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Enhanced Disaggregation of the Fishery Sector for Policy Simulation in CGE Models

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Introduction

- **The production activities in fishery sector : fish stock**

- The difference in production factors between the fisheries sector and the general economy is that, instead of using land, the fisheries sector acquires resources from the sea.
- In the MAGNET model, the inclusion of fisheries stock as production factors reflects the reality of the fisheries sector's production structure.

- **Transition from capture fisheries to aquaculture**

- It is expected that maintaining capture fisheries will become increasingly difficult in Asian countries (FAO, 2024)

Introduction

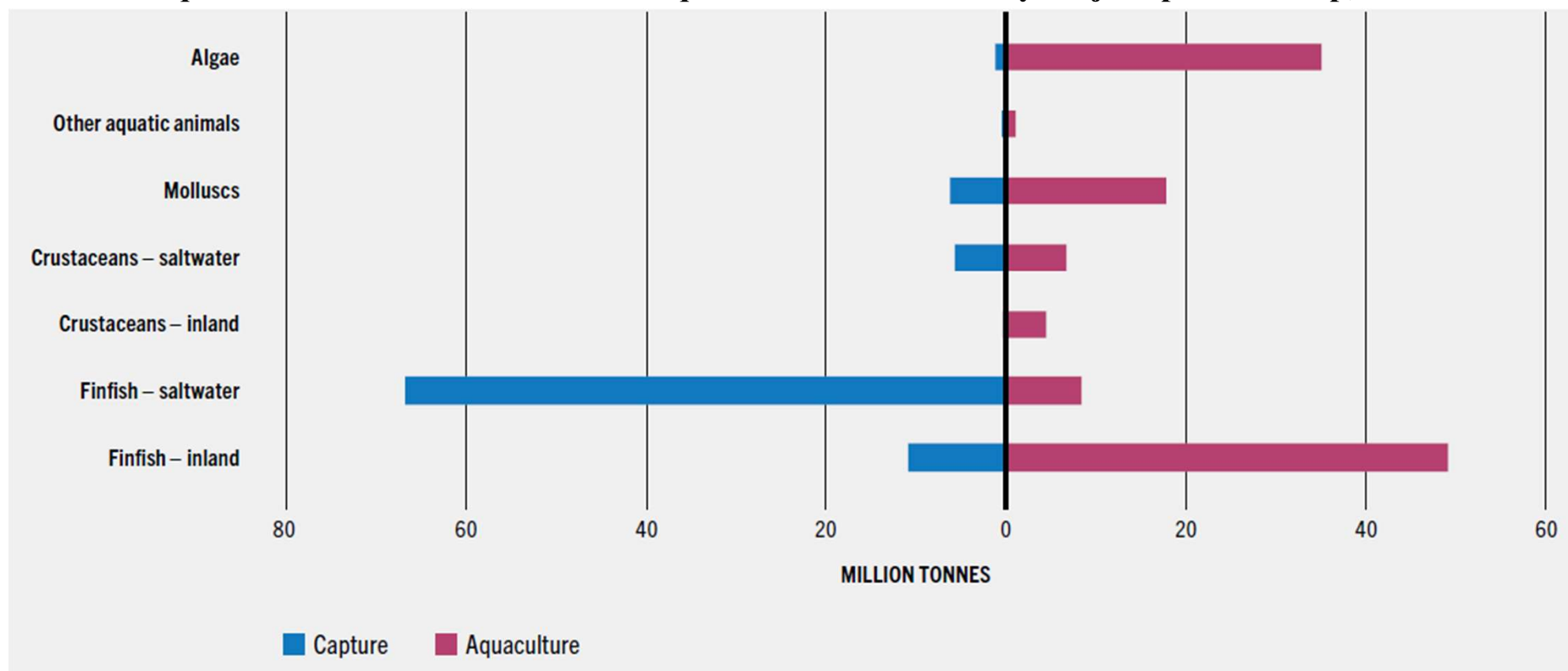
- **Database to establish a model that distinguishes between aquaculture and capture fisheries**
 - Unlike capture fisheries, aquaculture focuses on specific fishery species, necessitating detailed categorization of products (FAO, 2024)

The proportion of the top 3 species in total aquaculture production (2022)

Inland Aquaculture	Marine Aquaculture	Crustaceans	Molluscs	Algae
30.8	50.1	80.6	64.5	73.5

Introduction

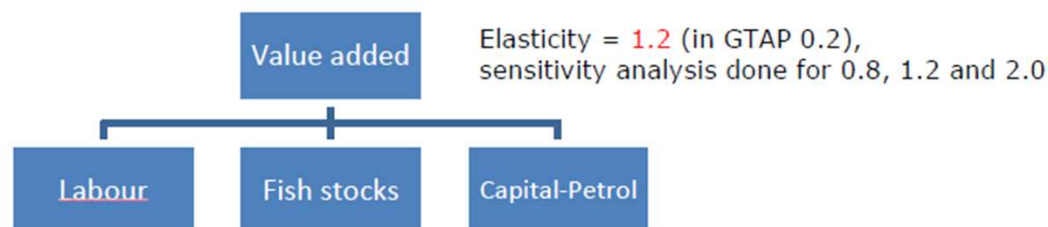
Share of Aquaculture in Total Fisheries and Aquaculture Production by Major Species Group, 2020



Literature review

- **MAGNET model**

- Noteworthy in the MAGNET fisheries model is the separation of production factors into labor, capital, crude oil, and “fish stock”

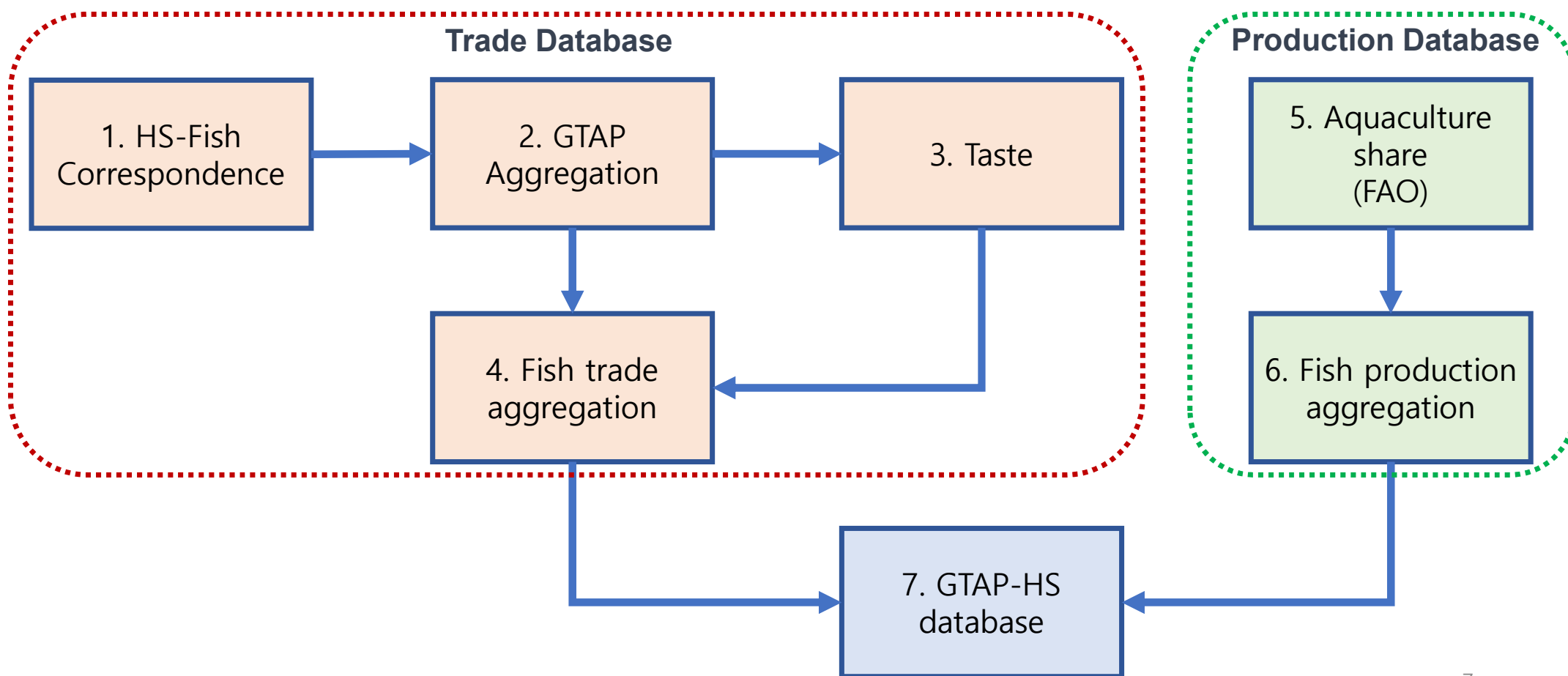


- Brexit on the fisheries sector in the United Kingdom (Bartelings and Kristkova, 2018)
- Bartellings et al. (2020) based on MAGNET by separating aquaculture and fish processing.

Methodology

- **Step 1: Definition of fishery products**
- **Step 2: Disaggregation for fishery trade**
- **Step 3: Disaggregation for fishery domestic production**
- **Step 4: Sets and parameters**

Methodology : Data Development



Methodology : step1

- 42 Fish products economically valid for Korea fish sector

products	import value	products	import value
Other_fish	1,327,459,404	Jellyfish	13,852,693
Shrimps	670,580,179	Sea_cucumbers	12,116,238
Crab	637,564,283	Sardines	11,043,194
Octopus	551,045,079	Abalone	10,809,043
Squid	451,820,943	Tilapia	10,407,060
Salmon	344,284,493	Jackhorse_mackerel	8,683,777
Pollock	325,128,490	Toothfish	6,638,054
Tunas	193,501,121	Herrings	6,497,988
Oceanic_animals	170,640,506	Carp	6,462,955
Other_Mollusca	132,051,485	Catfish	6,268,206
Eels	119,369,192	Other_Crustacean	3,475,445
Flatfish	91,026,180	Anchovies	2,084,369
Cods	85,959,097	Plaice	2,062,711
Clams	80,465,507	Sole	1,653,491
Mackerel	77,604,615	Trout	1,630,603
Rays(skate)	51,873,168	Laver	1,187,908
Spearfish	50,059,494	Seabream	731,085
Scallops	37,655,181	Oyster	569,398
Sharks	31,191,418	Seabass	193,733
Seaweeds	30,384,078	Sea_urchines	13,532
Mussels	15,949,906	Cobia	92

Methodology : step1

	A	B	C	D	E	F	G	H	I
1	x030111	030111	기타 어류	Other_fish	Oth_fsh	Fsq_Oth_fsh		Fsq_Abalone	Fsq
2	x030119	030119	기타 어류	Other_fish	Oth_fsh	Fsq_Oth_fsh		Fsq_Anchovy	Fsq
3	x030191	030191	송어	Trout	Trout	Fsq_Trout		Fsq_Carp	Fsq
4	x030192	030192	뱀장어	Eels	Eels	Fsq_Eels		Fsq_Catfsh	Fsq
5	x030193	030193	잉어	Carp	Carp	Fsq_Carp		Fsq_Clams	Fsq
6	x030194	030194	다랑어류	Tunas	Tunas	Fsq_Tunas		Fsq_Cobia	Fsq
7	x030195	030195	다랑어류	Tunas	Tunas	Fsq_Tunas		Fsq_Cods	Fsq
8	x030199	030199	기타 어류	Other_fish	Oth_fsh	Fsq_Oth_fsh		Fsq_Crab	Fsq
9	x030211	030211	송어	Trout	Trout	Fsq_Trout		Fsq_Eels	Fsq
10	x030213	030213	연어	Salmon	Salmon	Fsq_Salmon		Fsq_Flatfsh	Fsq
11	x030214	030214	연어	Salmon	Salmon	Fsq_Salmon		Fsq_Herrings	Fsq
12	x030219	030219	연어	Salmon	Salmon	Fsq_Salmon		Fsq_Jmk	Fsq
13	x030221	030221	넙치	Flatfish	Flatfsh	Fsq_Flatfsh		Fsq_Mackerel	Fsq
14	x030222	030222	가자미	Plaice	Plaice	Fsq_Plaice		Fsq_Mussels	Fsq
15	x030223	030223	서대	Sole	Sole	Fsq_Sole		Fsq_Ocn_Anrm	Fsq
16	x030224	030224	넙치	Flatfish	Flatfsh	Fsq_Flatfsh		Fsq_Octopus	Fsq
17	x030229	030229	가자미	Plaice	Plaice	Fsq_Plaice		Fsq_Oth_fsh	Fsq
18	x030231	030231	다랑어류	Tunas	Tunas	Fsq_Tunas		Fsq_Oth_Msc	Fsq
19	x030232	030232	다랑어류	Tunas	Tunas	Fsq_Tunas		Fsq_OthCrust	Fsq
20	x030233	030233	다랑어류	Tunas	Tunas	Fsq_Tunas		Fsq_Oyster	Fsq
21	x030234	030234	다랑어류	Tunas	Tunas	Fsq_Tunas		Fsq_Plaice	Fsq
22	x030235	030235	다랑어류	Tunas	Tunas	Fsq_Tunas		Fsq_Pollock	Fsq
23	x030236	030236	다랑어류	Tunas	Tunas	Fsq_Tunas		Fsq_Ry_skt	Fsq
24	x030239	030239	다랑어류	Tunas	Tunas	Fsq_Tunas		Fsq_Salmon	Fsq
25	x030241	030241	청어	Herrings	Herrings	Fsq_Herrings		Fsq_Sardines	Fsq
26	x030242	030242	멸치	Anchovies	Anchovy	Fsq_Anchovy		Fsq_Scallops	Fsq
27	x030243	030243	정어리	Sardines	Sardines	Fsq_Sardines		Fsq_Sea_uch	Fsq
28	x030244	030244	고등어	Mackerel	Mackerel	Fsq_Mackerel		Fsq_Sea_uch	Fsq

- fisheries products linking with HS system
 - 42 fish products commercially traded in Korea
 - Fresh (38) and Processed (41) fish products correspond with HS 6 digit (342)
 - Fresh products further split into 'aquaculture (Fsq)' and 'capture production(Fsh)'

Methodology : step1

- **Step 1: Definition of fishery products**

- In this study, the total number of fishery products established amounts to 118 excluding salts.
- Fishery products comprise of 38 as capture fisheries (live or fresh), 38 as aquaculture (live or fresh), 41 as seafood(processed), and 1 as seaweed, and 1 as animal feed.

- **The aquaculture-fishery production ratios**

- The 76 aquaculture and fisheries products are categorized by production methods. Each production value is proportionally aggregated according to the FAO's ASFIS classification system.

Methodology : step2

- **Step 2: Disaggregation for fishery trade**

- The aquaculture-fishery ratios are applied at the trade disaggregation stage.
- It is assumed that imported fishery products are imported according to the aquaculture-fishery ratio of the respective trading partner.

- **Korean Oyster : 92% produced by aquaculture**

- every country importing Oysters from Korea would allocate 92% of the total import value to the "Aquaculture_oyster" item, while 8% would be allocated to "Fishery_oyster."

Methodology : step2

- GTAP data v.11
 - Sectoral aggregation for 'fish' and 'food'
 - 'Ofd' sector split into fish, agricultural food, and feed
 - 'Crp' sector split into seaweed and other crops

View/edit sector aggregation

Click on white cells to change the aggregation. Edit table on right to change mapping from old to new sectors.
Right-click table on right to reinstate an old sector as a unique new sector.

Type into table below to change names of new sectors. Right-click on table below to add, remove, or re-order new sectors.

Current aggregation:
65 old sectors map to 5 new sectors

Old sector	New sector	Old sector description
1 pdr	1 Agr	Paddy rice
2 wht	1 Agr	Wheat
3 gro	1 Agr	Cereal grains nec
4 v_f	1 Agr	Vegetables, fruit, nuts
5 osd	1 Agr	Oil seeds
6 c_b	1 Agr	Sugar cane, sugar beet
7 pfb	1 Agr	Plant-based fibers
8 ocr	1 Agr	Crops nec
9 cti	1 Agr	Bovine cattle, sheep and goats
10 oap	1 Agr	Animal products nec
11 rmk	1 Agr	Raw milk
12 wol	1 Agr	Wool, silk-worm cocoons
13 frs	1 Agr	Forestry
14 fsh	2 Fsh	Fishing
15 coa	4 Mfg	Coal
16 oil	4 Mfg	Oil

OK Cancel Help 1 to 1 Copy Paste

No.	New sector code	comprising	New sector description
1	Agr	pdr wht gro v_f osd c_b pfb ocr cti oap rmk wol frs cmt omt vol mil pcr sgr b_t	Agricultural products
2	Fsh	fsh	Fisheries live
3	Fod	ofd	Food including fish food
4	Mfg	coa oil gas oxt tex wap lea lum ppp p_c chm bph rpp nmm i_s nfm fmp ele eeq ome	Manufacturing
5	Srv	mvh rtr cmf ely gdt wtr cns trd afs otp wtp atp whs cmn ofi ins rsa obs ros osg edu hht dwe	Service

Methodology : step2

- Trade value for 42 fish products
 - Based on 6-digit taste database, each fish products export and import data aggregated using taste program

File Contents Edit Sets Export Import History Search Aggregation Programs Help																
None	2															
AggTrdData	1 KOR	2 CHN	3 JPN	4 AUS	5 NZL	6 SGP	7 IDN	8 MYS	9 THA	10 VNM	11 PHL	12 LAO	13 KHM	14 BRN	15 ROW	Total
1 x030111	0	1.39	0.49	0.22	0.20	0.74	0.61	2.63	3.46	0.15	0.16	0.10	0.10	0.15	1.69	12.08
2 x030119	0	0.49	0.95	0.24	0.20	0.23	1.15	0.44	1.35	0.21	0.36	0.10	0.10	0.20	2.23	8.26
3 x030191	0	0.20	0.20	0.20	0.20	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.13	1.83
4 x030192	0	25.84	0.13	0.82	1.13	0.13	2.20	0.12	0.13	2.16	4.62	0.12	0.13	0.13	27.15	64.78
5 x030193	0	13.14	0.20	0.20	0.20	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.17	14.80
6 x030194	0	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.15	2.75
7 x030195	0	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.17	2.77
8 x030199	0	271.49	29.53	0.19	1.33	0.15	0.17	0.20	0.17	0.17	0.17	0.15	0.15	0.17	10.30	314.34
9 x030211	0	0.40	0.40	0.40	0.40	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	3.60
10 x030213	0	0.40	0.40	0.40	0.41	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.37	1.98
11 x030214	0	0.40	0.40	0.40	0.53	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	48.97	50.70
12 x030219	0	0.40	0.40	0.40	0.40	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	3.60
13 x030221	0	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.07	5.27
14 x030222	0	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.00	0.00	0.40	0.40	4.80
15 x030223	0	0.40	0.40	0.40	0.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.30	1.90
16 x030224	0	0.40	0.40	0.40	0.40	0.00	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.36	5.16
17 x030229	0	0.40	0.40	0.40	0.40	0.00	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.29	5.09
18 x030231	0	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.00	0.00	0.40	0.27	4.67
19 x030232	0	0.40	0.40	0.40	0.40	0.40	0.46	0.40	0.40	0.40	0.42	0.00	0.00	0.40	0.51	5.00
20 x030233	0	0.40	0.40	0.40	0.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.27	1.87

Methodology : step3

- **Step 3: Disaggregation for domestic production**

- We refined the domestic usage within fishery sectors, as outlined in the basic data, into 118 fishery products,
- Utilizing the FAO Global Fishery and Aquaculture Production Statistics as the criteria for disaggregation

- **Korean domestic production : Value-based data**

- Statistics Korea provides species-specific value data, which has been utilized for this purpose.
- It is important to check whether other countries also provide value data to ensure accurate data compilation.

Methodology : step3

	A	B	C	D
1	ASFIS species (Name)	fish_fgem_eng	fsh	fod
2	Cyprinids nei	Other_fish	Other_fish	Other_fish
3	Freshwater fishes nei	Other_fish	Other_fish	Other_fish
4	Rainbow trout	Trout	Trout	Trout
5	Angelsharks, sand devils nei	Sharks	Sharks	Sharks
6	Atlantic bluefin tuna	Tunas	Tunas	Tunas
7	Atlantic bonito	Other_fish	Other_fish	Other_fish
8	Barracudas nei	Other_fish	Other_fish	Other_fish
9	Bighead carp	Other_fish	Other_fish	Other_fish
10	Bleak	Other_fish	Other_fish	Other_fish
11	Blue and red shrimp	Shrimps	Shrimps	Shrimps
12	Blue whiting(=Poutassou)	Cods	Cods	Cods
13	Bluefish	Other_fish	Other_fish	Other_fish
14	Bogue	seabream	seabream	
15	Caramote prawn	Shrimps	Shrimps	Shrimps
16	Catsharks, nursehounds nei	Sharks	Sharks	Sharks
17	Common carp	Carp	Carp	Carp
18	Common cuttlefish	Squid	Squid	Squid
19	Common dace	Other_fish	Other_fish	Other_fish
20	Common dentex	Seabream	Seabream	
21	Common octopus	Octopus	Octopus	Octopus
22	Common sole	Sole	Sole	Sole

- ASFIS species and fish production correspondence
 - ASFIS fish products (2,588) are classified as 42 fish products, which fall under fsh (live or fresh fisheries) or fod (processed fisheries)
 - Only fsh products are further split using aquaculture ratio

Aquaculture share (FAO)

Country (Name)	ASFIS species (Name)	FAO major fishing...	Detailed production source (Name)	Unit (Name)	2008	2009	2010	2011
Afghanistan	Cyprinids nei	Asia - Inland waters	Aquaculture production (freshwater)	Tonnes - live wei...	900 E	1500 E	2100 E	2800 E
Afghanistan	Freshwater fishes ...	Asia - Inland waters	Capture production	Tonnes - live wei...	1000 E	1000 E	1000 E	1150 E
Afghanistan	Rainbow trout	Asia - Inland waters	Aquaculture production (freshwater)	Tonnes - live wei...	150 E	150 E	150 E	50 E
Albania	Angelsharks, sand...	Mediterranean an...	Capture production	Tonnes - live wei...	23	14	78	12
Albania	Atlantic bluefin tu...	Mediterranean an...	Capture production	Tonnes - live wei...	0	50	0	0 N
Albania	Atlantic bonito	Mediterranean an...	Capture production	Tonnes - live wei...	27	21	23	12
Albania	Barracudas nei	Mediterranean an...	Capture production	Tonnes - live wei...	...	...	7	...
Albania	Bighead carp	Europe - Inland w...	Aquaculture production (freshwater)	Tonnes - live wei...	0	0	0	0
Albania	Bighead carp	Europe - Inland w...	Capture production	Tonnes - live wei...	24	5	...	23
Albania	Bleak	Europe - Inland w...	Capture production	Tonnes - live wei...	190	530	505	360
Albania	Blue and red shri...	Mediterranean an...	Capture production	Tonnes - live wei...	...	...	...	...
Albania	Blue whiting(=Po...	Mediterranean an...	Capture production	Tonnes - live wei...	0	0	0	0
Albania	Bluefish	Mediterranean an...	Capture production	Tonnes - live wei...	0	0	0	0
Albania	Bogue	Mediterranean an...	Capture production	Tonnes - live wei...	132	154	80	88
Albania	Caramote prawn	Mediterranean an...	Capture production	Tonnes - live wei...	23	20	228	9
Albania	Catsharks, nurseh...	Mediterranean an...	Capture production	Tonnes - live wei...	...	...	...	...
Albania	Common carp	Europe - Inland w...	Aquaculture production (freshwater)	Tonnes - live wei...	74	6	0	0
Albania	Common carp	Europe - Inland w...	Capture production	Tonnes - live wei...	371	214	335 E	450
Albania	Common cuttlefish	Mediterranean an...	Capture production	Tonnes - live wei...	62	126	98	90
Albania	Common dace	Europe - Inland w...	Capture production	Tonnes - live wei...	8	4	...	4
Albania	Common dentex	Mediterranean an...	Capture production	Tonnes - live wei...	32	43	25	22
Albania	Common octopus	Mediterranean an...	Capture production	Tonnes - live wei...	82	109	47	113
Albania	Common sole	Mediterranean an...	Capture production	Tonnes - live wei...	63	69	120	68
Albania	Common spiny lo...	Mediterranean an...	Capture production	Tonnes - live wei...	3	1	...	2
Albania	Common squids ...	Mediterranean an...	Capture production	Tonnes - live wei...	107	60	64	52
Albania	Croakers, drums ...	Mediterranean an...	Capture production	Tonnes - live wei...	2	8	1	2
Albania	Crucian carp	Europe - Inland w...	Aquaculture production (freshwater)	Tonnes - live wei...	0	0	0	0
Albania	Crucian carp	Europe - Inland w...	Capture production	Tonnes - live wei...	380	208	225 E	230

- Ratio for aquacultural production by country

- FAO Global fisheries and Aquaculture Production Statistics
- Detailed production source
 - Aquaculture production (freshwater, brackish water, marine)
 - Capture production
- ASFIS species and fish production correspondence

Methodology : step4

- **Step 4: Sets and parameters**

- To ensure that the parameters for all types of fishery products were not uniform, elasticity values were calculated.
- Lim (2021) derived the Armington elasticity values for each fishery product using the Error Correction Model, as follows (Lim, 2021).

Methodology : step4

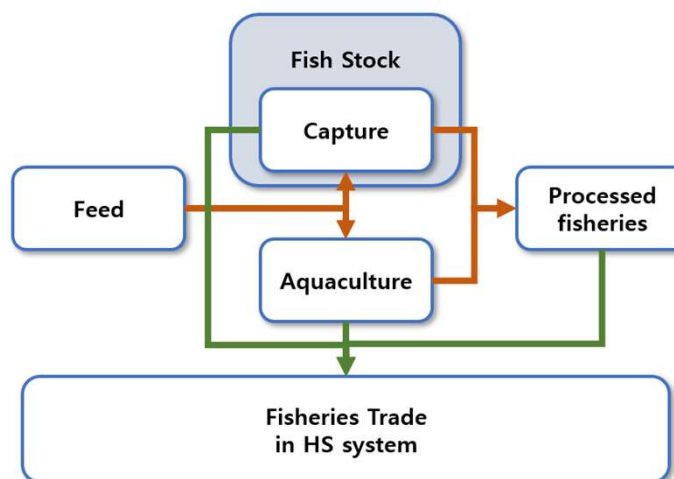
- **Step 4: Sets and parameters**
 - ESUBD parameters calculated by 4 types of regression models

Products	OLS		PAM		ECM		ECM2	
	Price	Armington	Price	Armington	Price	Armington	Price	Armington
1	-2.013***	2.661***	-0.968***	1.255***	-1.227***	1.384***	-1.043***	1.146***
2	-2.655***	3.221***	-2.583***	3.046***	-3.271***	3.067***	-3.680***	3.196***
3	-0.867***	1.341***	-0.332**	1.050***	0.382	0.915***	0.383	0.704***
4	-0.541***	0.522***	-0.519***	0.498***	-1.476***	0.606***	-1.826***	0.852***
5	-0.763**	1.091***	-0.339	0.625*	-0.318	0.606*	-1.097*	1.145**
6	-1.504***	1.262***	-0.778***	0.840***	-1.022***	0.951***	-0.898***	0.846***
7	-0.280***	0.684***	-0.174***	0.407***	-0.200	0.691***	-0.378**	0.697***
8	-0.907***	0.559***	-0.772***	0.560***	-0.931***	0.715***	-0.902***	0.884***
9	-0.246**	2.031***	-0.160	1.138***	-0.809***	1.343***	-0.629*	1.130***
10	-0.841**	2.704***	-1.075***	1.798***	-2.164***	2.067***	-2.023***	1.793***

Conclusion

- **Fishery sector : Feed, Capture, Aquaculture and Foods**

- Fishery resources are split by production method (aquaculture or capture fisheries) and degree of process (feed or foods)
- The relationships between the fisheries and other sectors could become clear



Conclusion: Utilizing Data

- **The international trade landscape is undergoing rapid changes, including**
 - the expansion of protectionist trade measures by various countries (non-tariff barriers such as TBT, SPS, environmental regulations),
 - the U.S.-China trade tensions (decoupling),
 - Russia's invasion of Ukraine (liberalism vs. authoritarianism),
 - inflation (demand and supply shocks), and
 - Trade issues beyond FTA policies.

End of presentation