Toward the Integrated Research in Fisheries Science

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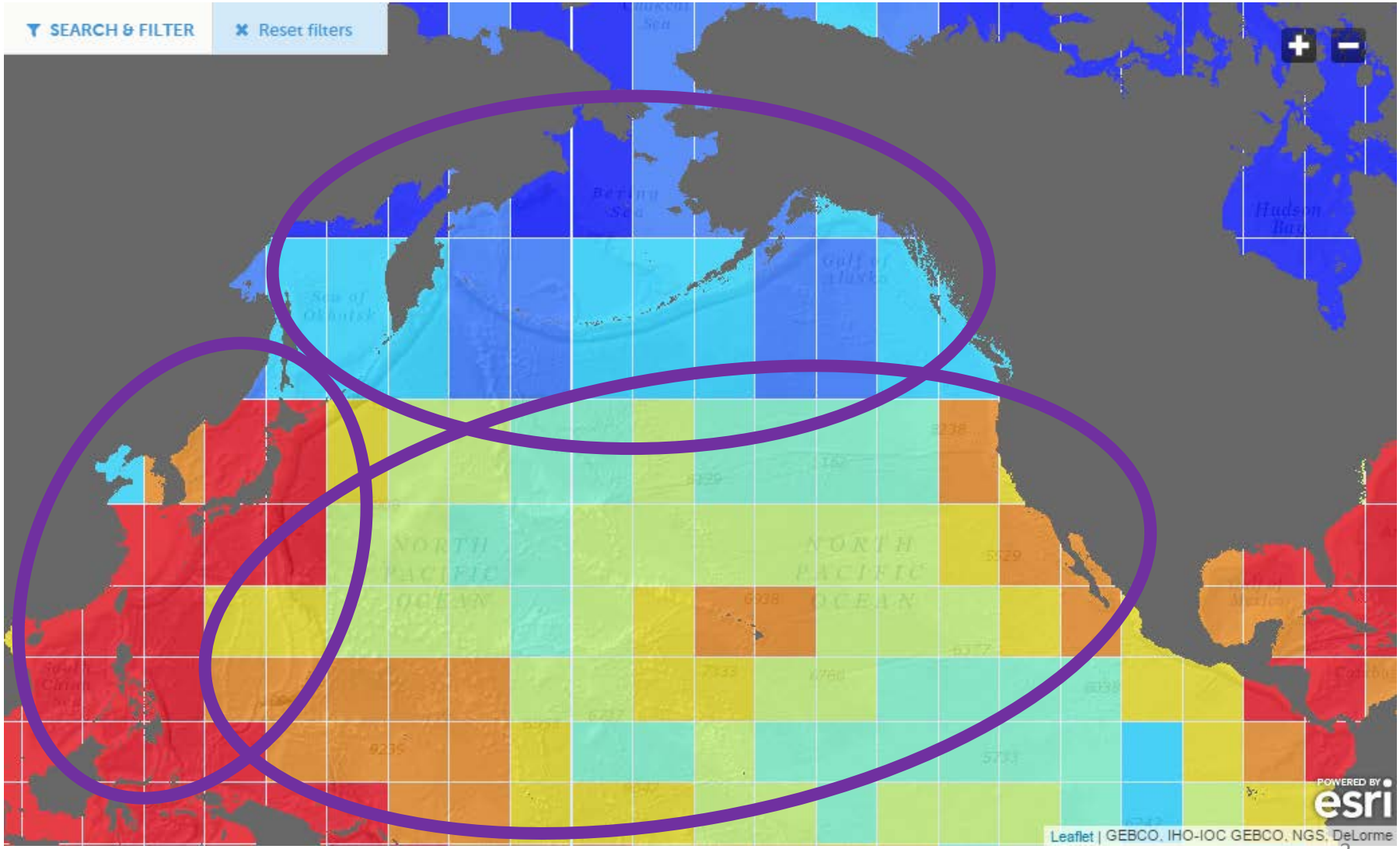
(S-HD, FUTURE SSC, PICES-MAFF Project)

- Each fishery in each country has its specific Social and Ecological conditions surrounding it.

- Without due attentions to these conditions, any fisheries management measures can not deliver effective results.

Global Pattern of Marine Biodiversity

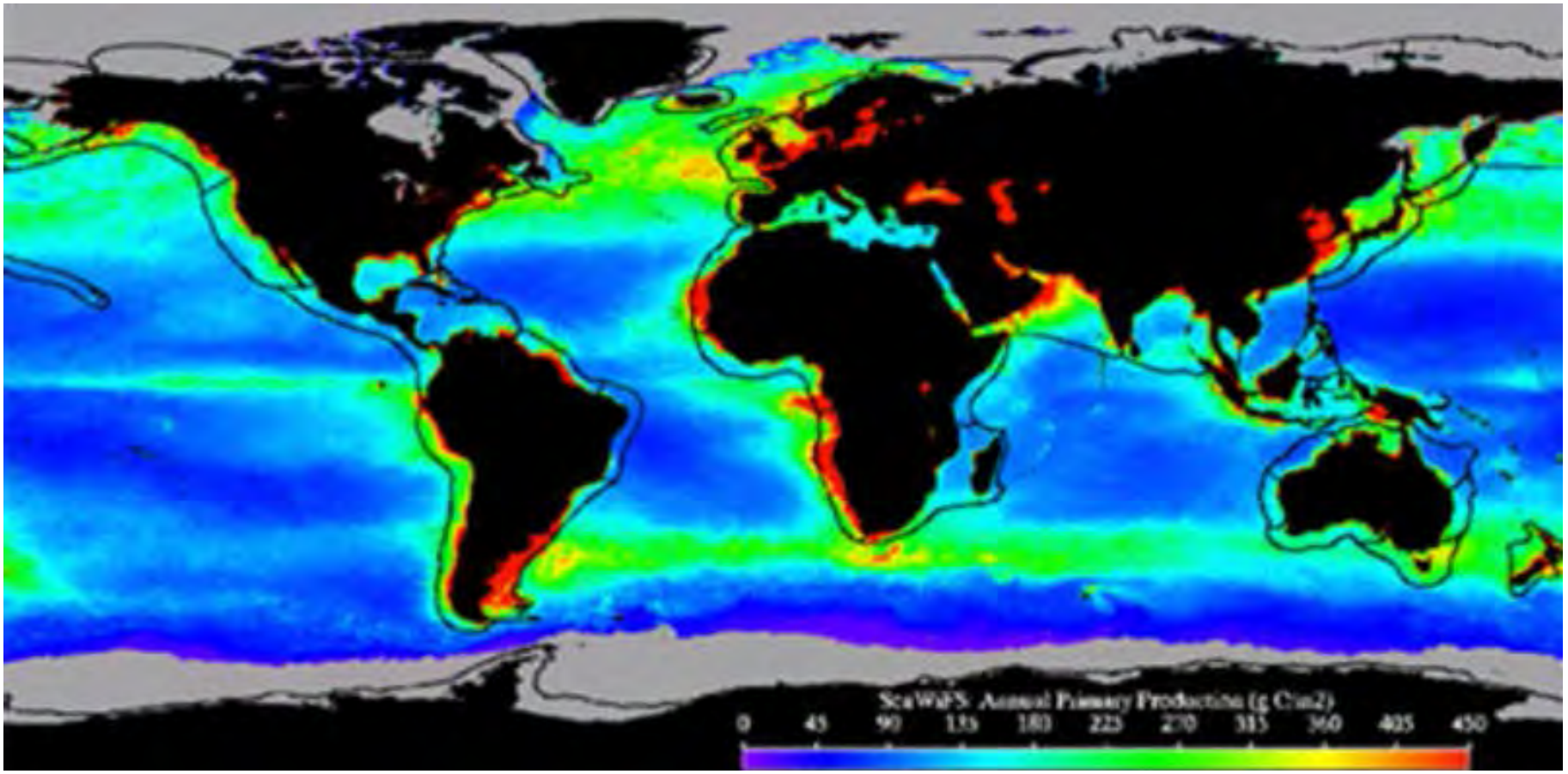
(UNEP 2010)



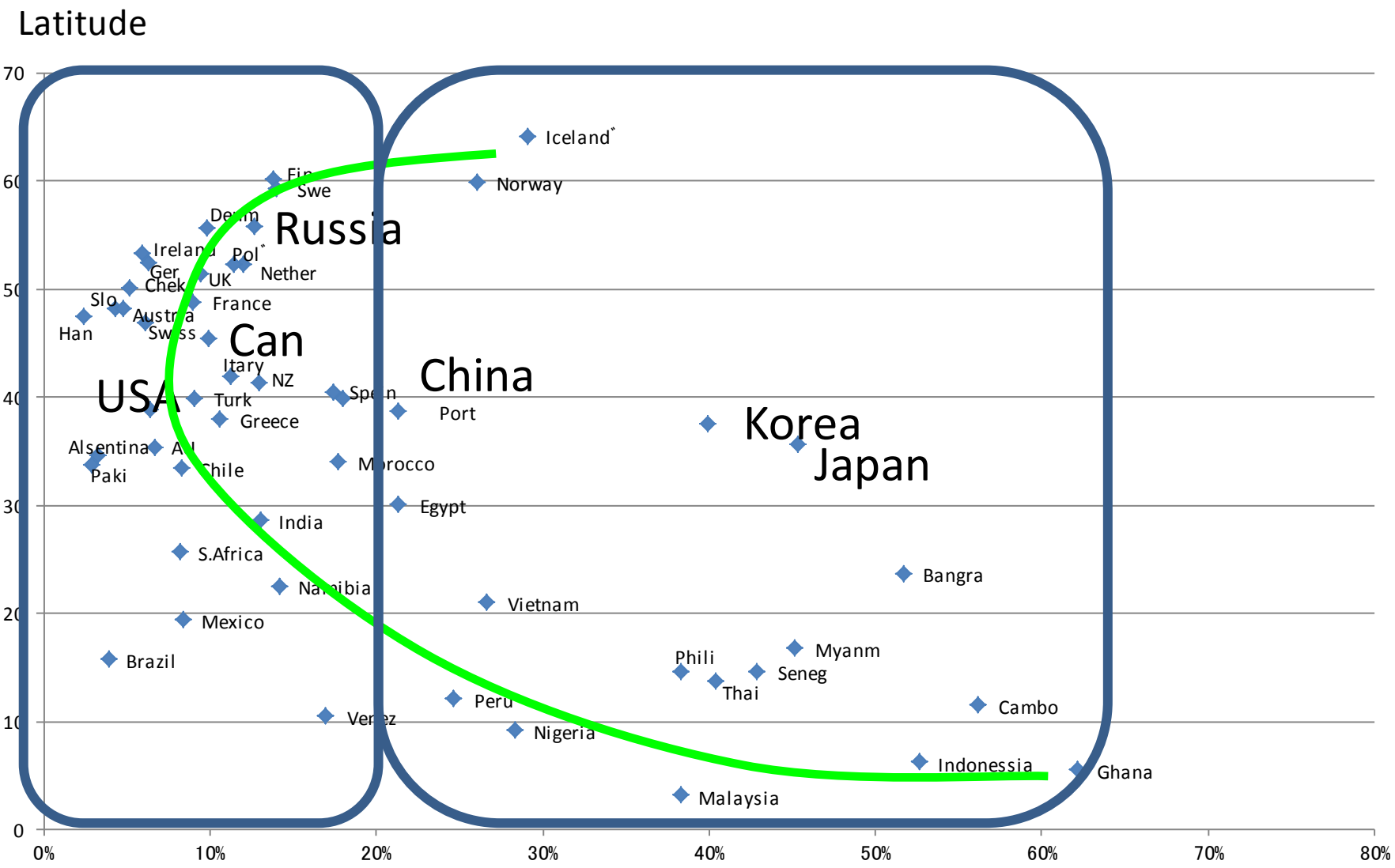
http://data.unep-wcmc.org/

Large Marine Ecosystems of coastal ocean

(http://lme.edc.uri.edu/)



Percentage of Seafood as the source of Animal Protein



Data Source: FAO Food Balance Sheet

Industrial Structure of Fisheries (FAO 1999)

Country	# of Fishers	# of Vessels	SSF ratio
Iceland	6,300	826	0.63
Norway	22,916	8,664	0.89
Denmark	4,792	4,285	0.86
UK	19,044	9,562	0.82
France	26,113	6,586	0.78
Canada	84,775	18,280	0.74
NZ	2,227	1,375	0.74
Spain	75,434	15,243	0.76
USA	C.A. 290,000	27,200	0.53
Korea	180,649	50,398	0.9
Japapn	278,200	219,466	0.98
AU	13,500	C.A. 5,000	N.A.

SSF < ISCFV 25 (the International Statistic Classification of fishery Vessels)

Social-Ecological Conditions of the fisheries sector in the Western side of the Pacific (incl. ASEAN)

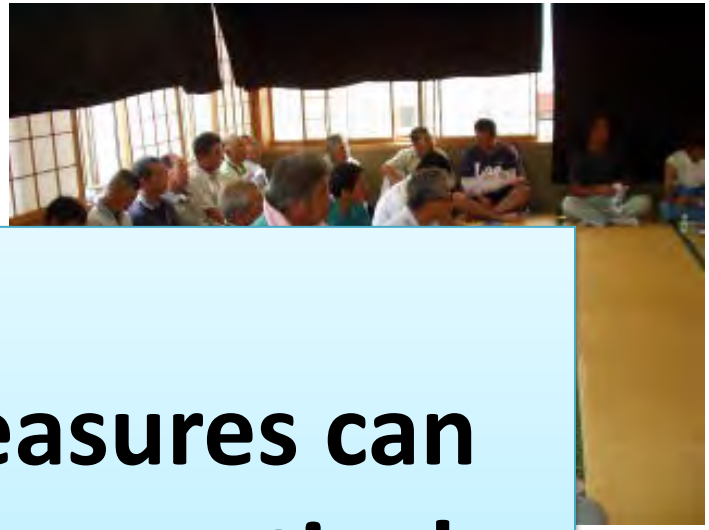
- A lot of SSF are catching high diversity of species with various gears for human consumption.

- To-down, command-and-control types of management is difficult to implement due to the high uncertainties and monitoring costs.

Co-Management is the realistic solution (sharing the management authorities and responsibilities between local fishers and government).

Image of the Fisheries Co-Management

http://ww



Various types of management measures can be introduced cooperatively by local fishers and government. It is cheap!

http://www.pref.mie.jp

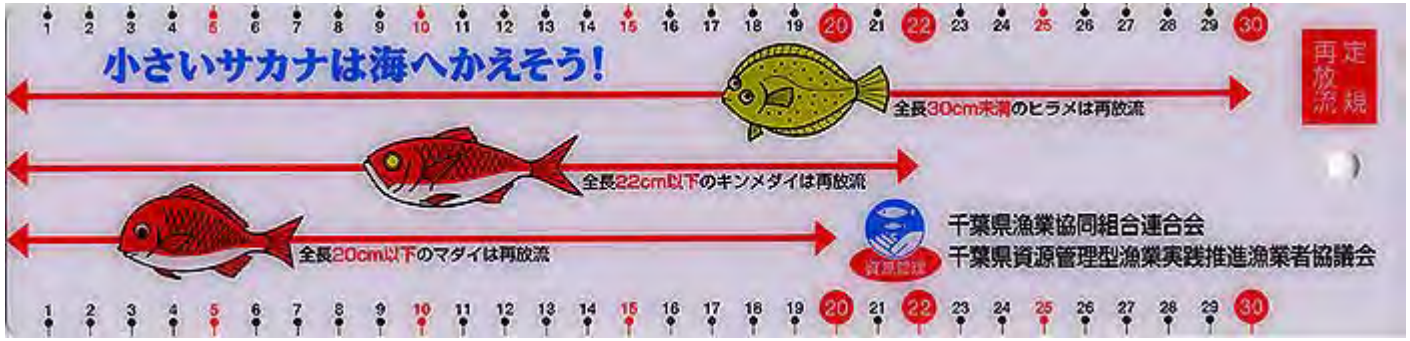
http://www.pref.iwate.jp

Examples of local fishers' activities in Japan

There are many "fish gathering forest" activities all over Japan.

(http://www.jf-net.ne.jp/amhiranaigyokyo/)

(http://www.jf-net.ne.jp/hkyubetsu/sigen.htm)



Fish scale with the minimum size limit produced by local Fishers (http://www.jf-net.ne.jp/cbgyoren/sigen.html)

Autonomous resource assessment and Individual Catch Quota (IQs) for sea cucumber fishers (Mutsu-bay, Photo by MAKINO).

Examples of local fishers' activities

Local fishers and researchers cooperatively conduct resource assessment, and set autonomous TAC every year (Sandeel fishery in the Ise Bay)

Photo by Dr. Tomiyama

How the Fisheries Science can contribute to Co-Management?

- To provide the scientific base to local stakeholders to facilitate their management activities for sustainable fisheries.
- It should be realistic and feasible and easy.
- Local stakeholders means not only the fishers, but also the processors, distributers, sellers, consumers, future generations, etc.

They have their specific interests and OBJECTIVES!

Five objectives of Fisheries in Japan

(Fisheries Research Agency of Japan 2009)

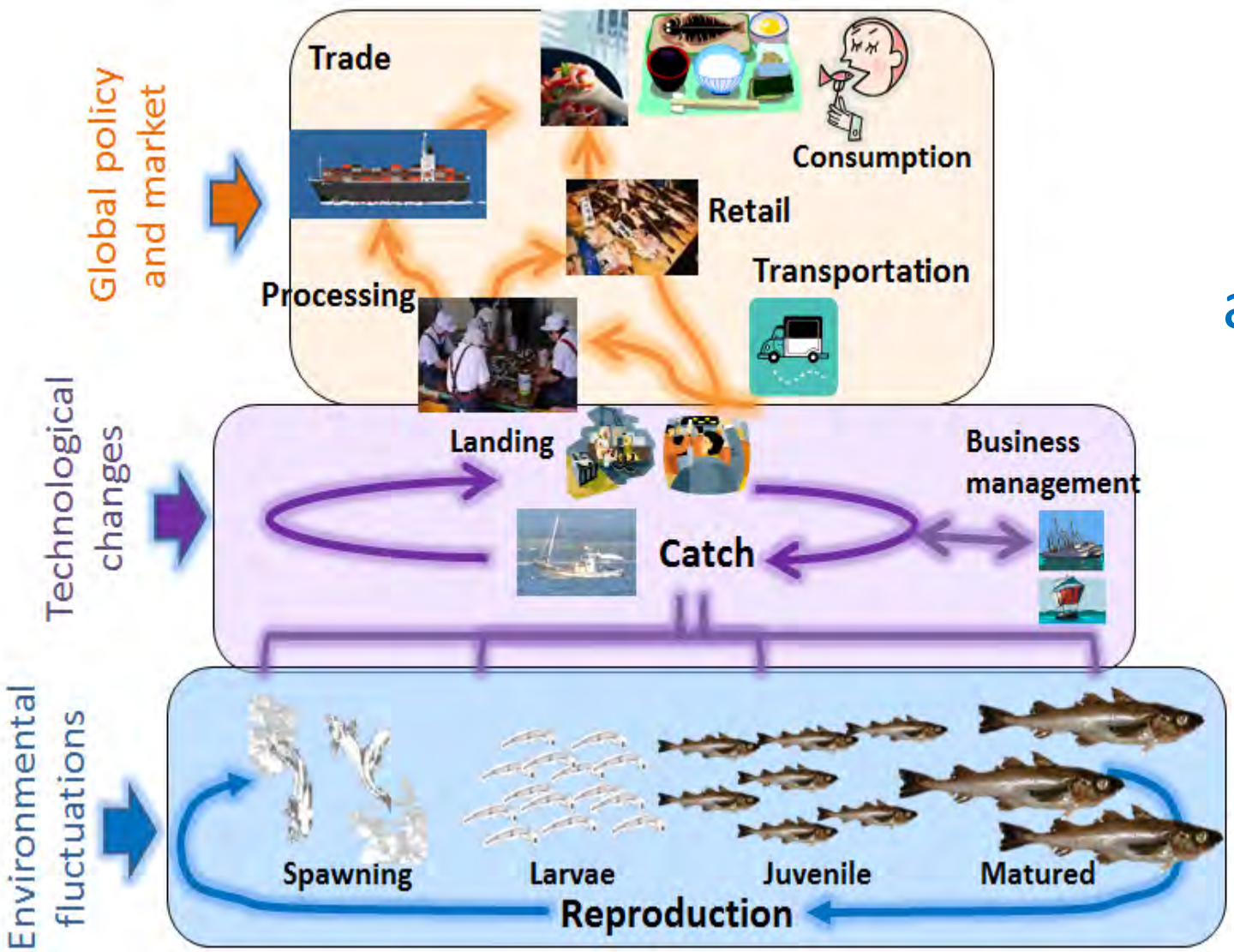
- All of them are important for various stakeholders.
- Fisheries science should deal with all of them scientifically.

How can we analyze such variety of objectives in fisheries?

- Traditional academic disciplines are indispensably important. They are sharp and deep.
- In addition, the logical integration of them is needed in order to analyze various objectives simultaneously.

- We are now trying to do this by integrating various academic disciplines according to the real movement of fish in the social-ecological systems.

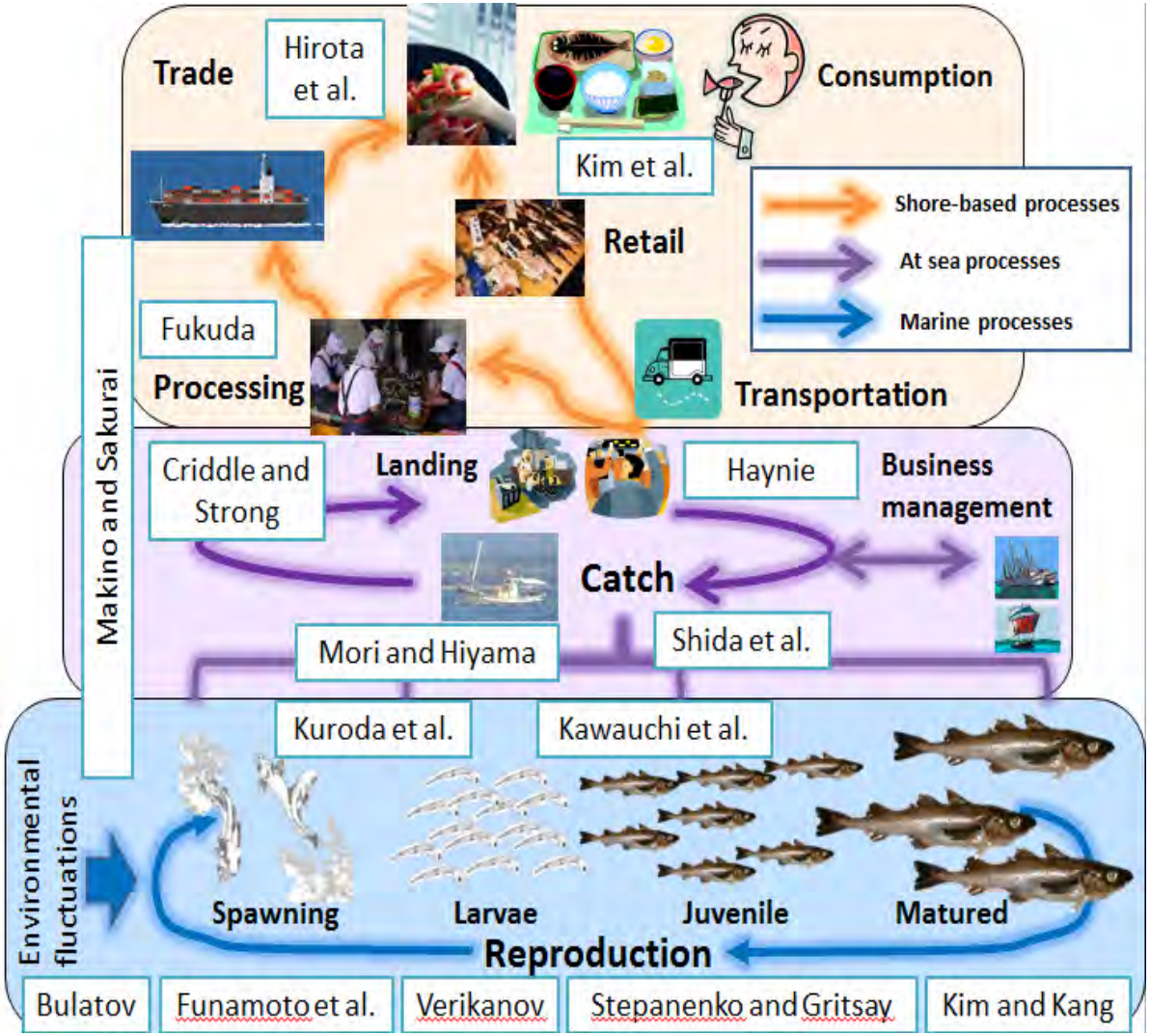
The "Fisheries System" concept
(c.f. material circulation)



Linking various disciplines according to the real movement of fish in the Fisheries System

Example 1: Walleye pollock

Makino M, Kim S, Velikanov A, Criddle K, Funamoto T, Hirota M, Sakurai Y (2014) ***Fisheries Science***, 80: 103-236.

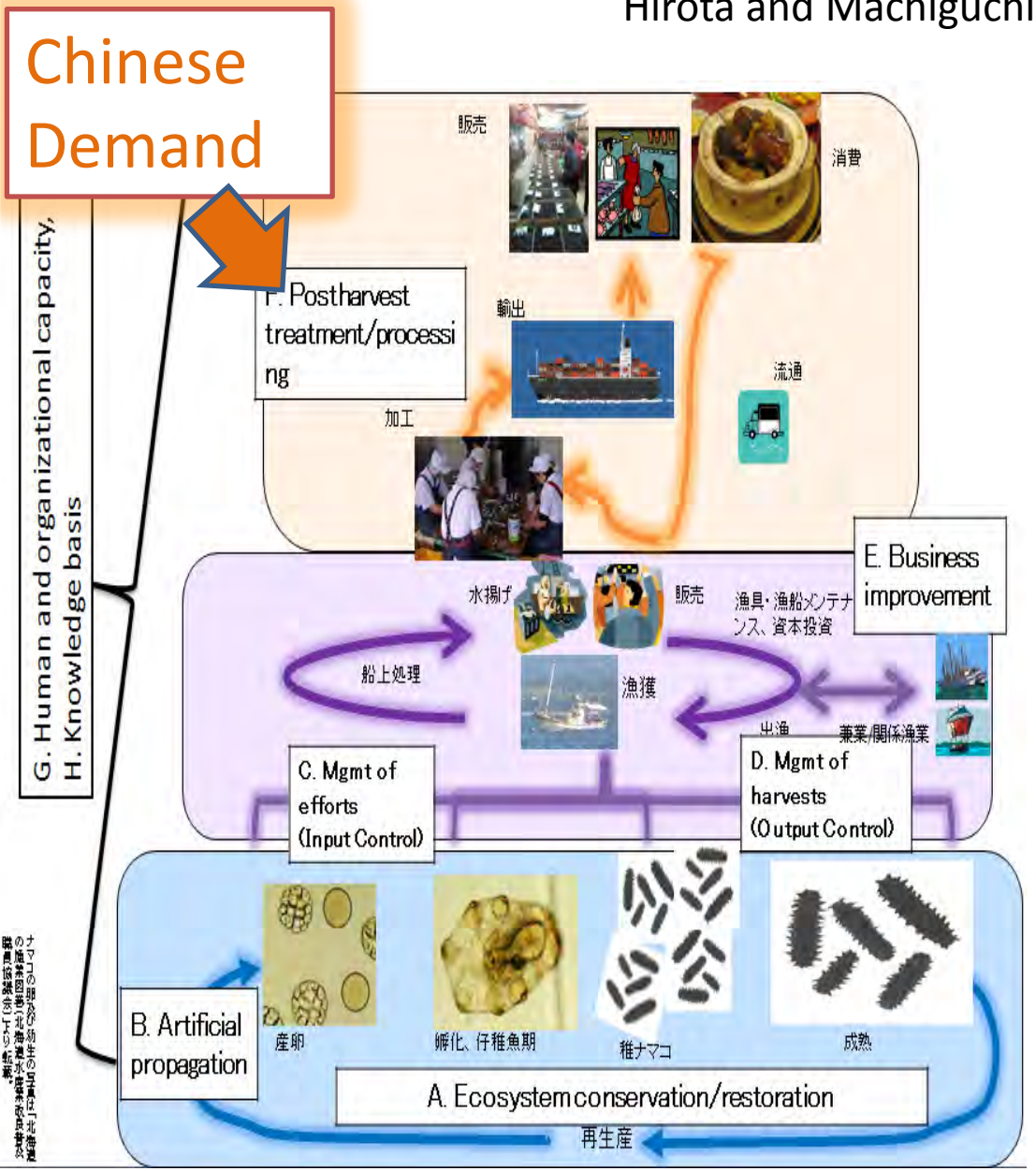


- Based on the results from S-5 of PICES 2012@Hiroshima.
- We collected the latest research results and prepared the platform for the integrated research in the future.

- Fis.Oceanography,
- Resource Dynamics,
- Spatial Economics,
- Market analysis,
- Fish Processing, etc.

Example 2: Sea cucumber in Hokkaido, Japan

Hirota and Machiguchi (2014)



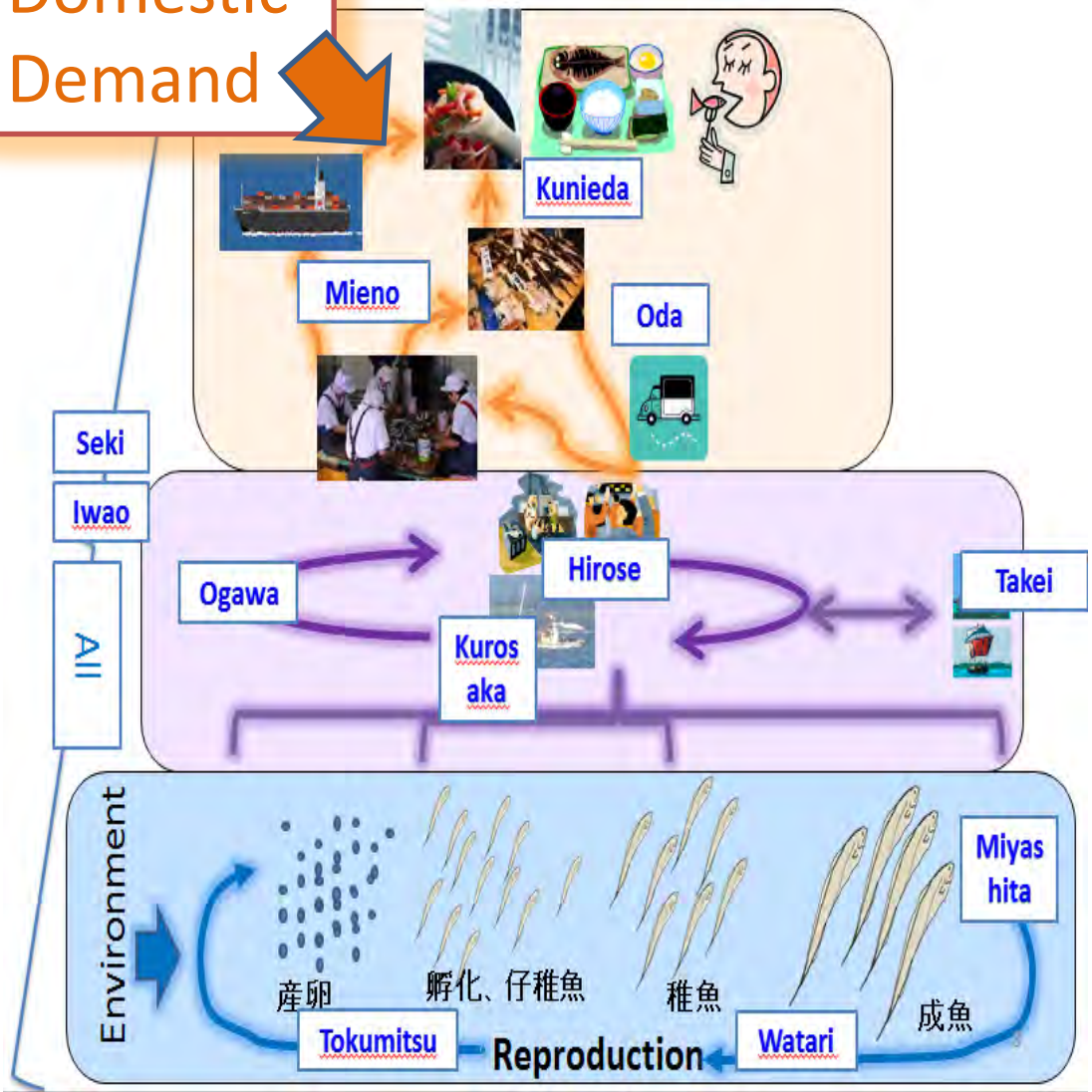
- Increased Chinese demand led to the overfishing in Japan.
- We proposed the set of activities (harvest strategy, processing, ranching, etc.) to local community to adopt to the change.

- Biology, marine ranching
- Resource Dynamics
- Resource Economics
- Market analysis
- Fish Processing
- Anthropology, etc.

Example 3: Hairtail (*Trichiurus lepturus*) in Bungo Strait, Kyushu area, Japan

Hirose et al. (2015)

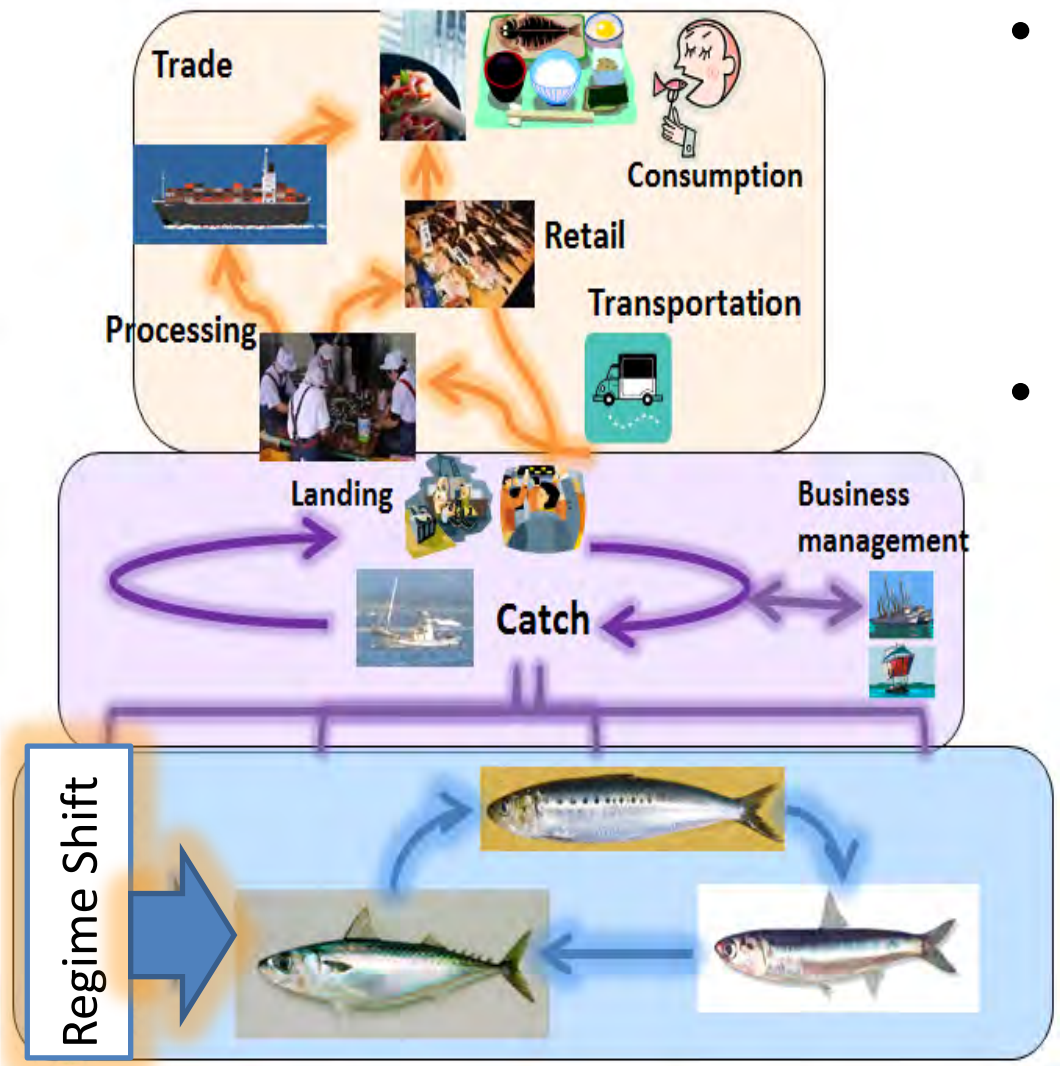
Korean/ Domestic Demand



- Strong Korean and domestic demand led to the overfishing in the area.
- We suggested set of activities to utilize Strong Year Classes to recover the resource while sustaining the local food culture.
  - Biology, Resource Dyn.
  - Engineering (e.g. gear)
  - Resource Economics,
  - Distribution/MKT analysis,
  - Sociology, etc.

Example 4: Species Alternation (SA) and the Large-scale Purse Seiners

Saito, Minobe, Sakurai, Makino (2013)



- Climate/Oceanographic Regime Shifts result in the Species Alternation Phenomena. Fishers couldn't adopt to it in the '90s (Mackerel overfishing).
- We suggested social, financial and resource policy measures for the adaptation/utilization of Species Alternation.

-Oceanography

-Biology, Resource Dyn.

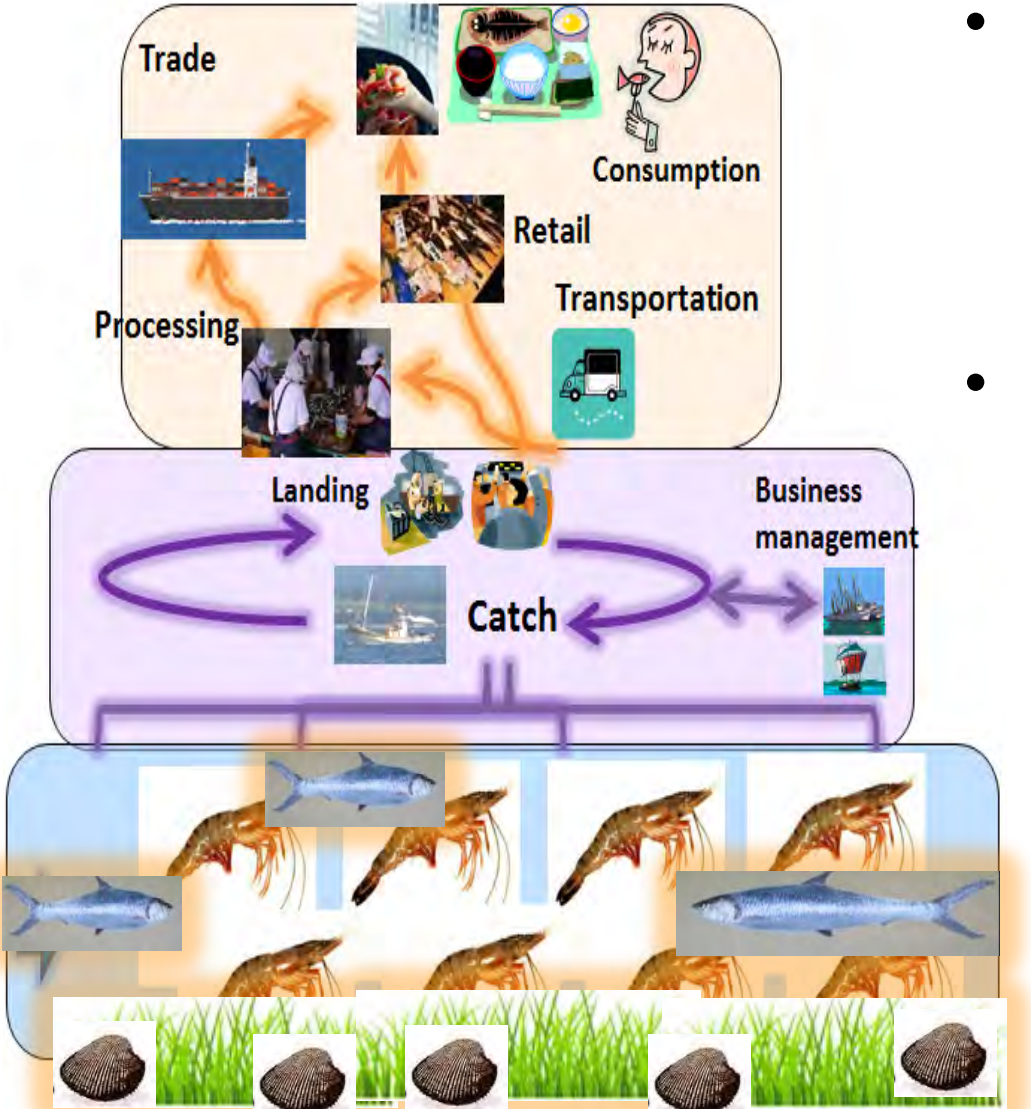
-Resource Economics,

-Interindustry (I/O) analysis,

-Distribution analysis, etc.

Example 5: PICES-MAFF Project of Integrated Multi-Tropic Aquaculture (IMTA)

(Makino et al. 2014)



- Intensive shrimp aquaculture in Indonesia resulted in marine pollution, shrimp mass-disease, abandon of the pond, land erosion, and loss of livelihood.
- We proposed IMTA (shrimp, fish, seaweed, and shellfish) for low emission and better Human Well-Being (more job, food, etc.)

  -Chemistry,

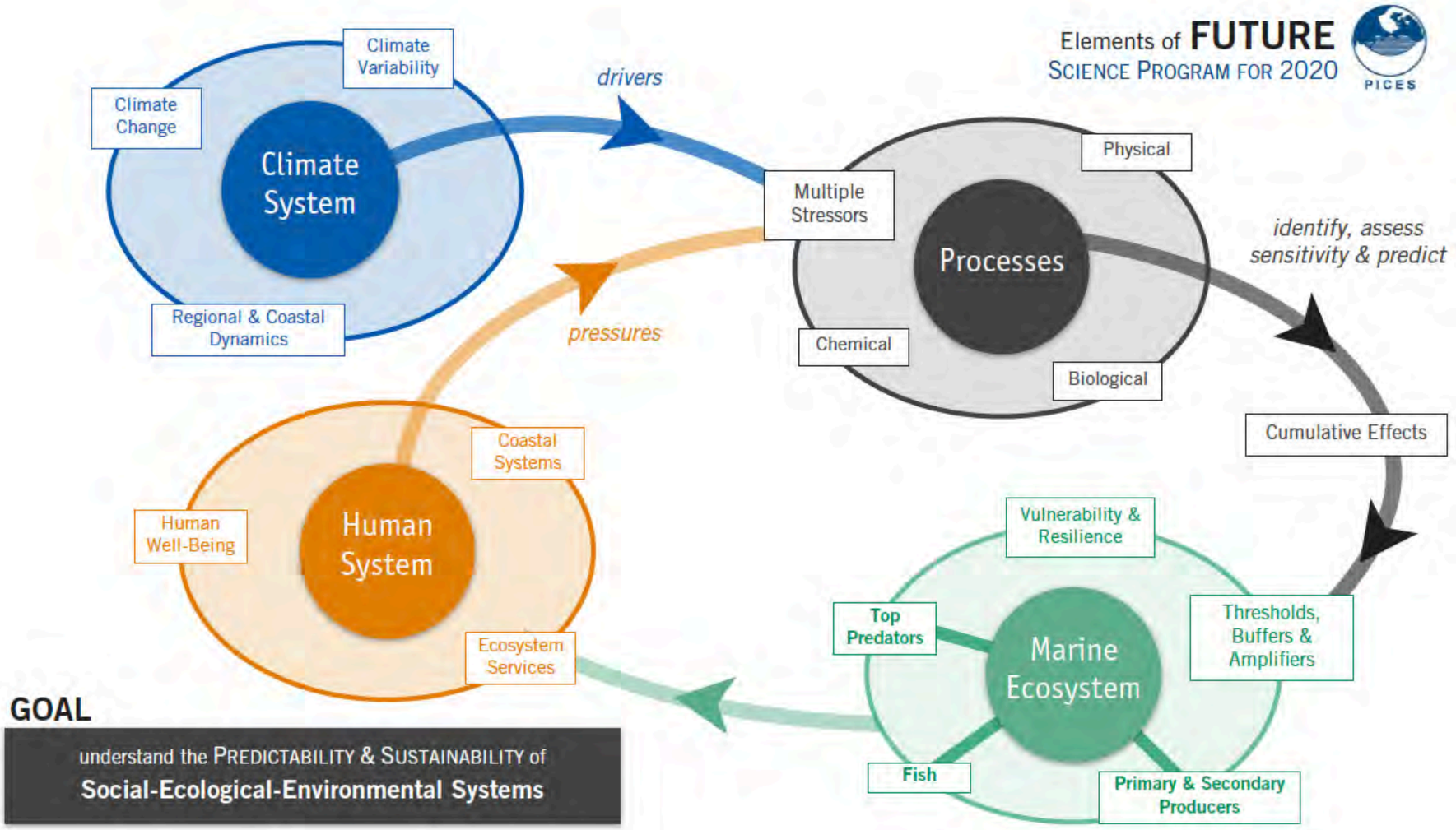
  -Biology

  -Economics

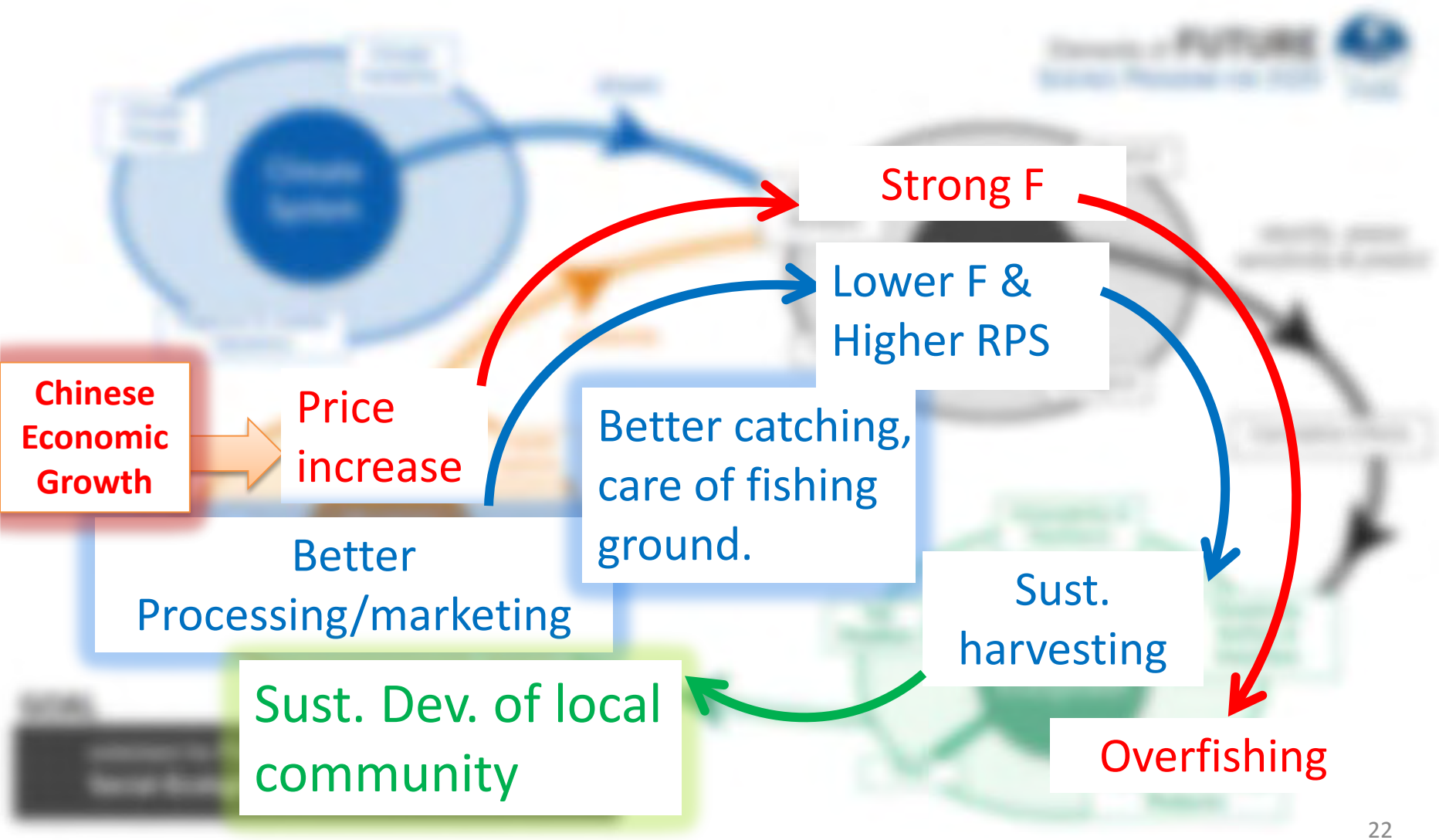
  -Sociology

  -Phycology, etc.

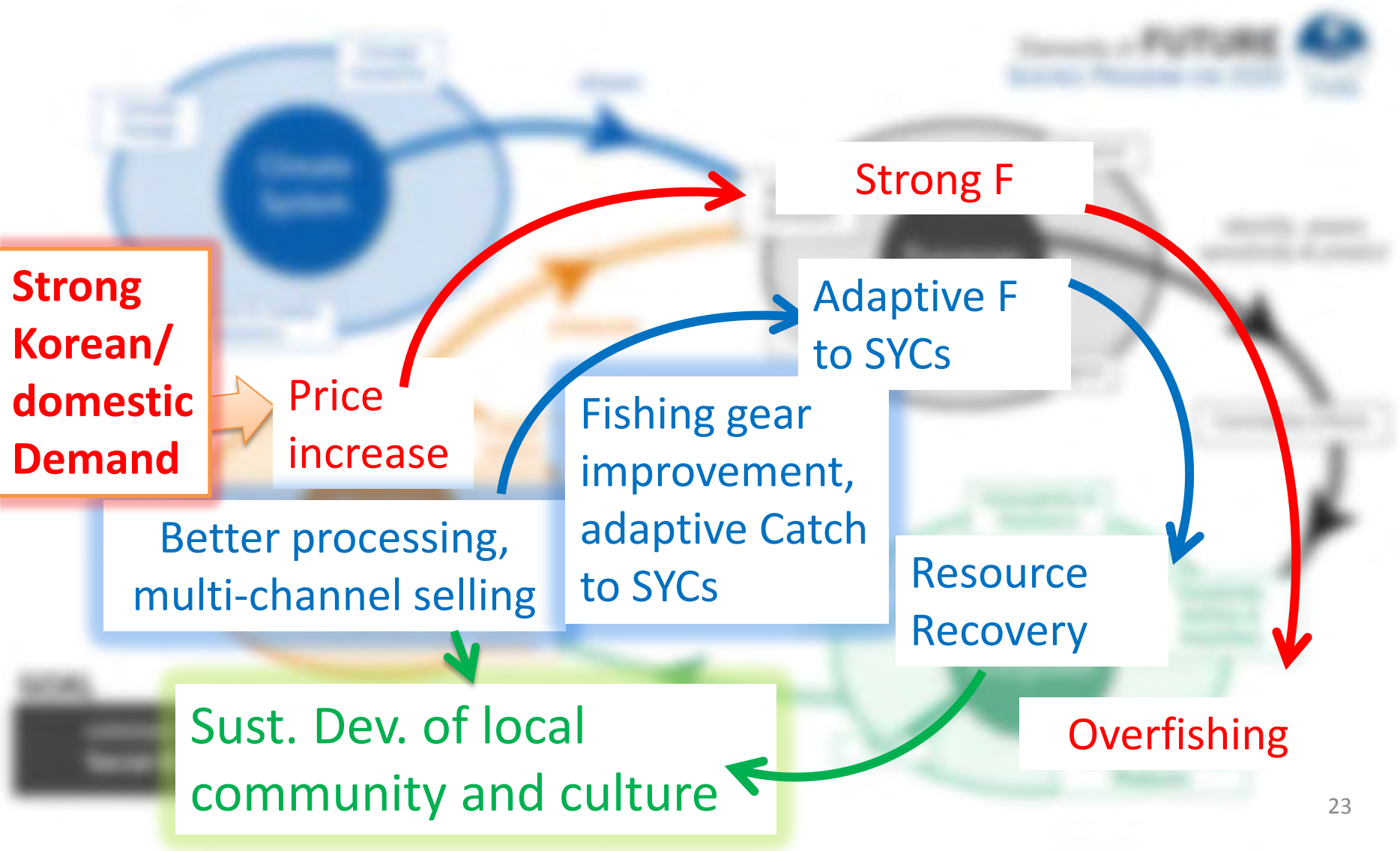
Translation of these examples by the FUTURE Diagram



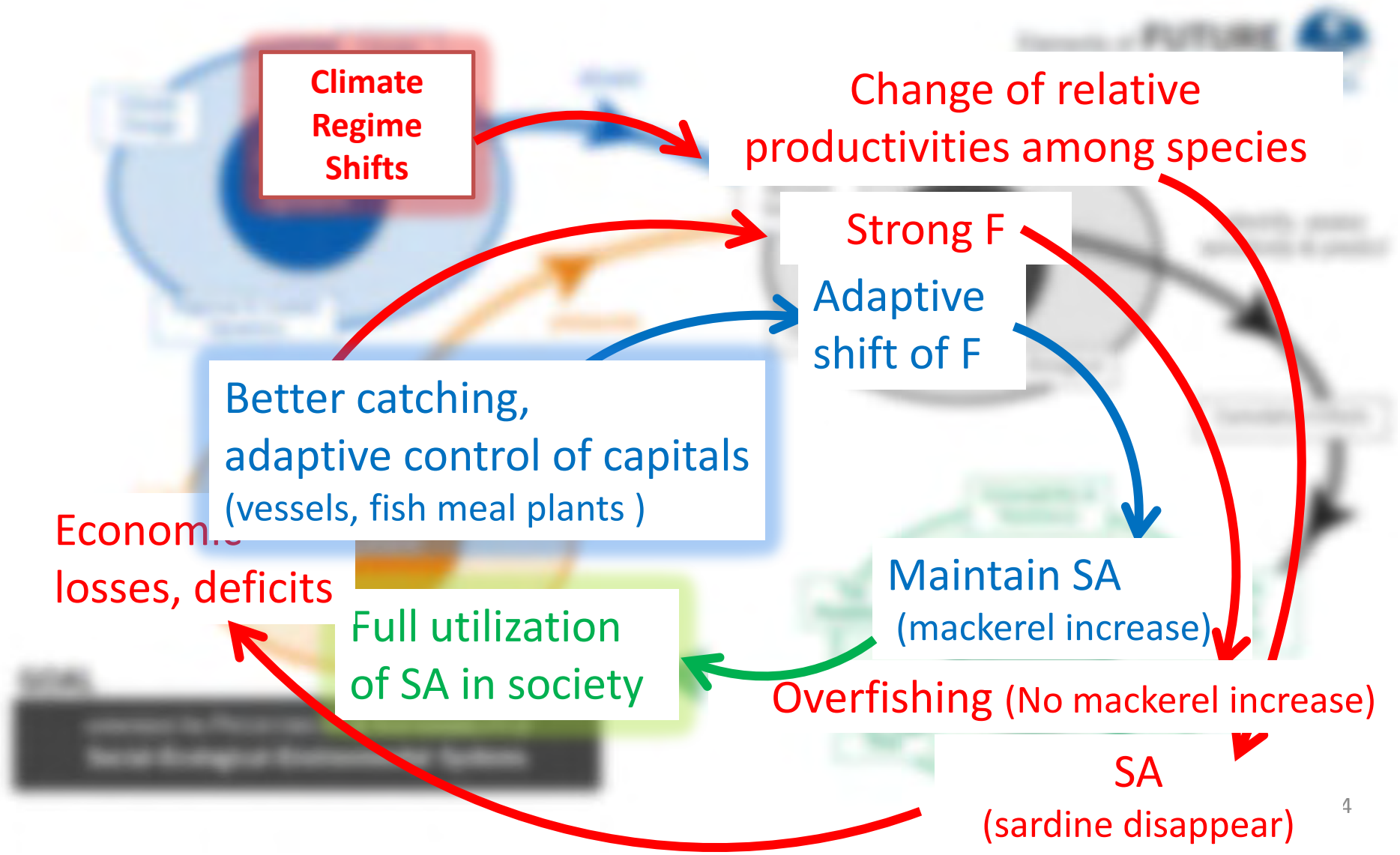
Example 2: Sea cucumber



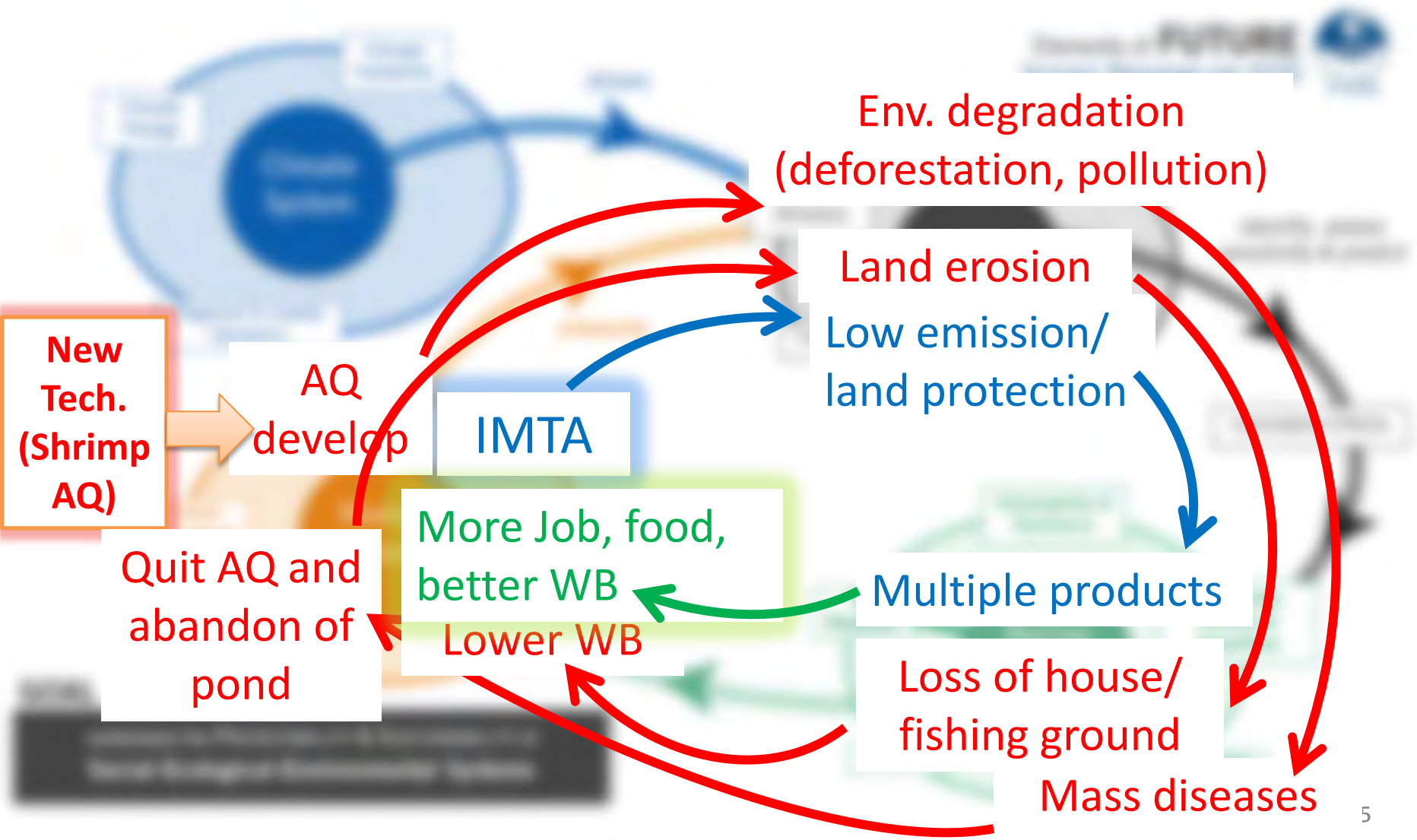
Example 3: Hairtail in Kyushu area (SYC = Strong Year Classes)

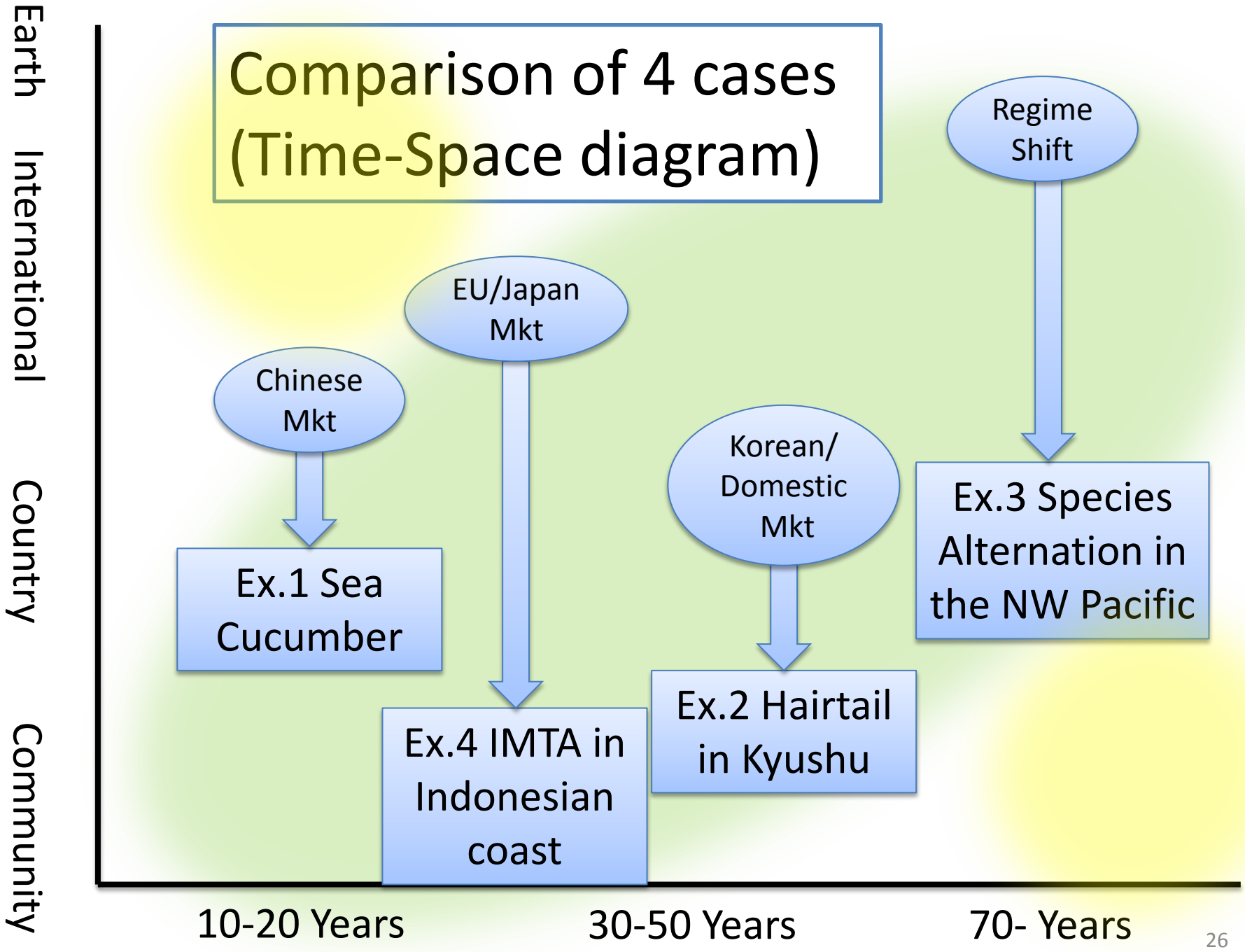


Example 4: Species Alternation (SA) in the North West Pacific



Example 5: IMTA in Indonesia
(AQ = Aquaculture, WB = Well being)




Comparison of 4 cases
(Time-Space diagram)
Earth
International
Country
Community
Regime Shift
EU/Japan Mkt
Chinese Mkt
Korean/ Domestic Mkt
Ex.3 Species Alternation in the NW Pacific
Ex.1 Sea Cucumber
Ex.4 IMTA in Indonesian coast
Ex.2 Hairtail in Kyushu
10-20 Years
30-50 Years
70- Years

FUTURE Diagram is powerful!

- It is very powerful to understand the Changes and Responses in SES.
- This kind of review / comparison of the existing integrated research projects from 6 Member Countries might show us the next step for the FUTURE program (e.g., Gap analysis).

- Committees & Ex.G.s to see how your activities is fit into it, what is missing, how you can link to other discipline, and add value to your study.
- Suggestions/modifications for better diagram is also important.

However, we should note that…

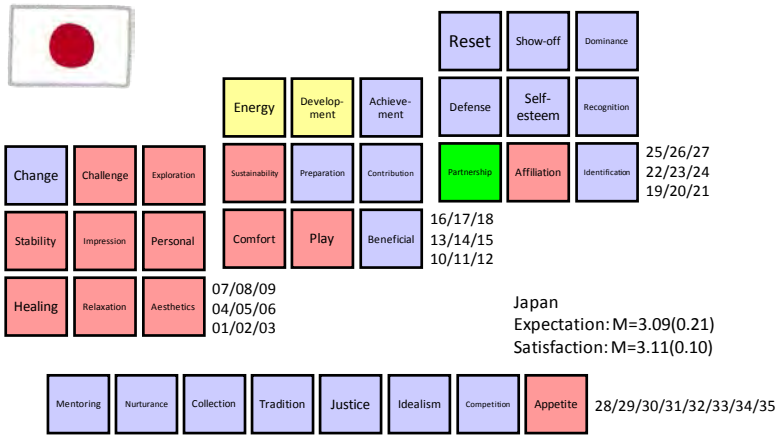
- Fisheries resource is just one of various Ecosystem Services from the sea.

- Appropriate balance among various Ecosystem Service Uses (not only the fisheries sector and fish eaters) to sustain the ecosystem structure and function should be discussed. Thais is an important part of "The Sustainability Science".

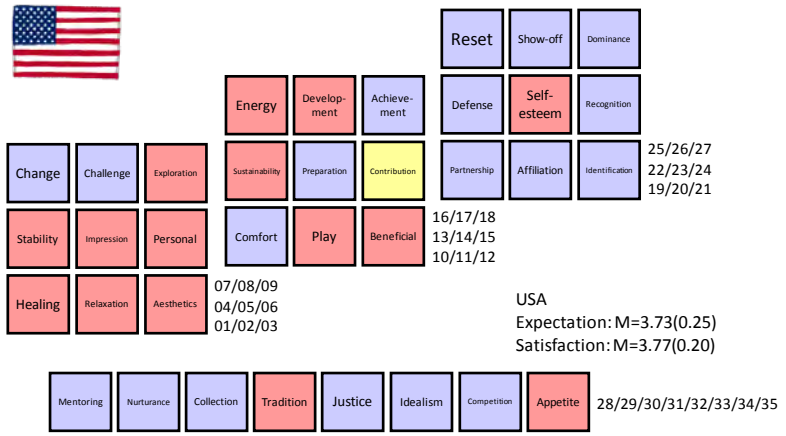
- The Appropriate balance would be different from country to country, from sector to sector.

Psychological analysis of Human Well-being from the Sea

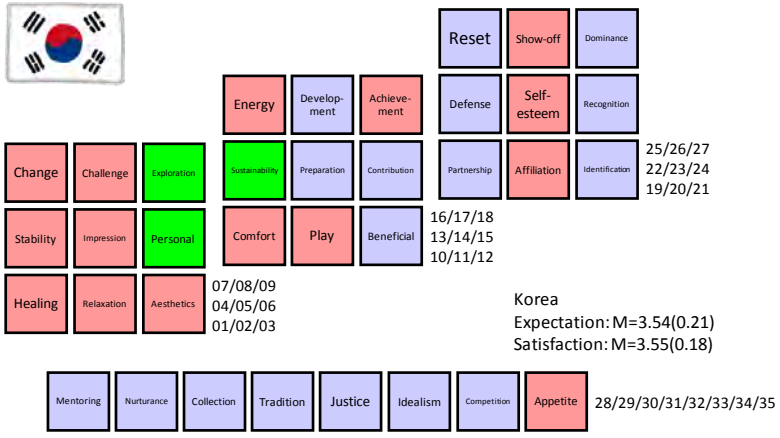
J. Hori at Session-3 of PICES2015 (Thursday)



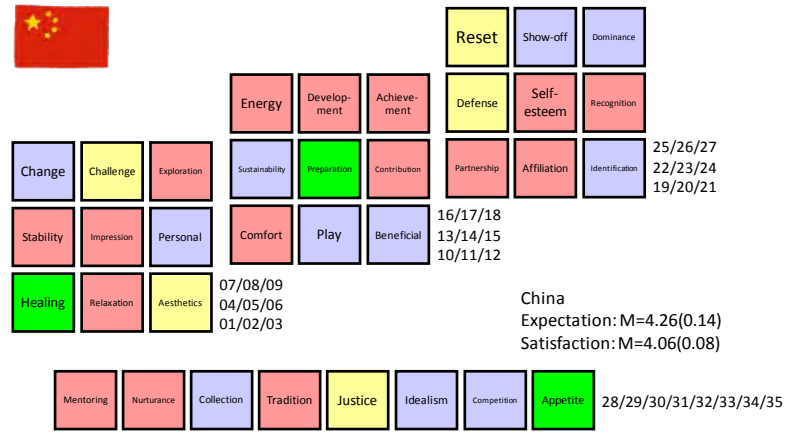
Japan
Expectation: M=3.09(0.21)
Satisfaction: M=3.11(0.10)



USA
Expectation: M=3.73(0.25)
Satisfaction: M=3.77(0.20)



Korea
Expectation: M=3.54(0.21)
Satisfaction: M=3.55(0.18)

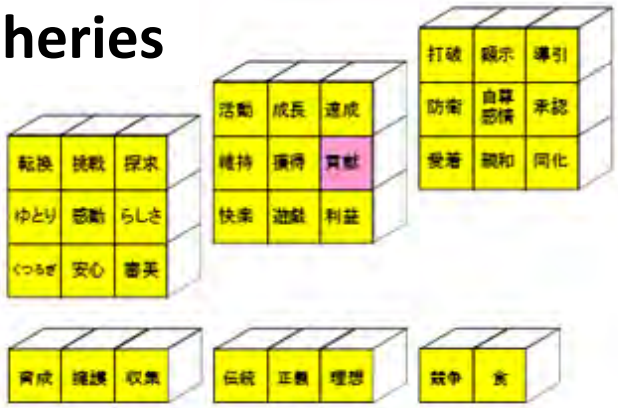


China
Expectation: M=4.26(0.14)
Satisfaction: M=4.06(0.08)

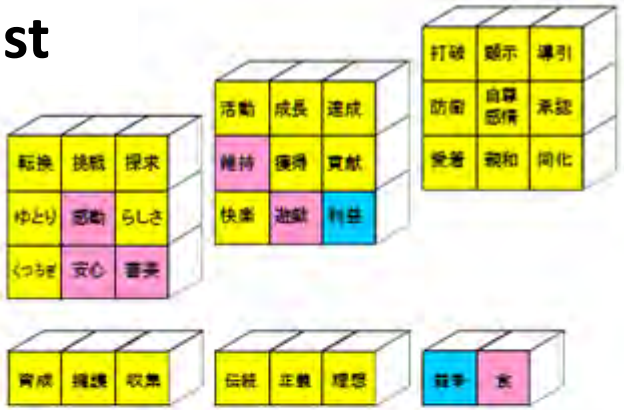
Russia and Canada will be added by the next Annual Meeting

Within Japan, you can see the differences of WB among Sectors (Hori 2014)

Fisheries

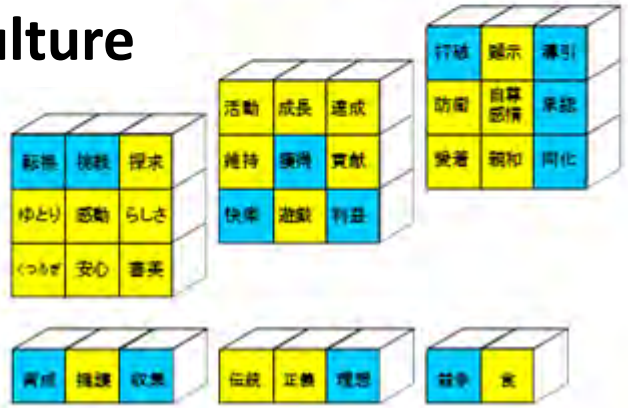


Tourist



Env. NGO

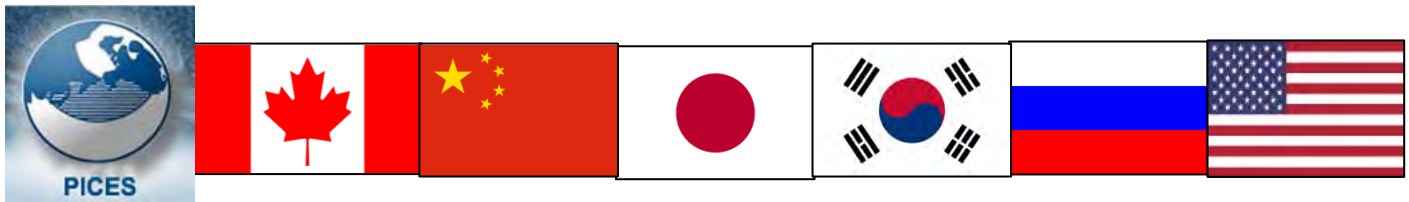
Agriculture



The next challenge is to bridge these gaps and find the balance for sustainability.

Conclusion

- "Fisheries System" concept can integrate various disciplines in fisheries science along with the real movement of fish within SES. This is useful to link various disciplines in SES. It is easy to understand (intuitive).
- "FUTURE Diagram" is powerful to see the interactions within SES (conceptual). Please try!! You can find how to add value to your study.
- The next challenge is to find the appropriate balance of Ecosystem Service Uses by various sectors.
- Review/comparison of integrated research projects using FUTURE Diagram would be the next step for the FUTURE and Sustainability Science by PICES.



Thank you!