Global Trade Analysis Project

Quantifying the Economic Impact of the U.S. Seafood Import Monitoring Program (SIMP) on Global Fisheries

A GTAP-HS Disaggregation Approach for Fishery Sector

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Outline

- **Motivation** — why species-level detail matters for SIMP analysis
- **The FGEM concept** — model species groups
- **Sector structure** — 121 HS6 commodities in four blocks
- Data sources and the ASFIS–FGEM concordance
- **TASTE:** matching fishery HS codes to FGEM (trade side)
- **VDMK:** Value-based domestic allocation (VDMK) mechanism
- Results, validation, and conclusions

Motivation: Why Species Detail Matters

- **Standard GTAP represents the entire fishery sector as ONE aggregated commodity.**
- IUU restricts overfishing in the ocean, however aquaculture in developing countries is essential.
- The U.S. SIMP requires catch documentation and chain-of-custody for 13 priority species groups (~1,100 species): shrimp, tuna, cod, crab, abalone, sea cucumber, etc.
- Compliance cost varies by species — documentation, supply-chain complexity, raw vs. processed form.
- **A single “fish” good cannot represent species-specific tariffs, quotas, or non-tariff measures.**

Resolution in fishery required

1
(GTAP sector)
↓
4
(Aqua, Capture, Food, Crops)
↓
121
(commodities)

Disaggregation must preserve GTAP accounting consistency at every step.

The FGEM : 121 commodity classification

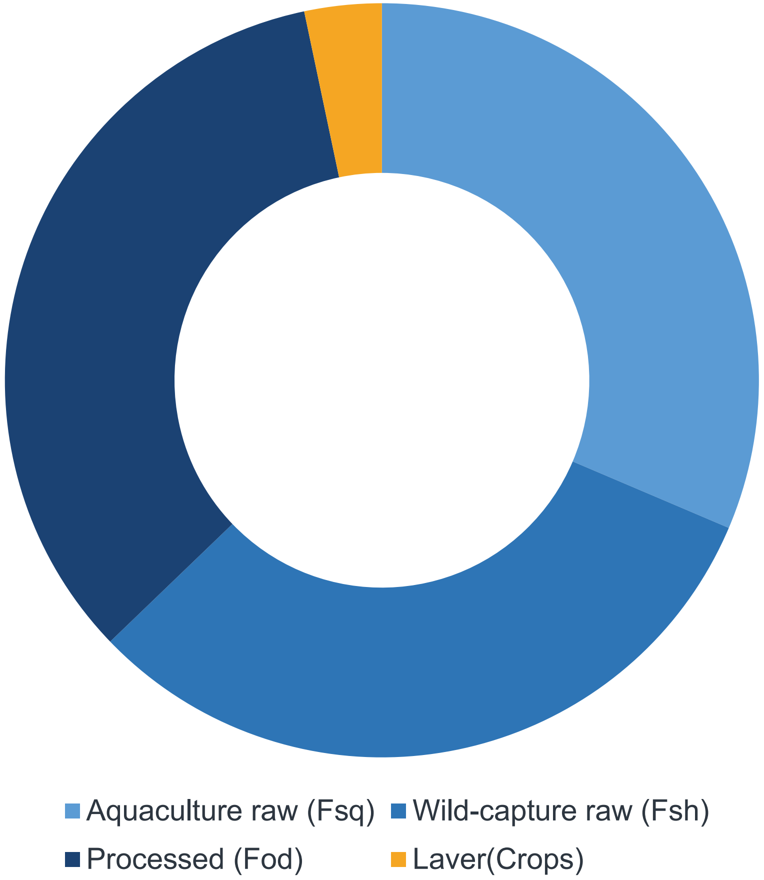
- **FGEM is the species-group classification that defines each disaggregated fishery commodity in the model.**
- It collapses the ~4,000 biological species in FAO's ASFIS list into ~40 economically meaningful groups.
- Grouping criterion: similar product form, market, and trade treatment — not pure taxonomy.
- **FGEM is the common key linking FAO data, KOSIS prices, and TASTE trade flows.**

Example FGEMs to ASFIS

Tunas	25 species
Cods	78 species
Shrimps	163 species
Squid	59 species
Salmon	17 species
Oth_fsh	1,755 species

Disaggregated Sector Structure

121 HS6 commodities across 10 GTAP regions, in four blocks



38 **Aquaculture — Fsq**
farmed output

38 **Wild-capture — Fsh**
caught output

43 **Processed seafood — Fod**
Fsh/fsq + Agri, feed, Jellyfsh, Sea_ccb, Seaweed

2 **Ancillary**
laver, Other crops

Data Sources and Concordances

Five primary inputs feed distinct stages of the build

1	**FAO production quantity**	Aquaculture & capture volumes (tonnes), 3-yr mean
2	**FAO aquaculture value**	Observed farmed value by species × country (USD)
3	**GTAP DOMSALES**	Regional control totals — Fsh / Fod / Crp
4	**ISIC industrial output**	Processed-food split: fish processing vs. feed
5	**Aquaculture-capture price ratio**	Korea unit prices for the coefficient k

Two concordances

ASFIS → FGEM

~4,000 species → ~40 FGEMs

Production → FGEM

National species names → model FGEM

FAO gives VALUE for aquaculture but QUANTITY only for capture — the asymmetry VDMK must solve.

ASFIS → FGEM: Aquaculture vs. Capture

Which species are farmed, caught, or both — fsq and fsh values (World, USD mn)

ASFIS species	FGEM	fsq (aquaculture)	fsh (capture)	Pattern
Common carp	**Carp**	**39,931**	**198**	Aquaculture only
Pacific oyster	**Oyster**	**10,833**	**80**	Aquaculture only
Rainbow trout	**Trout**	**6,206**	**49**	Aquaculture only
Abalone	**Abalone**	**2,976**	**30**	Aquaculture only
Blue crab	**Crab**	**16,379**	**22,357**	Both
Clams	**Clams**	**12,622**	**9,423**	Both
Atlantic cod	**Cods**	**38**	**11,731**	Both
European anchovy	**Anchovy**	—	**17,377**	Capture only
Alaska pollock	**Pollock**	—	**7,065**	Capture only
Common squid	**Squid**	—	**16,398**	Capture only
Patagonian toothfish	**Toothfsh**	—	**114**	Capture only

Reading the split

Aquaculture only
farmed species — carp, oyster, trout, abalone

Capture only
cannot be farmed — anchovy, pollock, squid

Both
farmed and caught — crab, clams, cod

—
means the species has no output in that block

The same 38 FGEMs span both raw blocks, so every species is comparable across production methods.

TASTE: Matching Fishery HS Codes to FGEM

Trade-side disaggregation using the GTAP TASTE utility

- **TASTE splits aggregated GTAP bilateral trade into HS6 detail using MAcMap trade & tariff shares.**
- Each fishery HS6 line is mapped to its FGEM via the concordance, then re-aggregated to the model commodity.
- Import value is split aquaculture vs. capture by the partner country’s production mix (mshr).
- **Result: import & export values are FGEM-consistent and comparable across all regions.**

HS6 → FGEM matching

HS6		FGEM
030214 Salmon, fresh	→	**Salmon**
030471 Cod fillets	→	**Cods**
160520 Shrimp, prepared	→	**Shrimps**
030743 Cuttlefish/squid	→	**Squid**

Aqua

Capture

Food

TASTE shares: $VCIF_k = TASTE\_SHARE_k \times VCIF_i$

VDMK : Production Database Built

Seven stages, each writing an intermediate consumed by the next

1. **Concordance** — ASFIS → FGEM
2. **FAO volumes** — aqua & capture qty
3. **FAO values** — observed aqua value
4. **Coefficient k** — cap/aqua price
5. **Allocate** — fsq fixed, fsh residual
6. **ISIC Rev. 4** — Fod disaggregation
7. **Ancillary** — Laver (Crops)
8. **Assemble** — Fsq + fsh + fod + etc.

Output: vdmk_final — 121 species, summing exactly to GTAP control totals

VDMK: Two-Step Allocation

Fix aquaculture to FAO value → distribute the capture residual

DOMSALES Fsh = control total (e.g. KOR 7,184 USD mn)

STEP 1 · fsq (aquaculture)

`= FAO observed value  (FIXED)`

KOR 38-species block = 2,302 USD mn

Laver & seaweed routed to Crp block

STEP 2 · fsh (capture)

`= DOMSALES − Σ fsq  (residual)`

KOR residual = 4,882 USD mn

Split across species by capture-value share

2,302 + 4,882 = 7,184 ✓ control total preserved for every region

Sequential design fixes aquaculture to the FAO figure while preserving the GTAP total exactly.

2 Internal Consistency

Two guarantees make the database simulation-ready

✓

Control totals preserved

fsq + fsh = DOMSALES Fsh
for every region, exactly

✓

FAO Aquaculture fixed to observed value

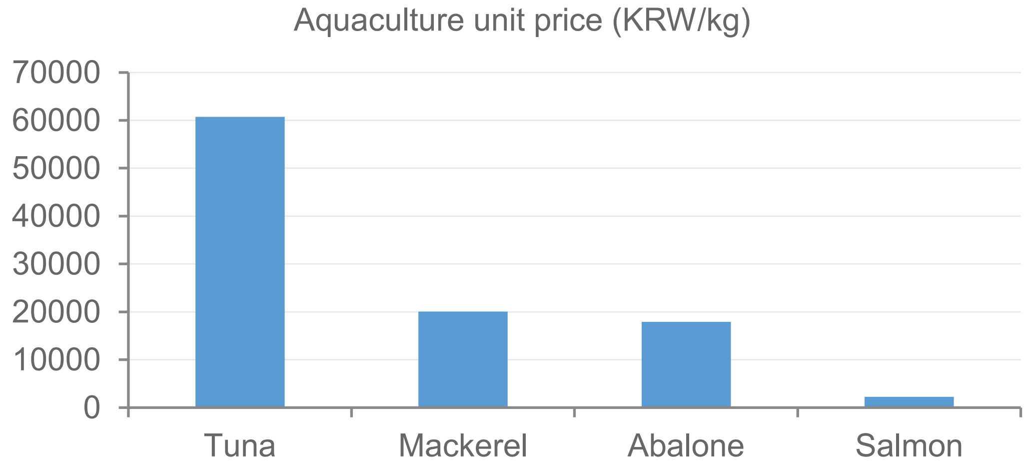
KOR 3,070 total → 2,302 raw + 768
routed to crops & processed blocks

Korean aquaculture share benchmarks well against the national production survey (~27.7%).

Why Split Domestic Output by Value

Farmed and wild output have very different unit prices

- **A quantity split would understate high-value farmed species (abalone, eel, flatfish).**
- GTAP is value-based, so VDMK splits the domestic total by VALUE, not tonnage.
- Aquaculture unit prices vary up to ~27× across species.




```
aqua_val = FAO observed value

cap_val = cap_qty × p_aq × k
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Cells allocated by value share → control total preserved

```
k = capture price / aquaculture price
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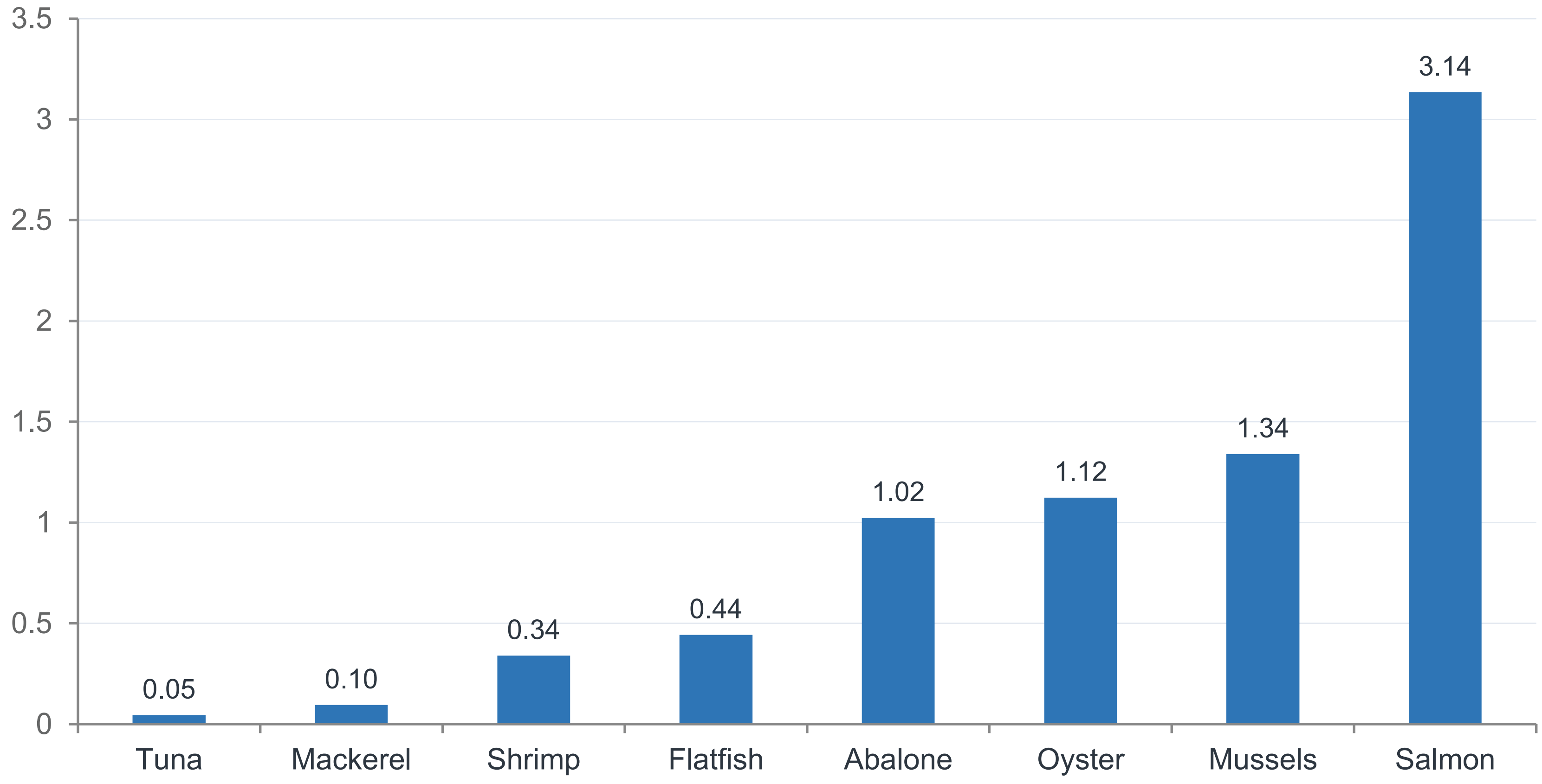
Dimensionless ratio — currency & per-tonne basis cancel.
Applied to the region-specific aquaculture price.
KOSIS national survey used ONLY to derive k.

The Capture-to-Aquaculture Coefficient k

k < 1: farmed dearer (finfish) · k > 1: wild premium (shellfish)



Three cases

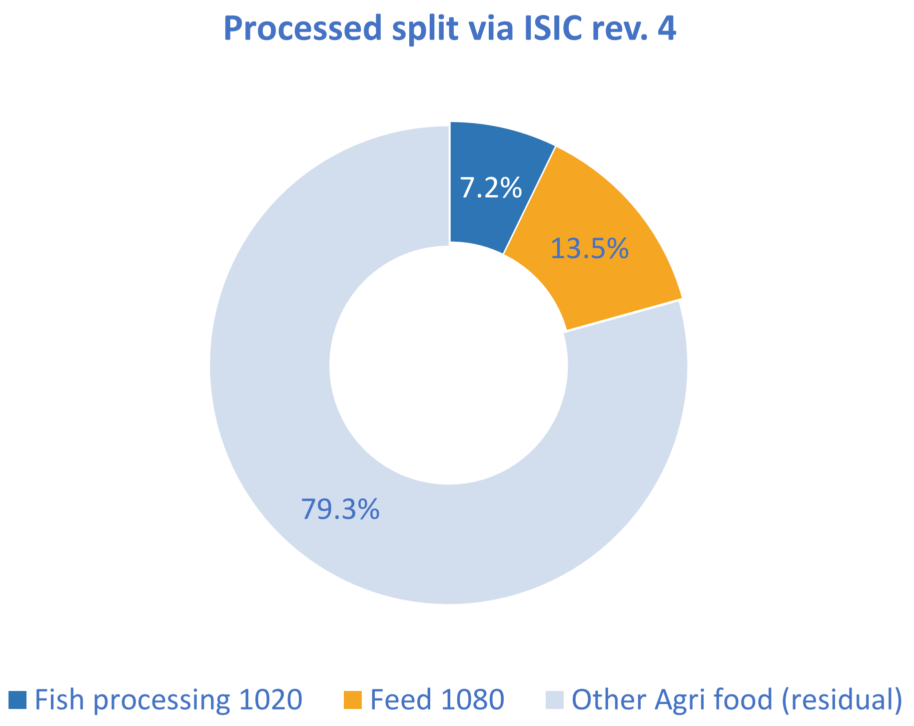
① **Both observed**
KOSIS empirical k (15 spp.)

② **Capture only**
k = 1, no adjustment (17 spp.)

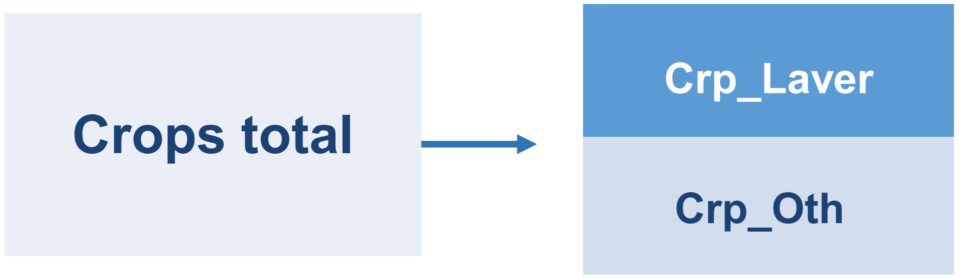
③ **Not in KOSIS**
k = 0.75 (FAO SOFIA 2024, 6 spp.)

Food and Ancillary Block(Laver, Feed)

- Processed-food total split via ISIC Rev.4
  : fish processing (1020), feed (1080), residual.
- Fish processing further split by value(fsh + fsq)



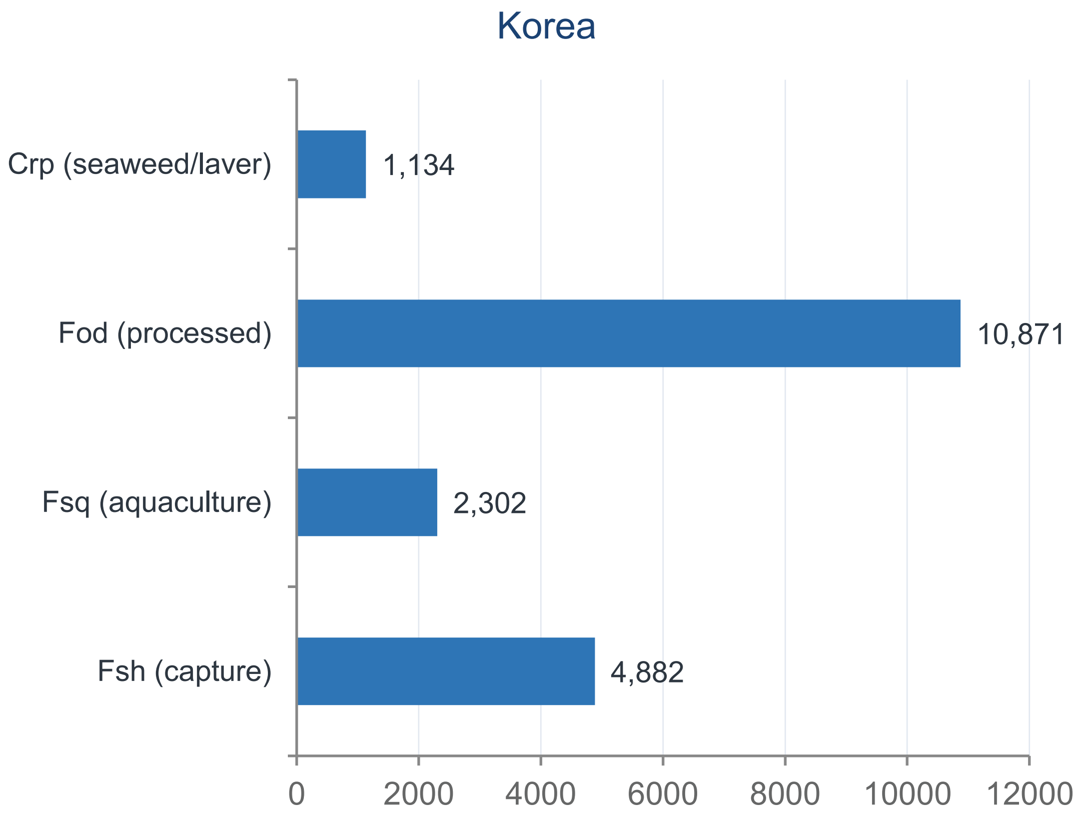
- **Korean laver (gim) split from GTAP "crops", not fishery.**
- Crops total split into Crp_Laver and Crp_Oth using FAO "Nori" aquaculture value.

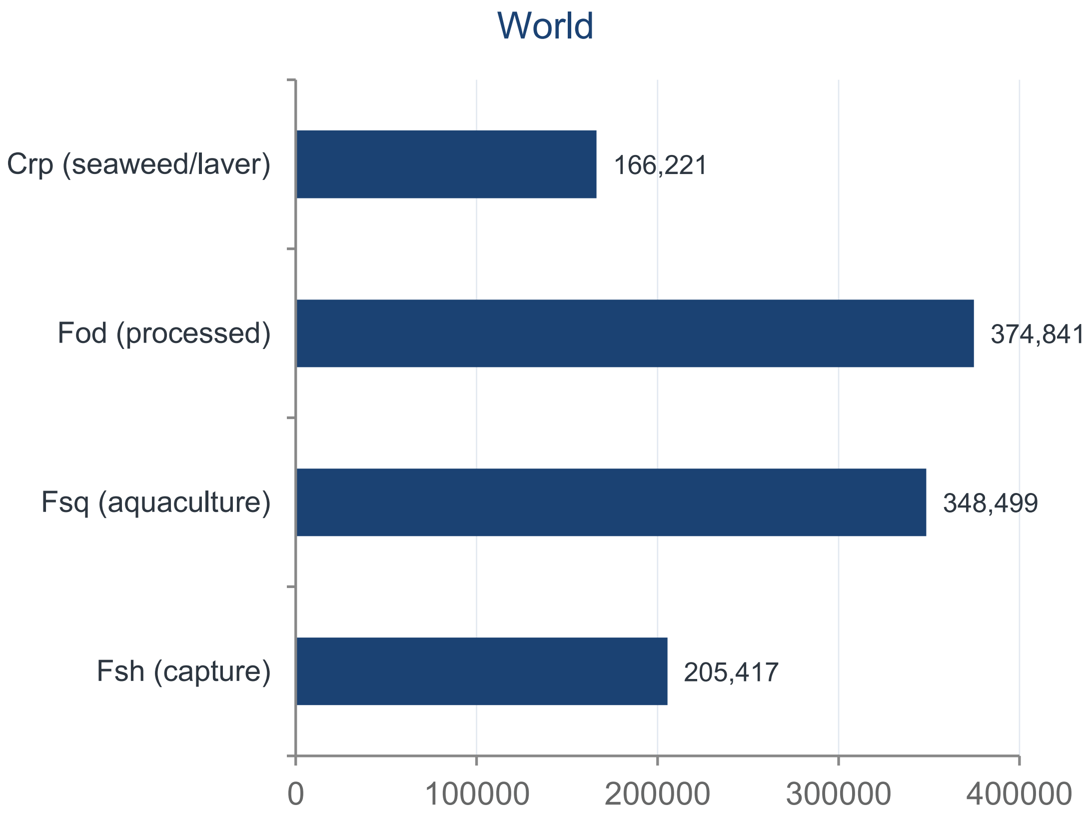


Laver share = FAO Nori value

Result: Fsh, Fsq, Fod, Crp

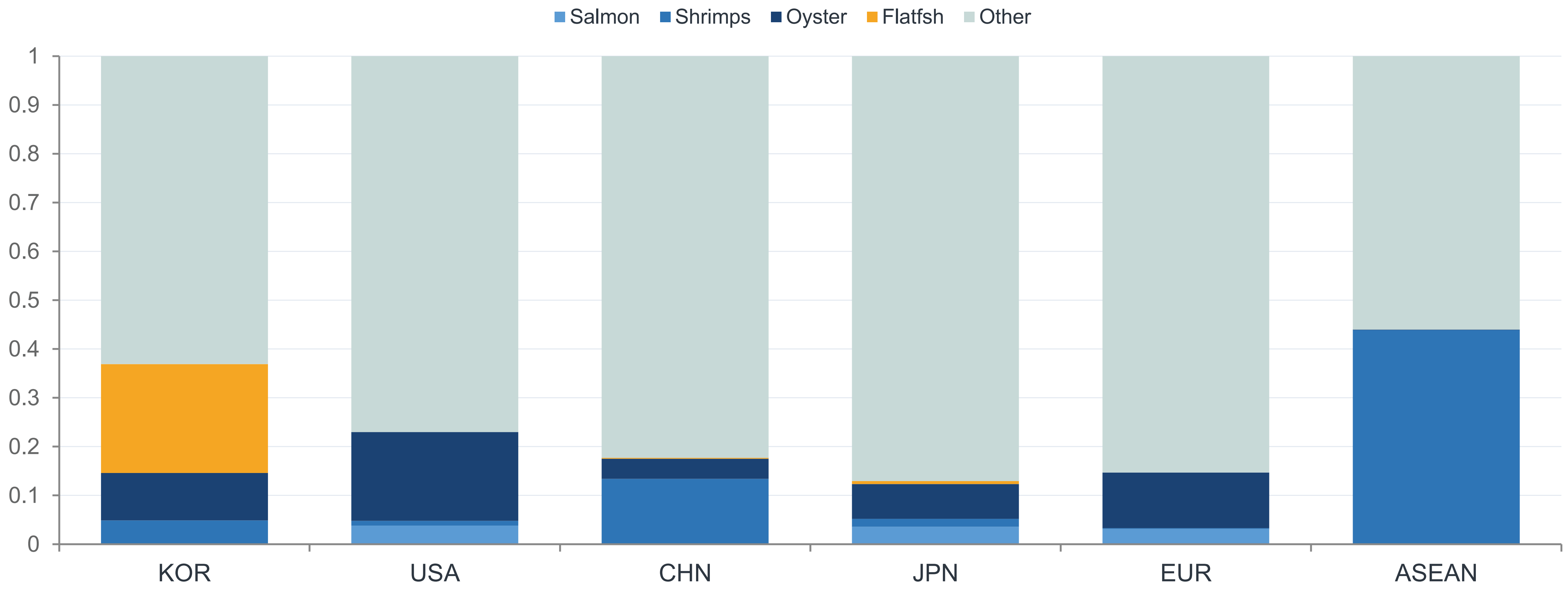
Domestic production by block (USD mn) — Fod excludes the non-seafood Agri residual





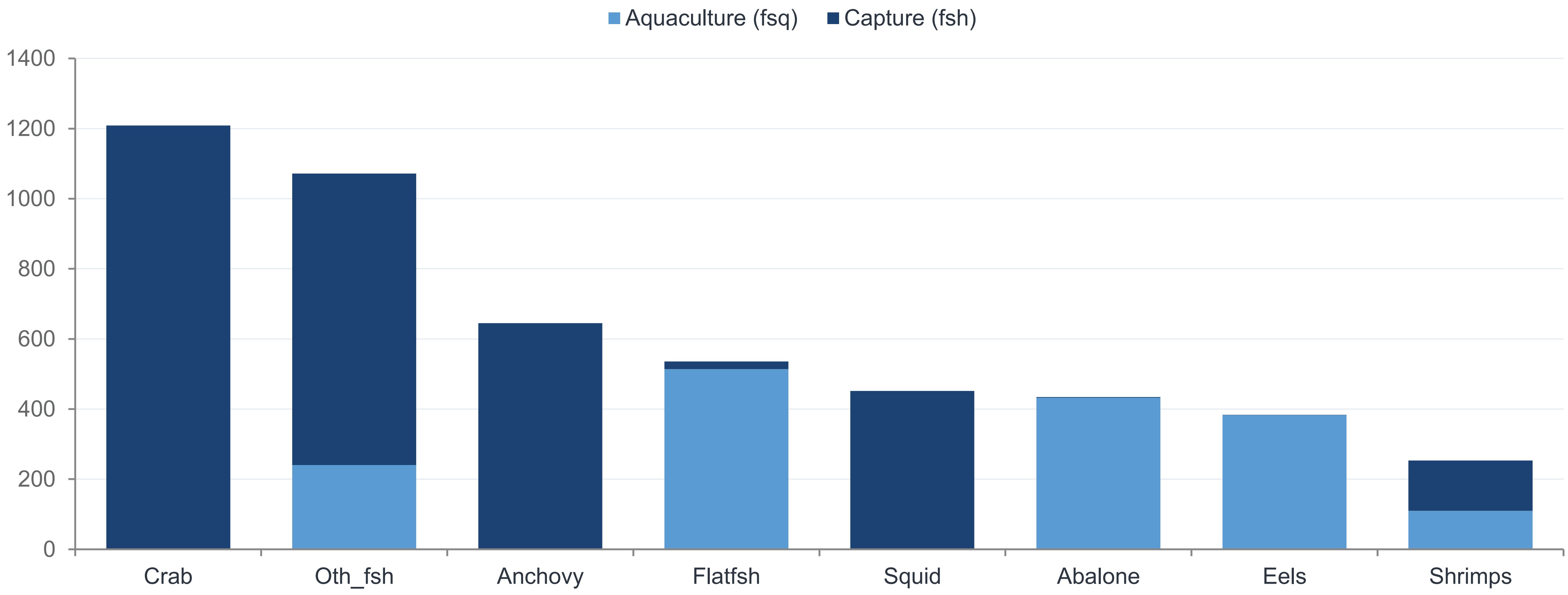
Result: Aquaculture Composition by Region (Fsq)

Within-region share of leading farmed species (%)



Result: Korea by Production Method

Aquaculture vs. capture value, top species (USD mn)



Insights and Conclusions

1. **One aggregated GTAP fishery sector into 121 FGEM-based commodities.**
2. **TASTE handles the trade side; VDMK handles the domestic side** — both are estimated in 38(43) fishery species value
3. VDMK fixes aquaculture to observed FAO value and distributes the capture residual, preserving **GTAP control totals exactly.**
4. **The k coefficient resolves FAO's value/quantity asymmetry**
5. **The result supports commodity-specific policy simulation**

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Questions / Comments?

A Reproducible Species-Level Fishery Database for GTAP-HS

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