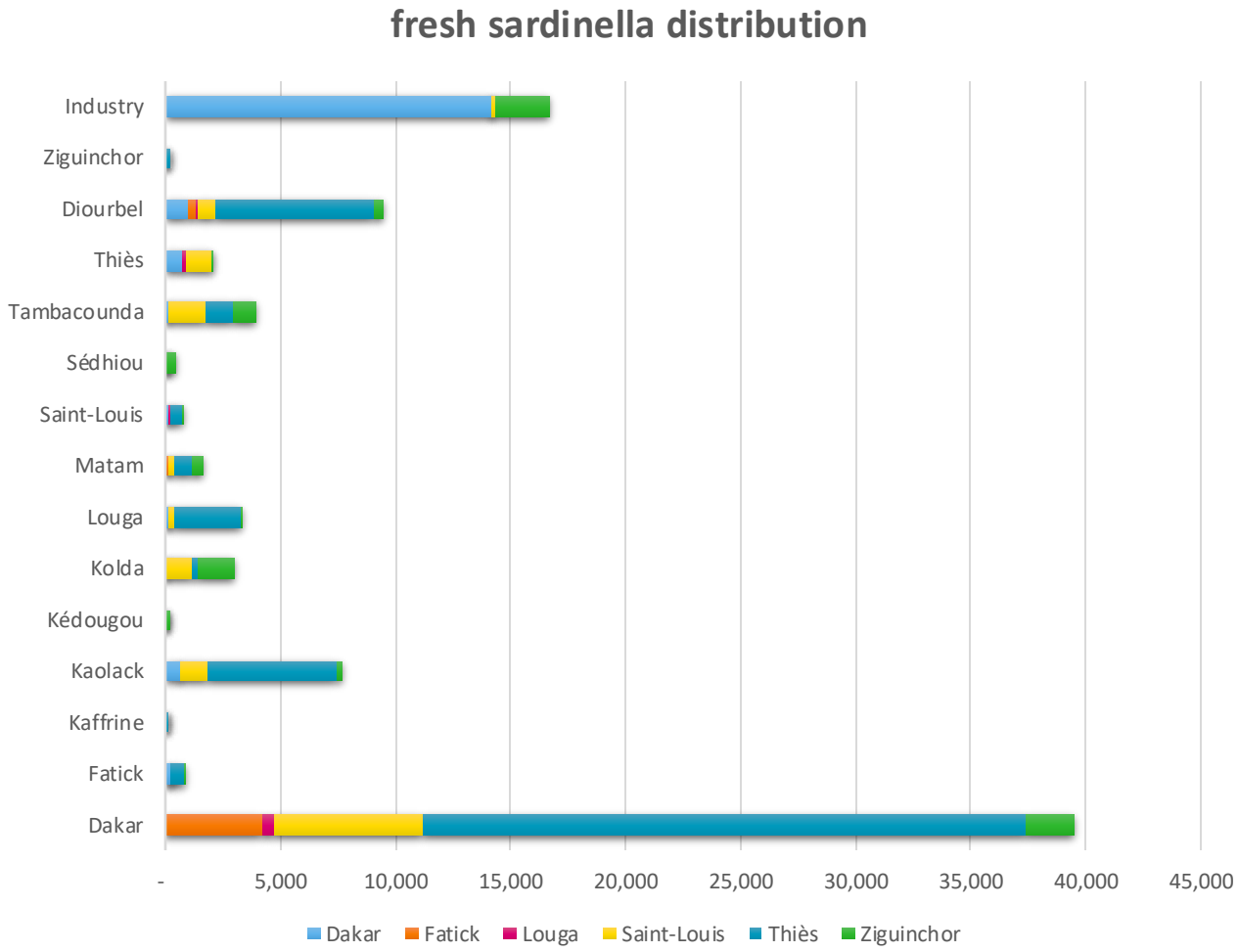


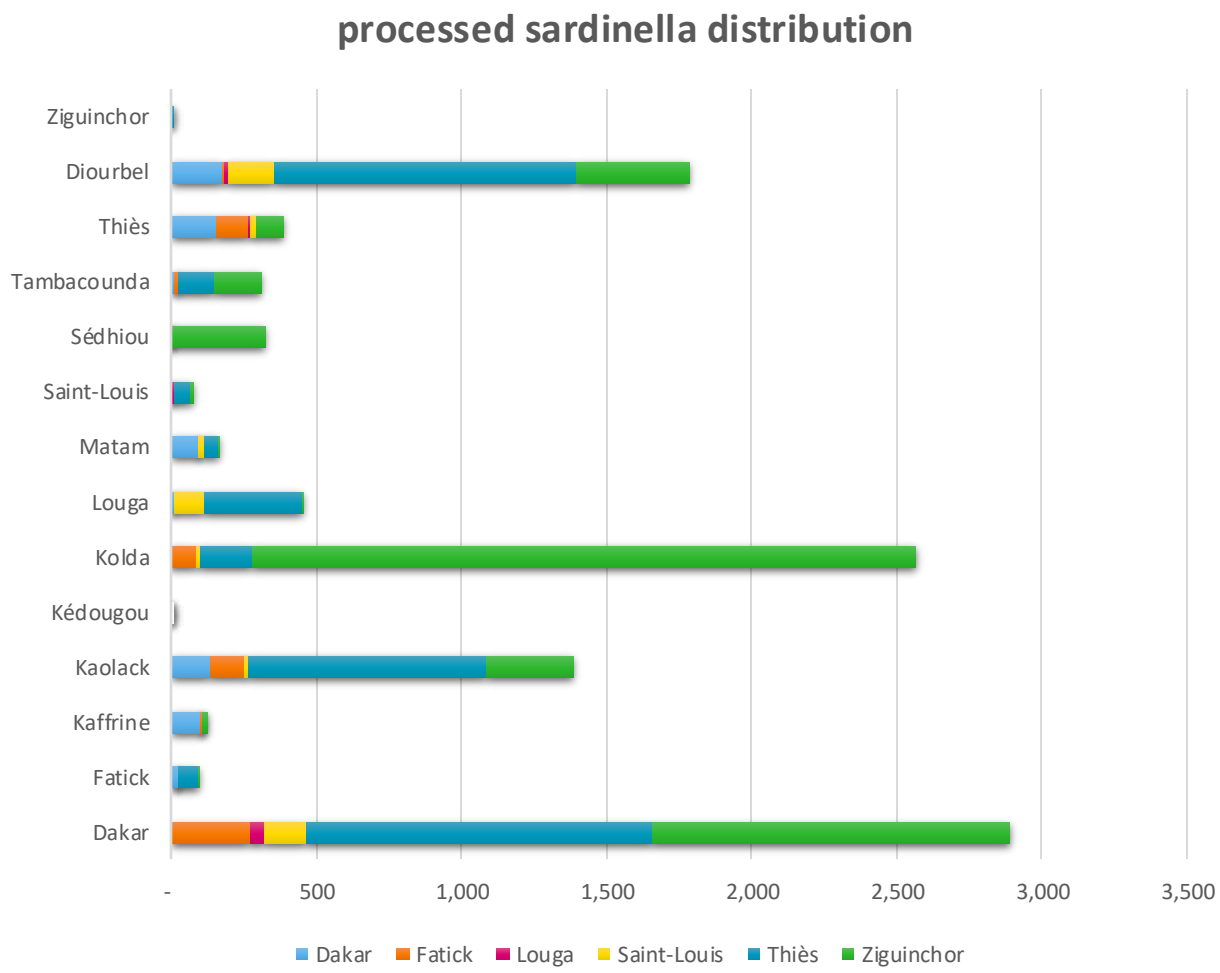
Example (benefit calculation for consumers):

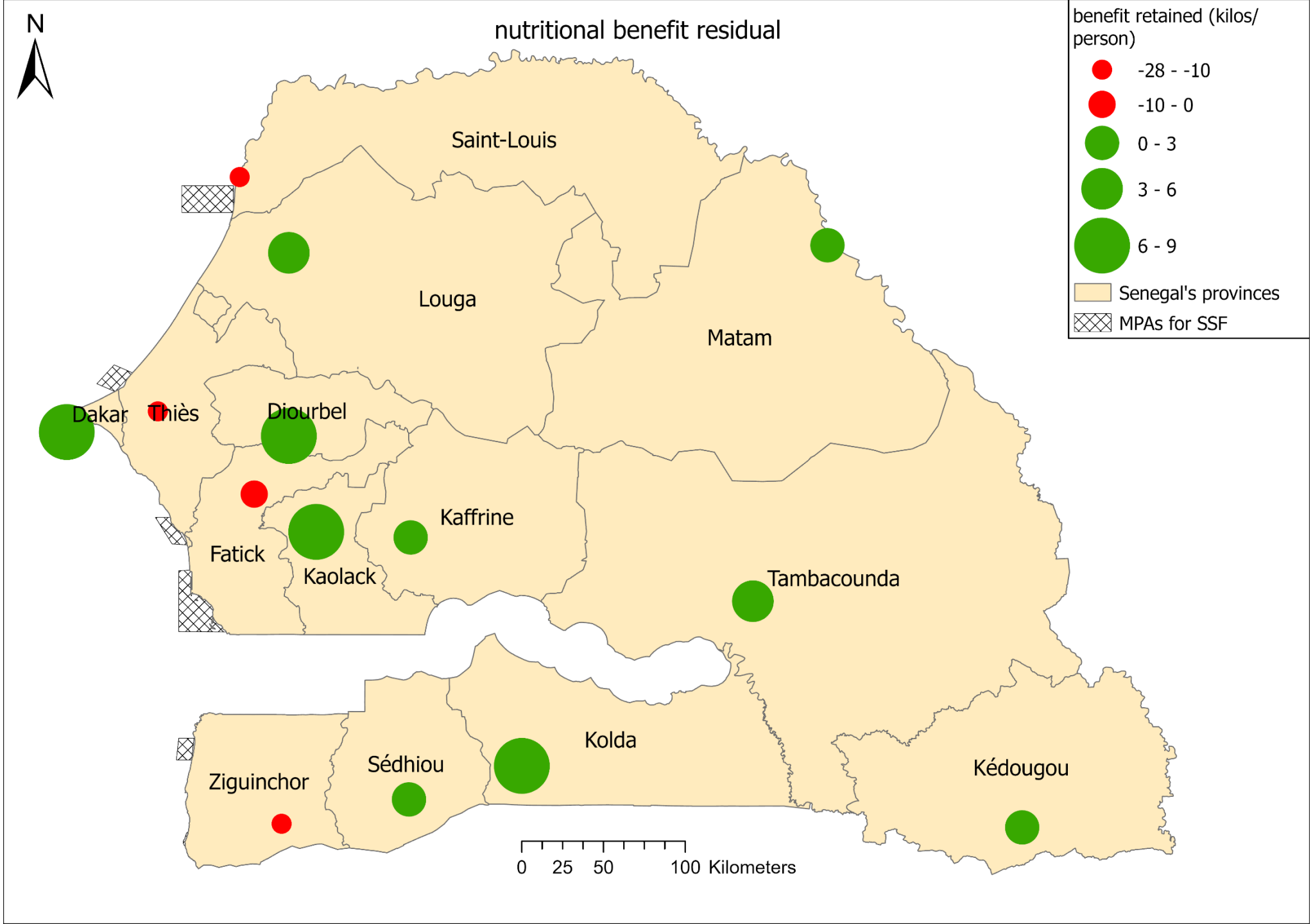
B_c = inflows − outflows − internal distribution − exports

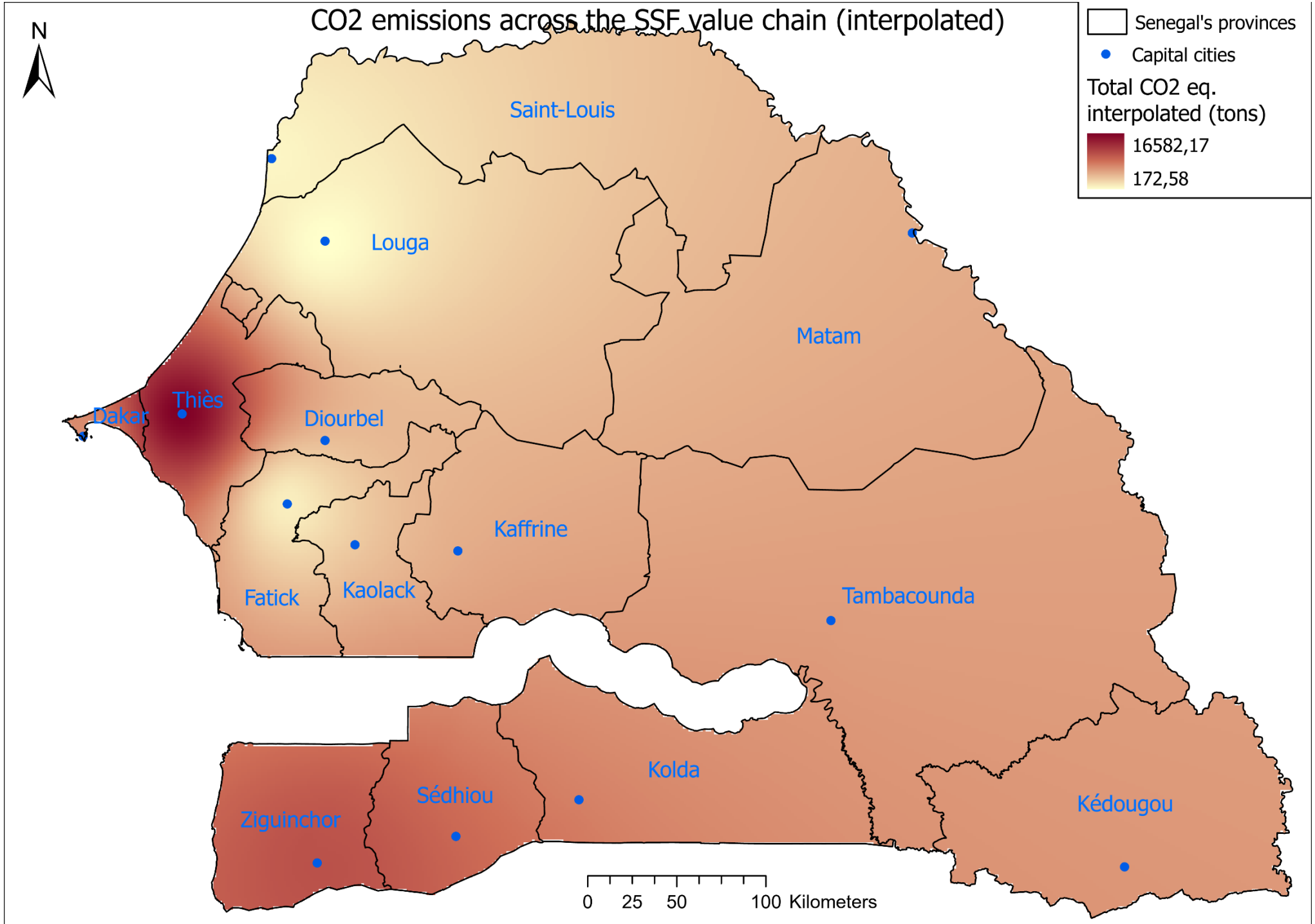
B_c refers to the nutritional benefit surplus or deficit calculated for each province within Senegal

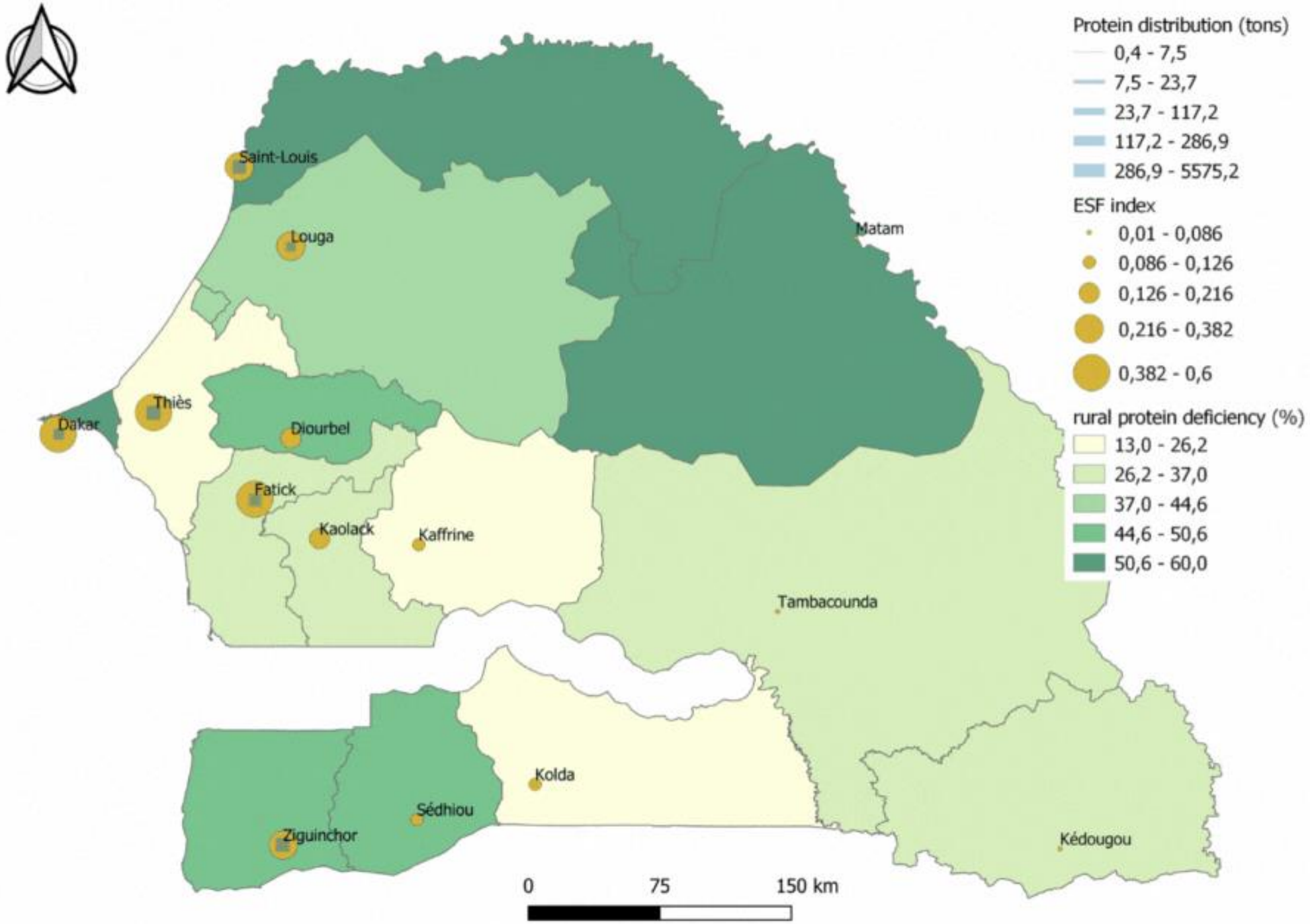
Results – Seafood flows within Senegal





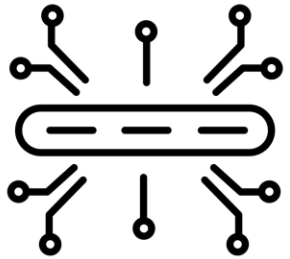

nutritional benefit residual
N
benefit retained (kilos/ person)
-28 - -10
-10 - 0
0 - 3
3 - 6
6 - 9
Senegal's provinces
MPAs for SSF
Saint-Louis
Louga
Matam
Dakar
Thiès
Diourbel
Kaffrine
Fatick
Kaolack
Tambacounda
Kolda
Sédhiou
Ziguinchor
Kédougou
0 25 50 100 Kilometers


CO2 emissions across the SSF value chain (interpolated)
N
Senegal's provinces
Capital cities
Total CO2 eq. interpolated (tons)
16582,17
172,58
Saint-Louis
Louga
Matam
Thiès
Dakar
Diourbel
Kaffrine
Fatick
Kaolack
Tambacounda
Kolda
Sédhiou
Ziguinchor
Kédougou
0 25 50 100 Kilometers

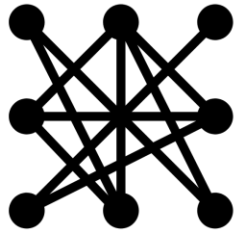

Protein distribution (tons)
0,4 - 7,5
7,5 - 23,7
23,7 - 117,2
117,2 - 286,9
286,9 - 5575,2
ESF index
0,01 - 0,086
0,086 - 0,126
0,126 - 0,216
0,216 - 0,382
0,382 - 0,6
rural protein deficiency (%)
13,0 - 26,2
26,2 - 37,0
37,0 - 44,6
44,6 - 50,6
50,6 - 60,0
Saint-Louis
Louga
Matam
Thiès
Dakar
Diourbel
Fatick
Kaolack
Kaffrine
Tambacounda
Kolda
Sédhiou
Ziguinchor
Kédougou
0
75
150 km

Discussion

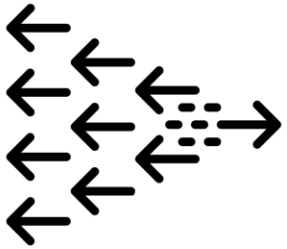
- Dakar emerges as a major processing and transportation hub for Senegal's fishery social-ecological system



- Interconnected nature of net benefit receival dynamics of beneficiary groups closer to the coast



- Regional variations in resource distribution for provinces away from the coast



Discussion

- environmental impact is viewed as an externality
- social and environmental factors at different spatial levels determine trade relations
- multiple actors across the value chain affect the marine social-ecological system
- marine ES flow is not just a straight line from A to B

Thank you for your attention!

Questions?