

Blue economy within a CGE framework: an analysis of the possible role of seafood within sustainable diets

June 5th 2024, Heleen Bartelings, Zuzana Smeets-Kristkova, Marcos Dominguez Viera



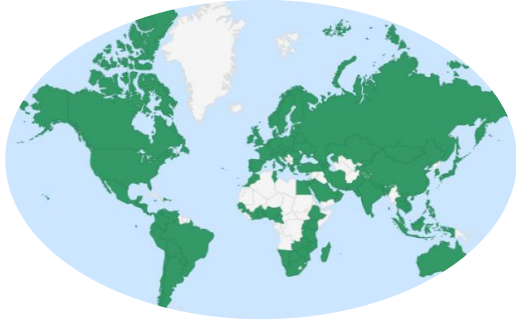
Introduction

- One of the greatest challenges: how to feed a fast growing world population in a sustainable way that does not threaten the carrying capacity of the Earth.
- According to the Eat-Lancet report on healthy diets, seafood would be a particularly promising source of proteins. This would include both wild capture fish as well as aquaculture fish and seaweeds.
- However this would require a significantly increased consumption and therefore production of fisheries and aquaculture products and the question is whether this is possible and what kind of implications this will have.

Introduction

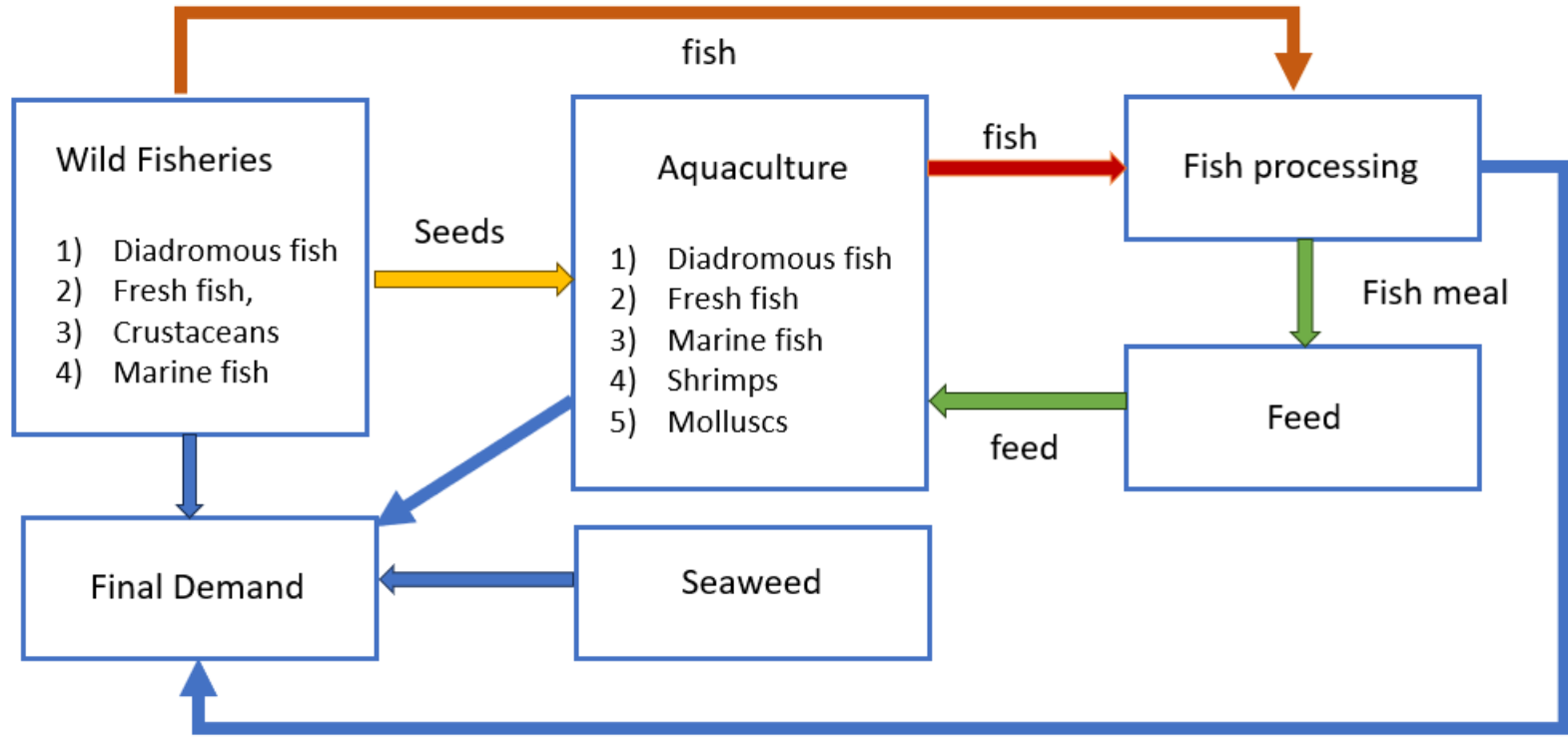
- This study contributes to this question by giving insights in the role seafood can play in a transition to a healthy diet
- Research question: What would be the socio-economic and environmental (and health) trade-offs if the population in developed countries would adopt a pescatarian focused healthy diet in 2050?

MAGNET - modular design philosophy

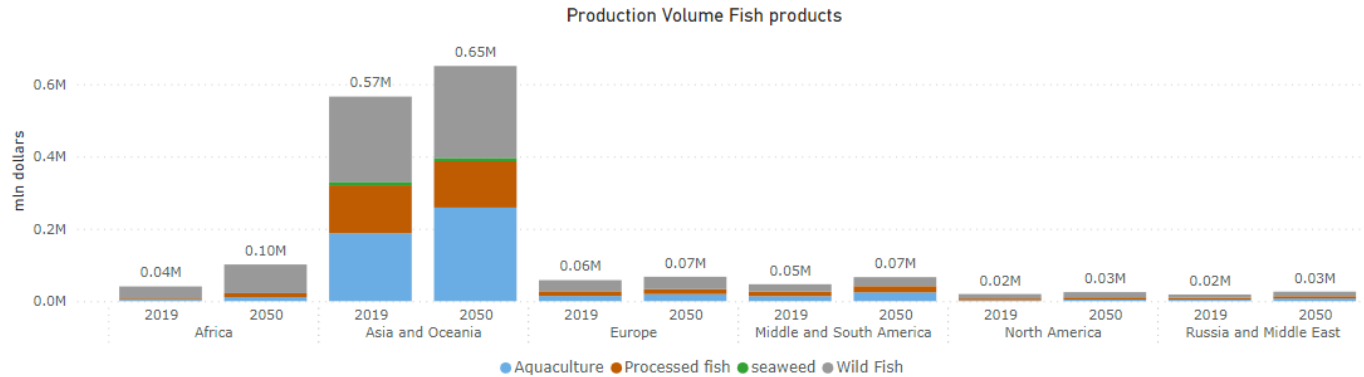


- GTAP model (and data) at the core - shared international starting point for global CGE models
- 160 regions, >120 sectors, 15 production factors (land, 5 labour types, capital, natural resources (forestry/mining), 3 fossil fuel resources, 4 wild fish stocks)
- Extensions
 - added as modules
 - creating parallel universes of different equations
- MAGNET is thus a model platform, not a single model

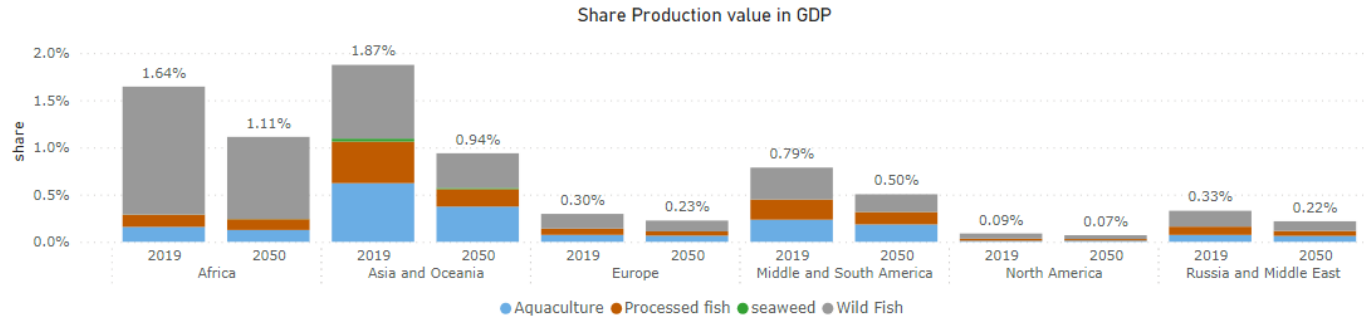
Blue economy module



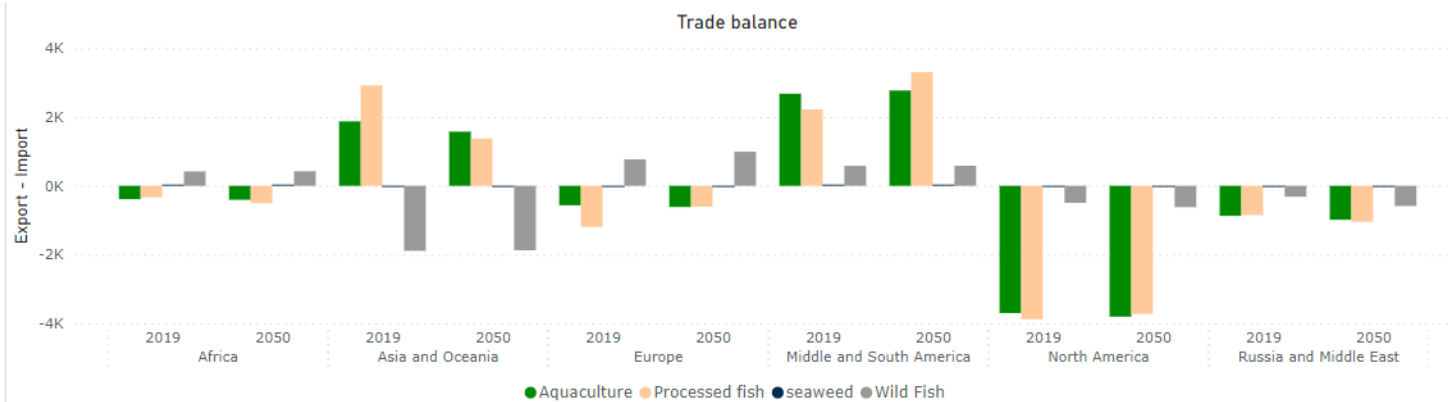
Role seafood in BAU



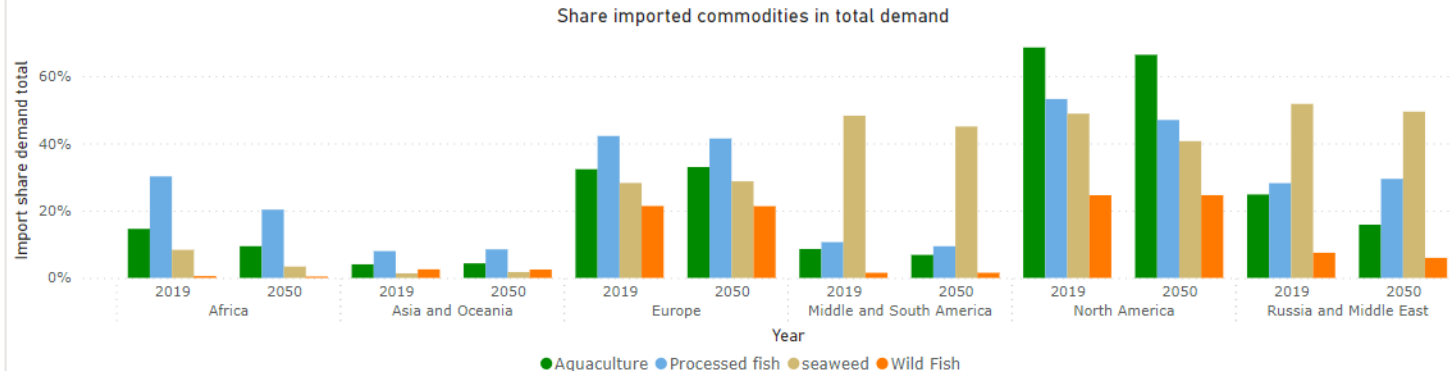
- 90% of world production fish products from Asia
- From which a majority from China
- Most aquaculture & seaweed products produced in Asia



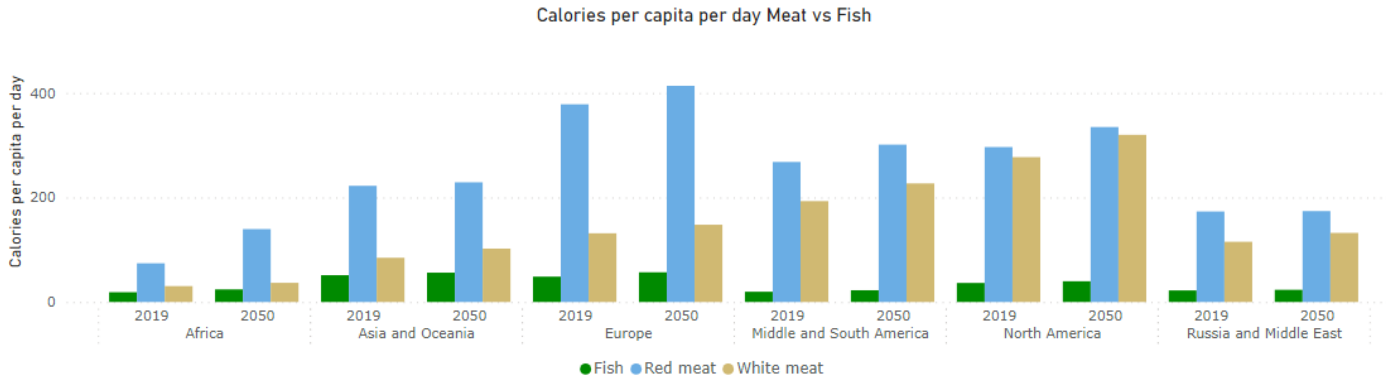
Trade balance



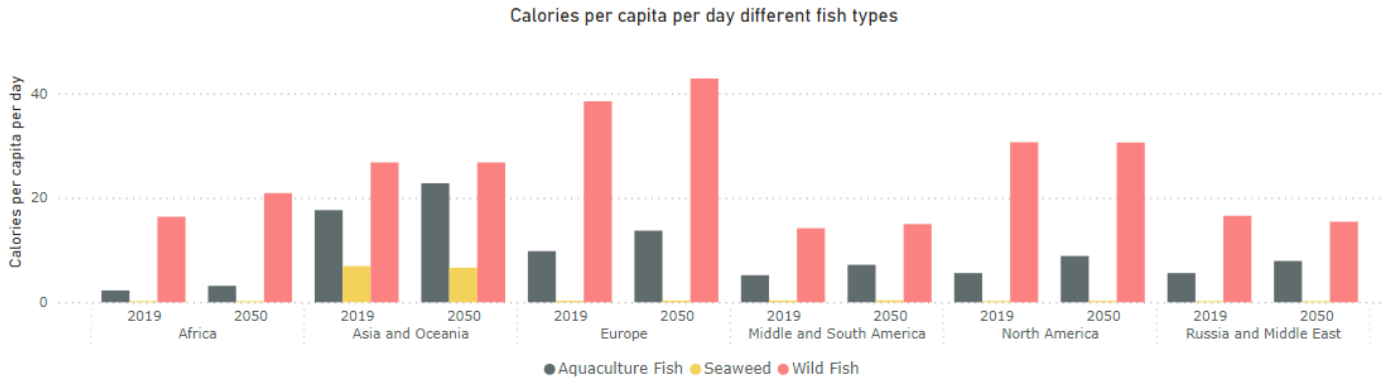
- Asia and Latin America are net exporters for fish products
- North America very dependent on imports of fish products
- High import dependency Europe is partly intra European imports



Consumption



- Diets are expected to become less healthy
- More red meat consumption
- Wild fish still the main source of fish protein apart from Asia

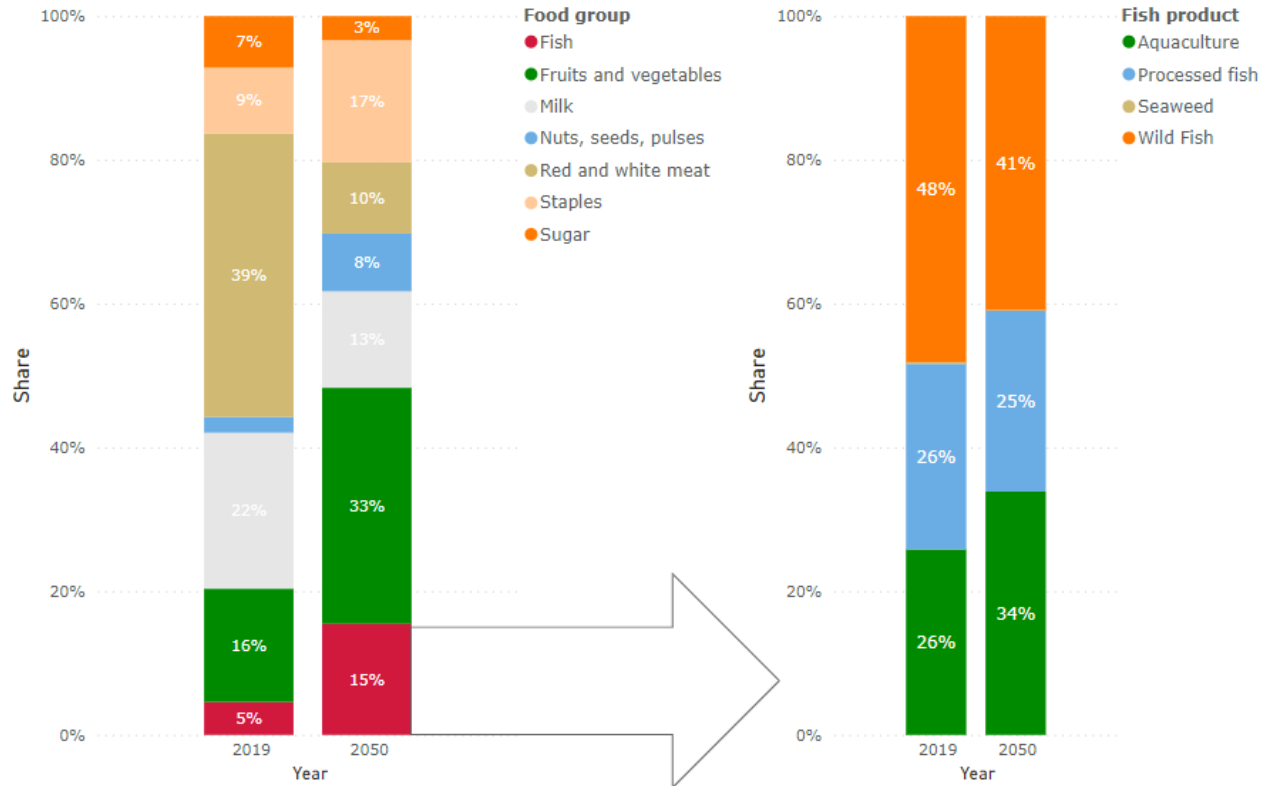


- Aquaculture is expected to grow faster than wild fish
- Seaweed mostly consumed in Asia

Pescatarian Eat Lancet diet

- Diets are exogenously shocked with fixed consumption targets on food group level
- Significant amount of the consumed food is processed and is often made from several primary food commodities
- Leontief inverse is used to derive the composition of primary food in processed food
- This allow us to target diet on food group level

Eat Lancet: shocks



Results: heat map impact Eat Lancet

Overview of the impact of the EAT-Lancet scenarios (vs BAU)

Country/Region	Increase in:					Reduction in:			
	Wages in agriculture	Added-value Food system	Self-sufficiency agri-food	Diet affordability	% Fruits&Veg in food consumption	% Sugar in food consumption	Land use	Fertilizer application	GHG emissions Agri-Food
Western EU	10	-6	1	-6	182	32	-9	-24	18
Rest of Western Europe	-3	-12	0	-9	181	53	0	-28	22
Eastern EU	1	-9	0	-4	143	55	-2	-6	13
Rest of Central Europe	5	15	5	-1	33	96	-1	-13	24
Canada	-2	-18	8	-3	120	100	-1	-2	29
United States	5	-17	1	-4	116	92	0	-18	38
Turkey	6	36	3	-6	7	36	-1	-15	6
Republic of Korea	1	-8	-13	-11	81	100	-2	-28	8
Japan	17	1	-2	-6	237	35	-6	-34	19
Oceania	1	-9	4	-8	103	65	0	-9	16
Africa	2	1	-1	-1	-1	1	-1	-4	0
Russia and Middle East	0	1	0	-1	0	0	0	-5	1
Rest Asia and Oceania	2	2	0	-2	0	0	-1	-5	3
Middle and South America	2	2	0	0	0	0	-1	-4	1
Total	4	-1	0	-3	32	26	-1	-8	6
Economy & inclusivity			Food security & health				Environment		

Results: Impact fish sectors

Impact of the EAT-Lancet scenarios in the FISH sector (vs BAU)

Country/Region	Increase in:					Reduction in:			
	Wages	Added-value	Self-sufficiency ratio	Fish affordability	Consumption aquaculture	Consumption wild fish	Consumption seaweed	Consumption processed fish	GHG emissions
Western EU	-1	101	1	-2	157	133	23	149	-123
Rest of Western Europe	-2	109	-10	-2	268	214	22	257	-133
Eastern EU	0	271	-17	-5	637	383	19	702	-290
Rest of Central Europe	1	142	-43	-4	563	520	17	526	-156
Canada	-1	80	-4	-3	108	83	27	97	-81
United States	-4	114	-7	-2	195	157	49	181	-118
Turkey	-1	1,187	-12	-7	1,451	1,166	9	1,251	-1,442
Republic of Korea	-1	9	1	0	18	17	20	17	-4
Japan	0	10	1	0	19	18	21	18	-1
Oceania	-4	34	-4	-1	76	68	33	75	-31
Africa	-1	7	2	-1	0	0	0	0	-2
Russia and Middle East	-1	8	3	-1	0	-1	1	-1	0
Rest Asia and Oceania	-1	5	2	0	0	0	0	0	0
Middle and South America	-1	17	10	-1	0	-1	0	-1	-8
Total	-3	22	0	-2	25	21	3	28	-38
Economy & inclusivity					Food security & health			Environment	

Results: Food security

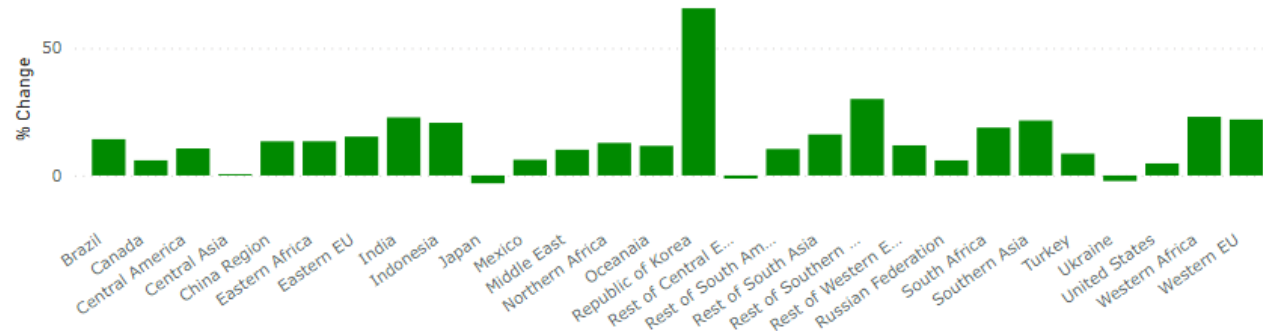
Affordability of diets for poor households: Rural wage /cereal price index (% change)



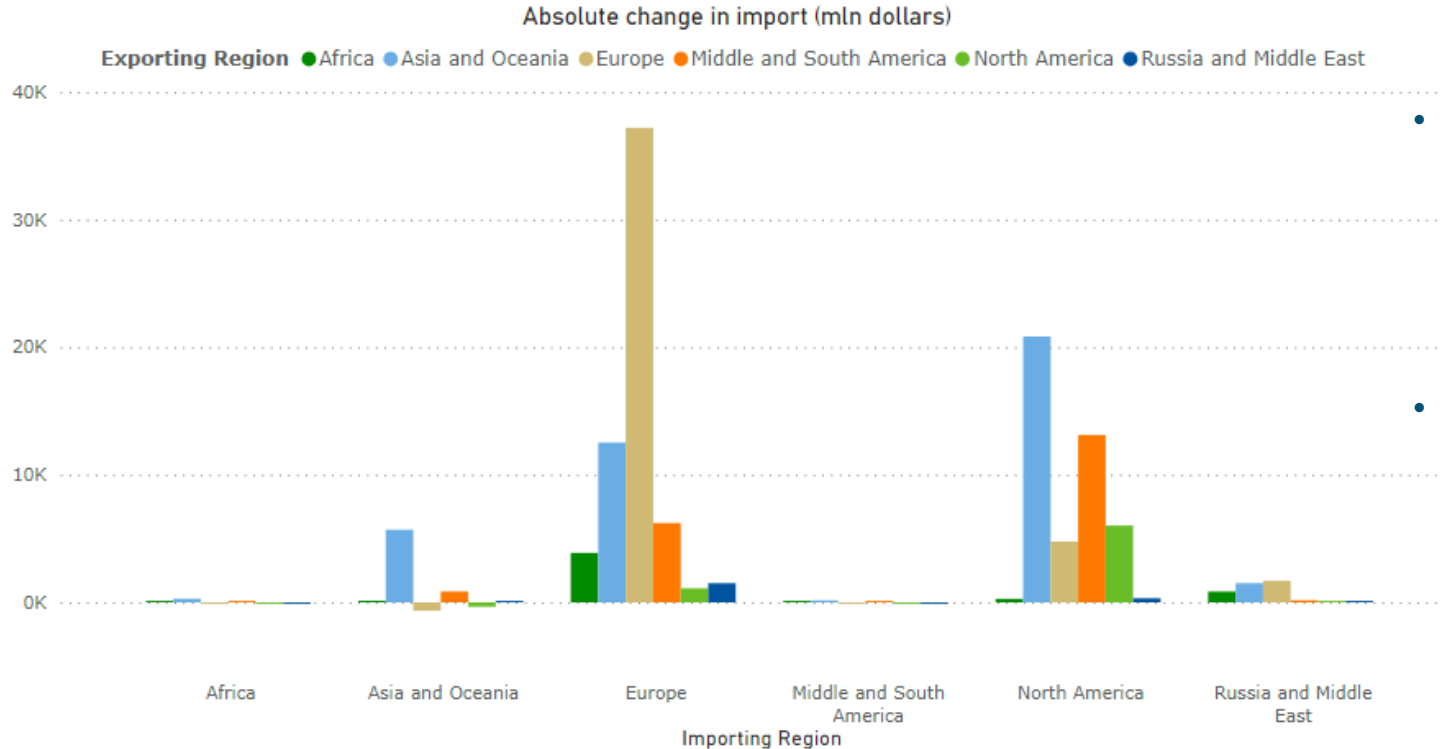
Overall enough calories can be produced

But the diet can reduce food security due to rising food prices

Caloric availability: Calories/capita/day (%change)



Results: impact trade fish products



- Both Europe and North America become more reliant on fish imports
- Europe increases its import from Africa

Discussion (1)

General trade-offs eat lancet:

- Health increases, emissions improve, wages in agriculture increases however added-value of food industry declined because of the reduction in meat intensive sectors.
- To produce enough crops, crop production becomes more fertilizer intensive and more crop land is needed.
- Aquaculture is growing faster than wild fish as wild fish is limited by available fishstocks, however this does mean that fishfeed production needs to expand.
- African export market of fish is intensified but comes at a tradeoff as affordability of food decreases.

Discussion(2)

Next steps:

- Compare pescetarian Eat Lancet diet with a standard crop based Eat Lancet diet
- Is the expected increase of production of wild fish in line with maximum sustainable yield
- Calculate footprint fish feed and compare with livestock feed

Thank You!

More information about
MAGNET can be found at:

<https://www.magnet-model.eu/>



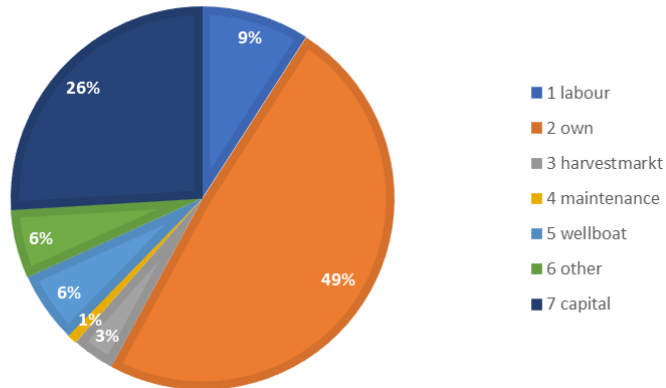
Seaweed data

Available data sources:

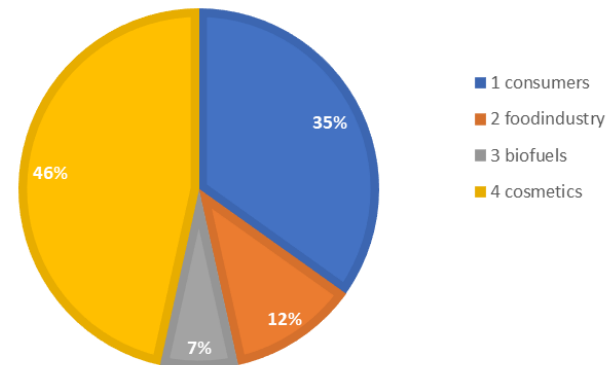
- FAO data about production and total export
- average cost structure seaweed sector (source EnAlgae model for offshore cultivation of seaweed)
- Average demand structure seaweed product (estimate, see table)

markets	%	price (euro per kg DM)
food (direct consumption)	30%	2.5
food industry (including alginate)	25%	1
feed		
biofuel (poor quality, damaged, etc)	30%	0.5
cosmetics	10%	10

COSTSTRUCTURE SEAWEEED

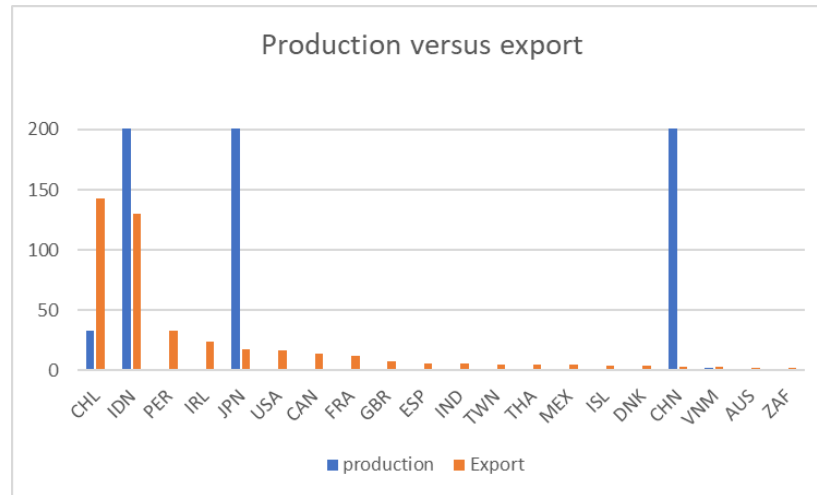


DEMAND SEAWEEED



Seaweed data: assumptions

- Export and production data FAO did not fit, in many cases there was export without enough production -> solution raise production to match exports.



- Only data available about total export and no data about which country was importing -> solution use trade pattern from GTAP data base