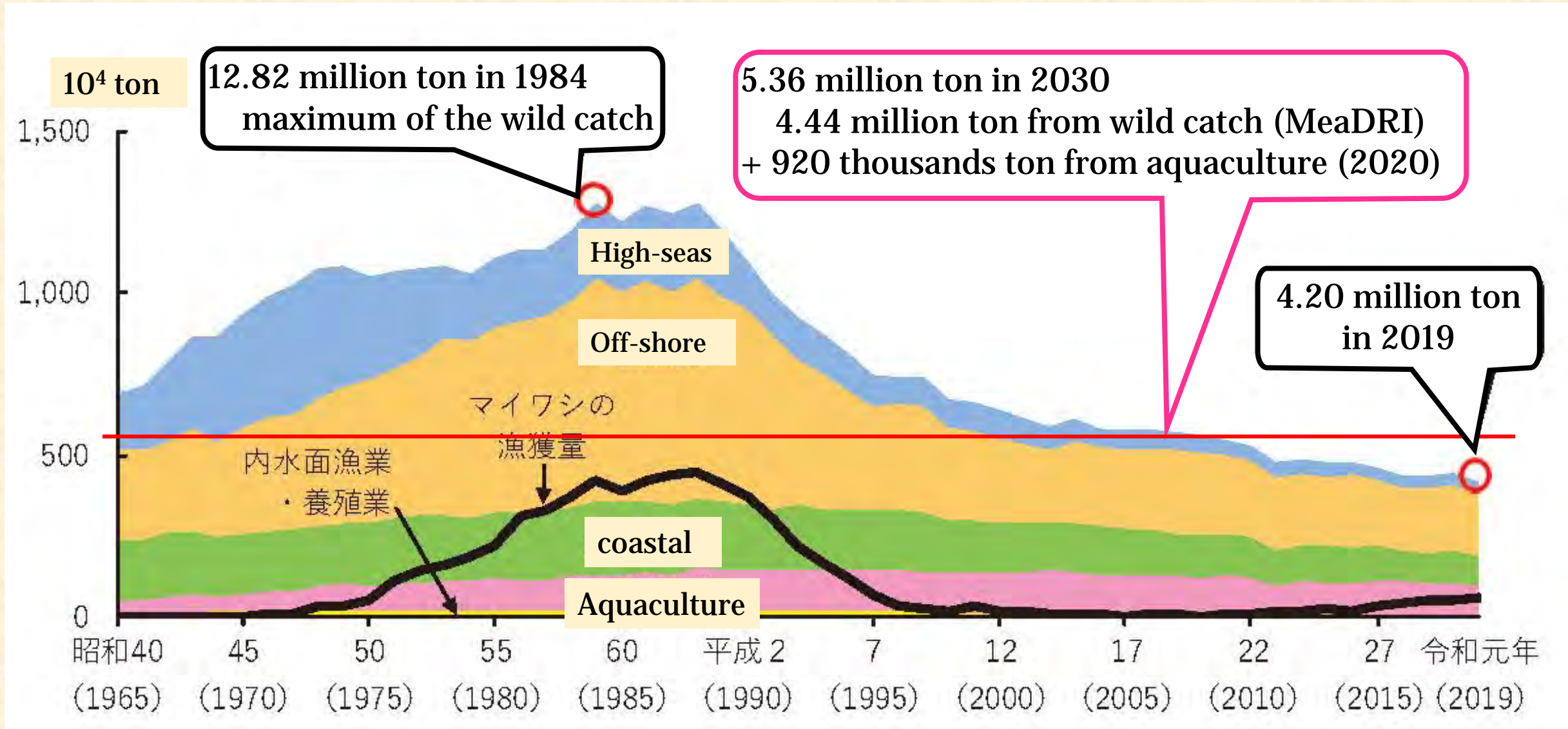


Needs of innovative image analyses in Fisheries Research —in relation to the recent fisheries measures —

- Background
- Needs in the recent fisheries measures
 - Enactment of the amended fishing law
 - Smart fisheries
 - Measures for achievement of Decarbonization and Resilience with Innovation (MeaDRI)
- Objectives in Research and Technology
 - Development of automatic analysis technology for sophisticated resource evaluation
 - cutting-edge sorting system in fish processing

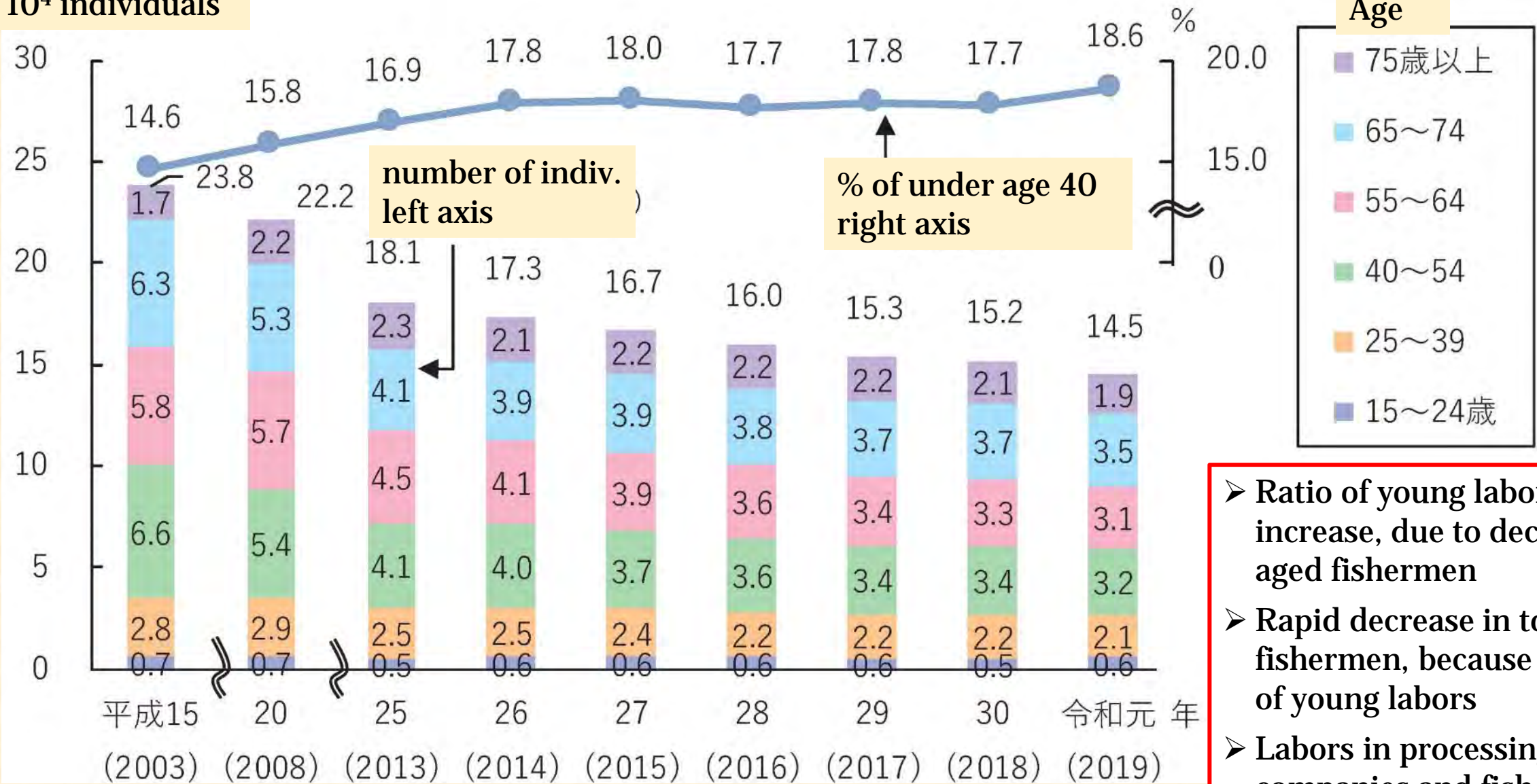


Present status of fisheries (catch amount)



Present status of fisheries (age structure of fishermen)

10⁴ individuals



- Ratio of young labors slightly increase, due to decreasing aged fishermen
- Rapid decrease in total fishermen, because of shortage of young labors
- Labors in processing companies and fish markets also rapidly decrease.

Recent major schemes

1. Implementation of amended fishing law (Dec. 2020)

- Increase of TAC management species, targeting MSY level
- Increase of stock assessment target species
- Abolition of out-of-date fisheries regulations
 - **Renewal of fisheries management policy**
 - **Reacting to the decrease of landings**

2. Smart fisheries (Feb. 2020)

- Corresponding to the Digitalization in National Growth Strategy
 - **Sustainable use of fish resources**
 - **Growth industrialization of fisheries**

3. MeaDRI (May, 2021)

- Growth strategy in Agriculture, Forestry and Fisheries
 - **Productivity improvement with SDGs**

- Need to explain the present poor catches under the reformed management scheme.
- Measures against uncharted climate change, unpredictable from historical data

- 4. Task committee for poor catches (June, 2021)
 - Measures against climate change
 - Robust fisheries system against climate change
 - Abolition of unrealistic fisheries regulations

Process of Renovated Fisheries management system

【 Research of stock status 】

(Governments / Researchers / Fishermen)

✓ Collection of catch data

- Catch (amount, effort)
- Fish size (length, weight, maturity)

✓ Surveys by research vessels

- Oceanographical survey
- Survey of eggs and larvae (recruitment)

✓ Analyses of marine environment

- Estimation of primally production and zoo-planktons by cutting-edge tech.
- Relationships between environment and population fluctuation

✓ Enhancement of information collection

- Fishing location, season
- Echo of fish school, Temperature, Salinity

【 Evaluation of stock 】

(Research institutes)

Independent from Governments

✓ Stock assessment (annual)

- Biomass
- Fishing pressure
- Kobe plot, etc.

✓ Information for deciding resource management rules (Setting and renewal)

1. Positive list of resource management goals
2. Scenarios to reach resource management goals (years, annual catches and stock levels)

【 Resource management goals 】

(Government)

Explain to stakeholders

1. ① Ideal population level for maintaining MSY (Target Reference Point)
② Population level for avoiding overexploitation (Limit Reference Point)
2. Other reference point (in case of difficulty for determining 1.)

【 Harvest Control Rule 】

(Government)

Hearing from stakeholders

【 Collection of fishing data 】

(Fishermen)

✓ Collection of catch data

- Data collection using by ICT technologies



【 Resource management measures 】

TAC, IQ

- TAC is decided in the range of ABC, recommended by research institutes.
- Flexibility in the implementation process, considering the fisheries
- IQ will be started after enough preparation period

Hearing from stakeholders

Resource Management Agreement (RMA)

- Voluntary managements should be authorized as the RMA by prefectural authorities.
- Results of stock assessment and regulations in RMA should be published for accomplishing the goal.

Roadmap for promoting new fisheries management

Improvement of scientific survey, stock assessment, and accuracy

- Expansion of assessment
- Collection of catch data

Expansion of TAC management species, based on MSY-targeted stock assessment

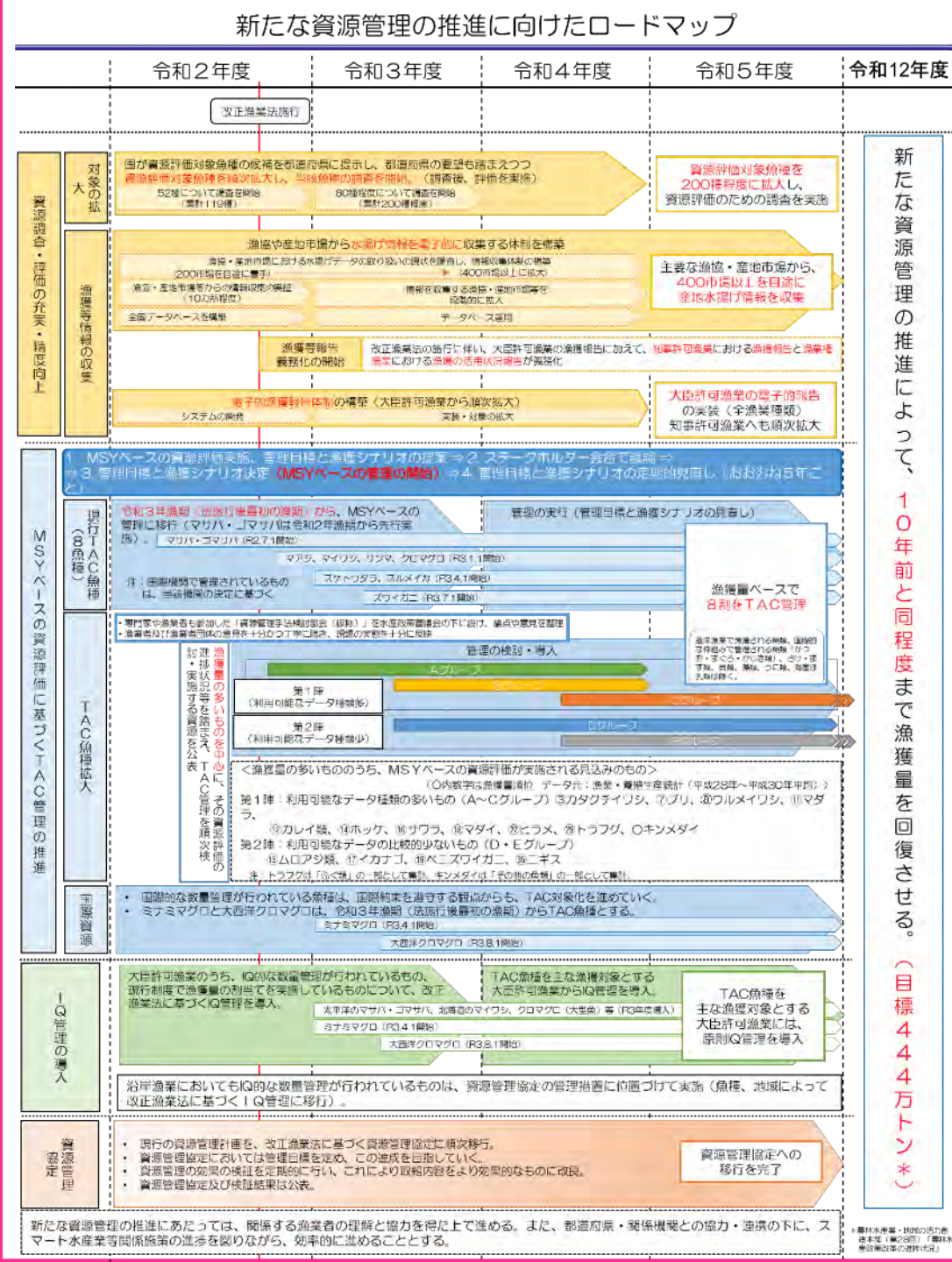
- Ordinary TAC species (8 species)
- Increase of TAC regulated species
- Fish resources managed at RFMOs

Introduction of IQ management

Resource Management Agreement

Roadmap from 2020 to 2023 and objectives toward 2027 are described

農林水産業・地域の活力創造本部(第28回)「農林水産政策改革の進捗状況」より



Roadmap for promoting new fisheries management

FY2020

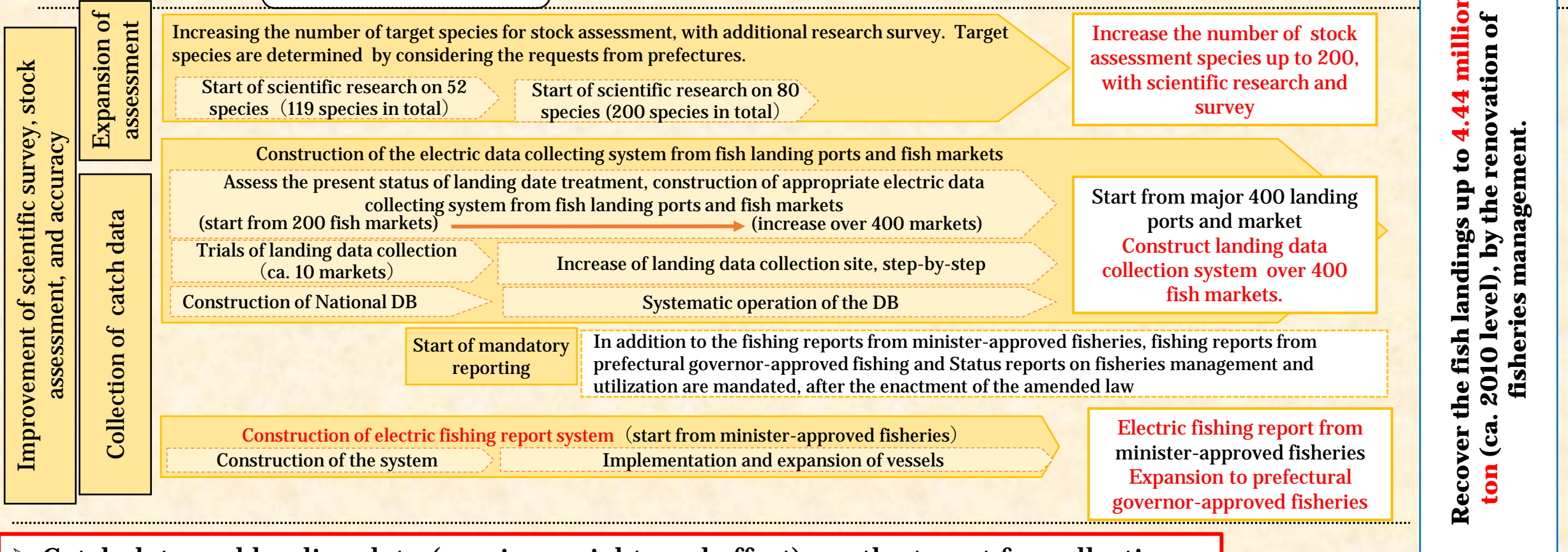
FY2021

FY2022

FY2023

FY2030

Enactment of the amended fishing law



- Catch data and landing data (species, weight, and effort) are the target for collecting.
- Stock assessment by production models will be conducted at the first step.
- Biological data (length, age, sex, and maturity) are essential for the improvement of stock analysis.

Improvement of research, expansion of stock assessment (increase of target species)

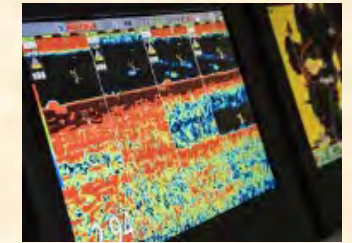
- The number of target species for stock assessment was 50 in 2018, excluding Pacific saury and bluefin tuna.
- After the amendment of Japanese fisheries law, the ministry should try to assess the stock status of all species of fisheries resource.
- The number of target species for stock assessment should be increased around 200 by 2023. Then, continuous efforts should be kept for data collection and improvement of assessment accuracy. (cf: 479 stocks in US, 226 stocks in EU)

<Criteria in selection for stock assessment>

1. Widely distributed species at present
2. From now on, the following species will be added:
 - i. Request from prefectural government
 - ii. Target species in minister-approved fisheries
 - iii. Widely caught species
 - iv. Widely enhanced species
 - v. Commonly distributed species
 - vi. Species expected as data-rich for stock assessment



Trawl survey



Acoustic survey



Grid survey by research vessels

Prefectural research institutes

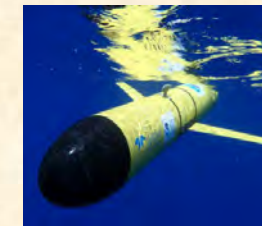


Branch of FRA

FRA



Research institute of university



Glider (ROV, AUV)



Research in fish market

Improvement of research, expansion of stock assessment (increase of target species)

- In 2019, stock assessments were conducted on the total 67 species, including 17 local species.
- In 2020, target species for stock assessment increased to 119 species, including requested from prefectures (31 species) , minister-approved fisheries (15 species), Widely enhanced species (6 species).
- In 2021, target species for stock assessment increased to 192 species.

FY2018: 50 species

Walleye pollock, Horse mackerel, Sardine, Chub mackerel, Spotted mackerel, Common squid, Snow crab, カタクチイワシ、カレイ類、キアンコウ、キダイ、キチジ、キンメダイ、ケンサキイカ、サメガレイ、サワラ、シャコ、ソウハチ、タチウオ、トラフグ、ニギス、ニシン、ハタハタ、アオダイ、アカガレイ、アカアマダイ、イカナゴ、イカナゴ類、イトヒキダラ、ウマツラハギ、ウルメイワシ、エソ類、オオヒメ、カタ、ハマダイ、ハモ、ヒメダイ、ヒラメ、ブリ、ベニズワイガニ、ホッケ、ホッコクアカエビ、マアナゴ、マガレイ、マダイ、マダラ、マナガツオ類、ムシガレイ、ムロアジ類、ヤナギムシガレイ、ヤリイカ

FY2019: 67 species

Fat greenling, Blackthroat seaperch, Grunt, イシガレイ、ウスメバル、ガザミ、キビナゴ、クマエビ、クルマエビ、コウイカ、ツクシトビウオ、ツノナシオキアミ、ハマトビウオ、ホソトビウオ、マコガレイ、マルソウダ、メイタガレイ

FY2020: 119 species

Greeneyes, Bigfin reef squid, アカカマス、アブラガレイ、イシカワシラウオ、イセエビ、イボダイ、イラコアナゴ、ウチワエビ、エソイソアイナメ、オニオコゼ、カイワリ、カサゴ、カワハギ、キジハタ、キツネメバル、キントキダイ、クエ、クロザコエビ、クロソイ、クロダイ、ケガニ、コノシロ、サヨリ、サルエビ、シイラ、シログチ、シロサバフグ、シロメバル、ジンドウイカ、スジアラ、スズキ、ソディカ、タイワンガザミ、チダイ、トゲザコエビ、ハツメ、ババガレイ、ヒレグロ、ホウボウ、ホシガレイ、ホタルジャコ、ポタンエビ、マダコ、マトウダイ、ミギガレイ、ミスダコ、モロトゲアカエビ、ヤナギダコ、ヤマトカマス、ヨシエビ、ヨロイイタチウオ

FY2021: 192 species

Mottled spinefoot, Red stingray, Red rice prawn, Bloody clam, アカシタビラメ、アカマンボウ、アカヤガラ、アサリ、アブラボウス、アラ、アンコウ、イイダコ、イシガキダイ、イシダイ、イトヨリダイ、イヌノシタ、ウバガイ、ウミタナゴ、エソアワビ、エソボラモドキ、エッチュウバイ、カガミダイ、カナガシラ、カミナリイカ、カンパチ、キュウセン、クジメ、クオアワビ、クオウシノシタ、クログシラレイ、ケムシカジカ、コウライアカシタビラメ、コショウダイ、コブダイ、コマイ、サザエ、シバエビ、シマアジ、ショウサイフグ、シライトマキバイ、シラエビ、シリヤケイカ、シロギス、スナガレイ、スマ、タカベ、タナカゲンゲ、チカメキントキ、トコブシ、トヤマエビ、トリガイ、ナカツカ、ニベ、ネズミゴチ、ノロゲンゲ、ハガツオ、ハマグリ、バラメヌケ、ヒメジ、ヒラツメガニ、ヒラマサ、ホタルイカ、ボラ、マゴチ、マダカアワビ、マナマコ、マハタ、マフグ、マルアジ、メガイアワビ、メジナ、メダイ、ユメカサゴ

FY2022 -

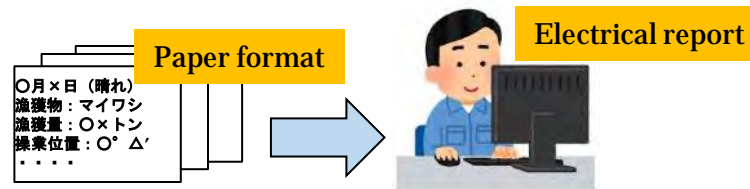
Continuous efforts for data collection, improvement of assessment accuracy

Collection of fishing data for accurate stock assessment

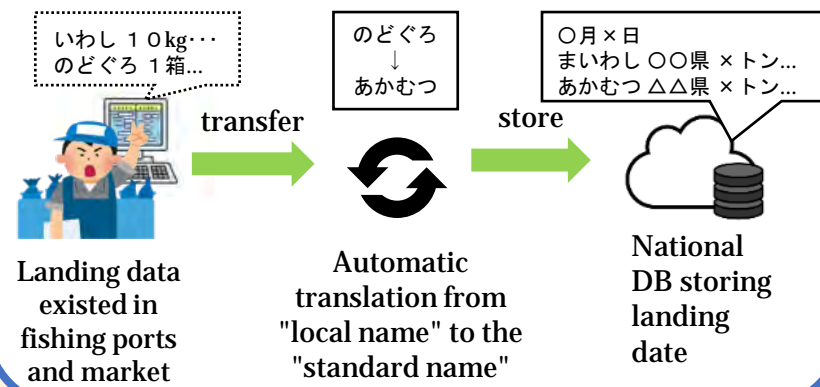
- Collection of fishing data is crucial for explaining both of population size and fishing effort, estimating the effect of climate change on stock fluctuation, monitoring of fisheries management, are important both for stock assessment and for fisheries management.
- JFA takes the following actions to enhance the collection system of fishing data:
 - Fishing reports from fishermen are mandated not only for minister-approved fisheries, but also for prefectural governor-approved fisheries. Status reports on fisheries management and utilization are mandated in cases of fisheries under territorial fishery right. These data will be used for the analysis.
 - Real time electrical reporting system of fishing reports will be constructed for the minister-approved fisheries.
 - Electric reporting system of landing information will be constructed at the major fishing ports and fish markets, planned up to 400 fish markets.

Implementation of electrical reporting system

- Fishing reports are mandatory for minister-approved fisheries (large scale purse seiners, offshore bottom trawl, stick-held dip net for saury, etc.).
- Construction and implementation of electric reporting system will be accelerated.



Rapid data collection from fishing ports and markets



- Catch data and landing data will be obtained.
- Biological data (length, weight, age, maturity, etc.) are essential for improvement of stock analyses.
- Effective multi-species data collection by ICT technology.
- Production model is mainly used at the first step.

2. Smart Fisheries

Future image in 2027

(Growth strategy council Feb 9, 2021)

Smart Fisheries try to bring about **Fisheries of next generation** in 2027, balancing a **sustainable use of fisheries resources** and the industrial growth of fisheries.

Stock assessment based on MSY by electric data

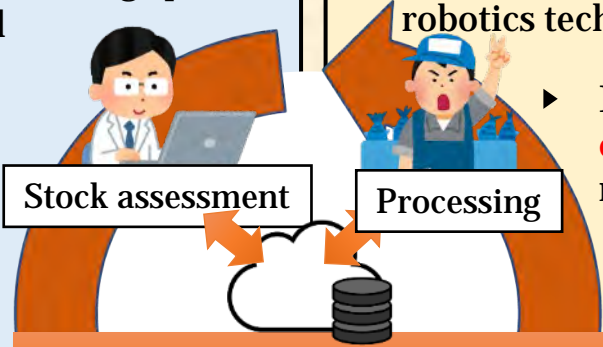
- ▶ Stock assessment on **ca. 200 species** will be conducted by **electric data collection**.
- ▶ **MSY based stock assessment** will be conducted on TAC setting species.
- ▶ Progress in collected data usage among fishermen and companies, promoting effective operation and management, establishment of new business.



Effective data collection and storage at fish markets.

Collaboration among fishermen and processing companies promote **construction of fisheries** at major production areas **value-chain**. Implementation of automation and high value-added production.

- ▶ Automation of sorting and processing processes by AI, ICT and robotics technologies. Improve the productivities by **enhancement of information distribution**, as the **cybercommerce**
- ▶ Introduction of **fresh-frozen technology** and **enhancement of information distribution to consumers** realize **high value-added production**, supported by ICT.



Automatic sorting by image sensing technologies



New technologies **rise the production and income levels**, then **sustain fisheries workers**

<Coastal fisheries>

- ▶ Fishermen utilize detail information of sea condition (current, temperature, etc.) via their **smartphone** and effectively decide **their operation**.
- ▶ Accumulated data can be used for training of young generation.



沿岸漁場予測技術

<Aquaculture>

- ▶ **Rapid maneuver around red-tide** can be operated by warning information via smartphones.
- ▶ Effective and sustainable aquaculture **by the digital data on feeding, growth, etc.**



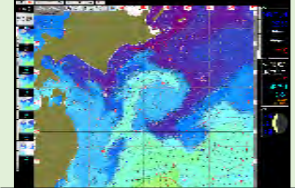
Fisheries, Aquaculture

<Education>



情報共有・人材育成

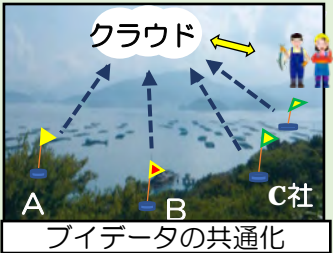
<Off-shore and High-seas>



漁場形成予測システム



自動かつお釣り機

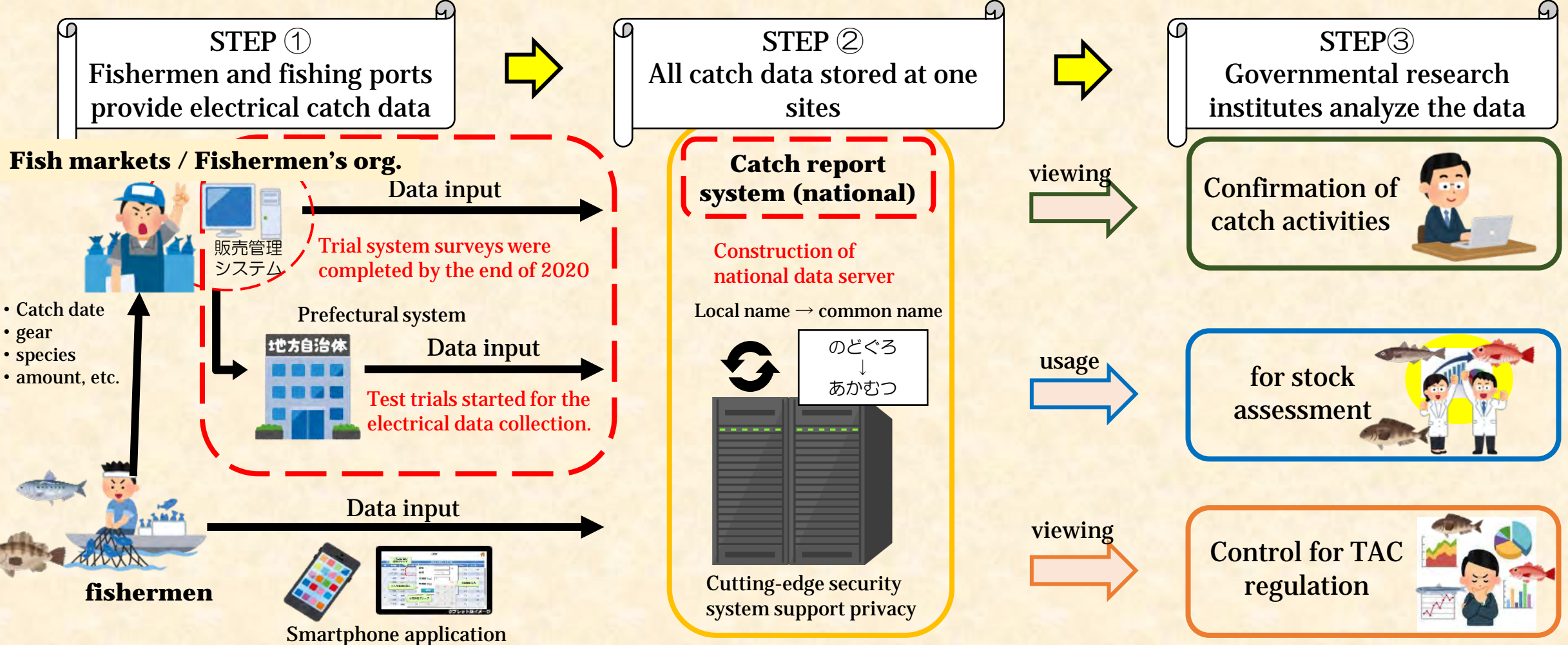


クラウド
A B C社
バイデータの共通化

- ▶ Fisheries forecast systems supported by satellite remote sensing and AI analyses provide **effective selection of fisheries ground** and **energy-saving cruises**.
- ▶ Automatic fishing gear promote labor-saving

Integrated promotion for improvement of stock assessment and implementation of appropriate management measure (Growth strategy council Feb 9, 2021)

- Construction of data collecting system on catch report from licensed fishing boats, based on the amended fishing law. The system supports easy-access from fishermen without troublesome documentation and provides collected data to use stock assessments, by the promotion of electrical data collecting system.
- Implementation of the electric data collecting system will start to collect the landing data at the major ports and fish markets, targeting to 200 sites by the end of 2021.



Roadmap for promoting Smart Fisheries

Improvement of stock assessment

- Expansion in species for stock assessment
- Improvement of stock assessment accuracy

Increase of productivity in fisheries and aquaculture

- Improvement of accuracy of fisheries forecast
- Sophistication of Aquaculture
- Innovation of automatic labor-saving technology
- Education of newly developed technology

Increase of productivity in fisheries value chain

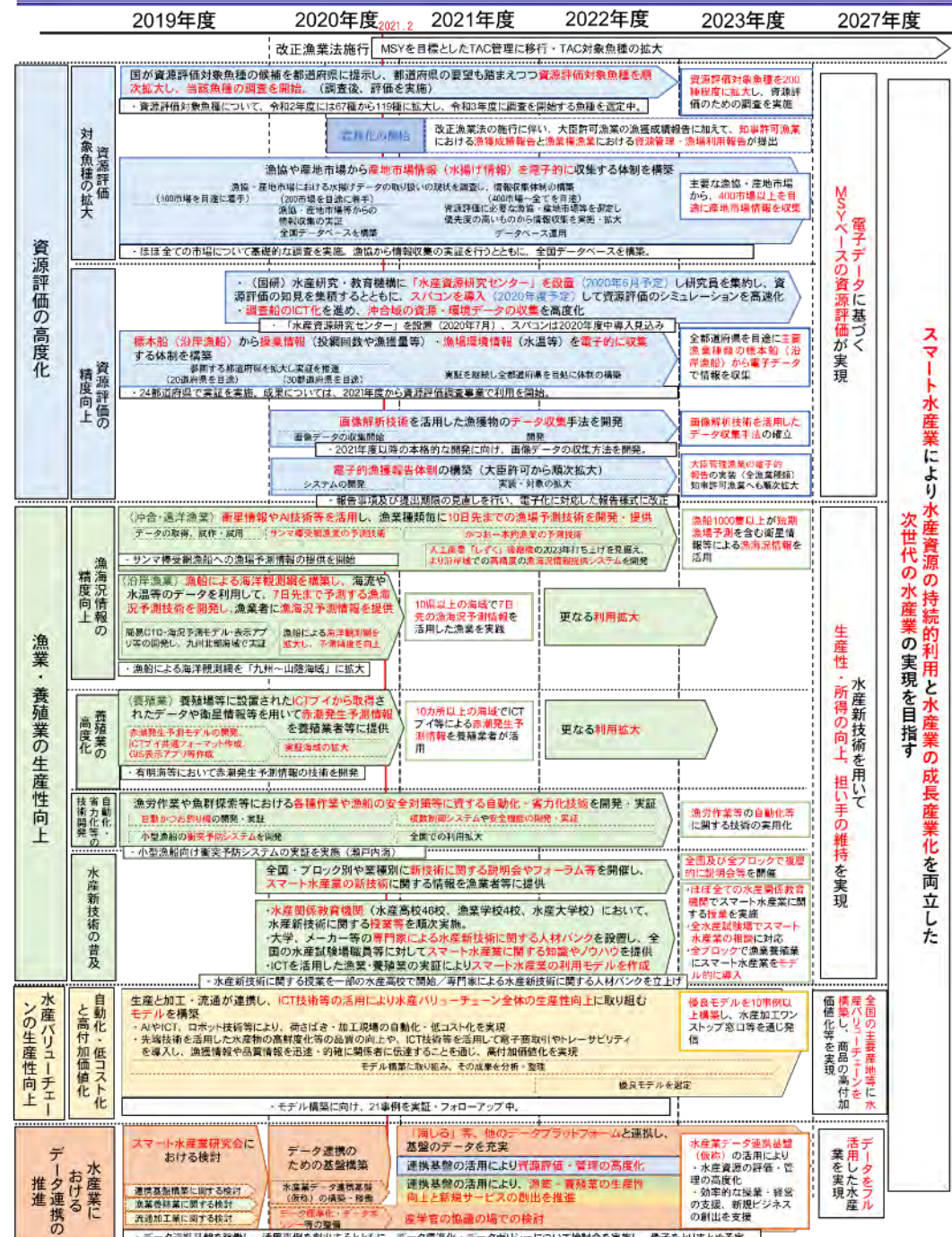
- Automation and low-cost with additional high-value products

Promotion of data-sharing in Fisheries

- Construction and diffusion of data-sharing platform

令和2年2月26日 未来投資会議構造改革徹底推進会合「地域経済・インフラ」会合(農林水産業)(第15回) 配布資料より作成

スマート水産業等の展開に向けたロードマップ



スマート水産業により水産資源の持続的利用と水産業の成長産業化を両立した次世代の水産業の実現を目指す

Roadmap for promoting Smart Fisheries

Improvement of stock assessment

- Expansion in species for stock assessment
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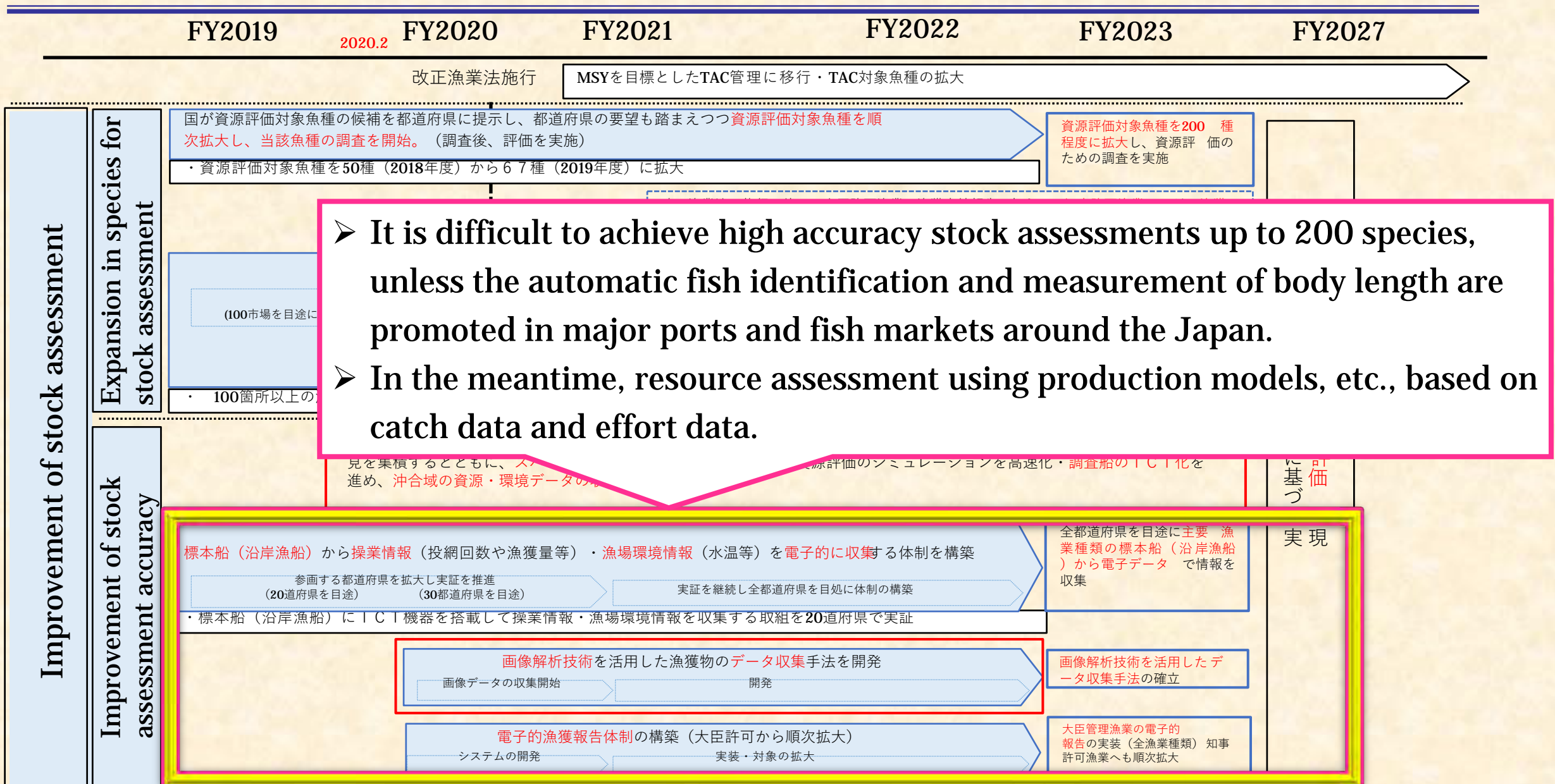
- Automation and low-cost with additional high-value products

Promotion of data-sharing in Fisheries

- Construction and diffusion of data-sharing platform

- Expansion of mandatory catch reports
- Construction of electric landing report system from fishing ports and markets
- Collection of information from fishing boats on operation and environments
- Collection of catch date via image sensing technology
- Construction of electric reporting system from fishing boats
- Automatic fisheries forecast system supported by data collection from fishing boats and AI technology
- Automatic red-tide forecast system by ICT sensing buoys in aquaculture farm
- Automation with labor-saving in cruising and fishing operation
- Education of innovative technology and training experts
- Automatic sorting, processing, packing system by ICT technology
- Introduction of e-commerce and full traceability

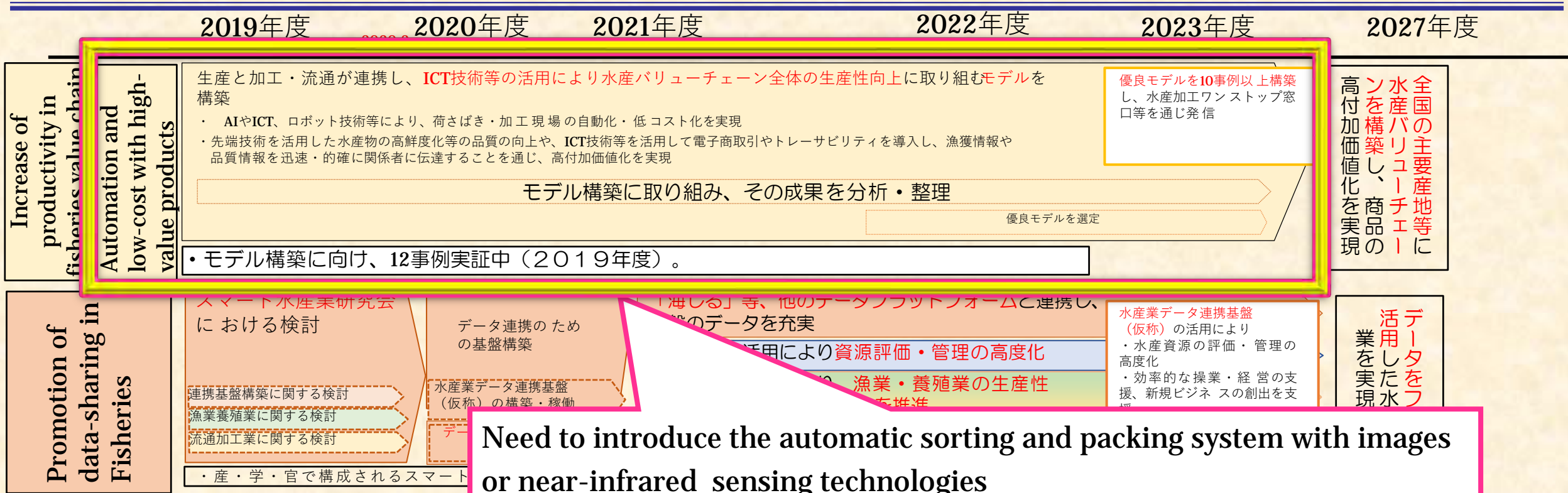
Roadmap for promoting Smart Fisheries (1)



➤ It is difficult to achieve high accuracy stock assessments up to 200 species, unless the automatic fish identification and measurement of body length are promoted in major ports and fish markets around the Japan.

➤ In the meantime, resource assessment using production models, etc., based on catch data and effort data.

Roadmap for promoting Smart Fisheries (2)



Need to introduce the automatic sorting and packing system with images or near-infrared sensing technologies

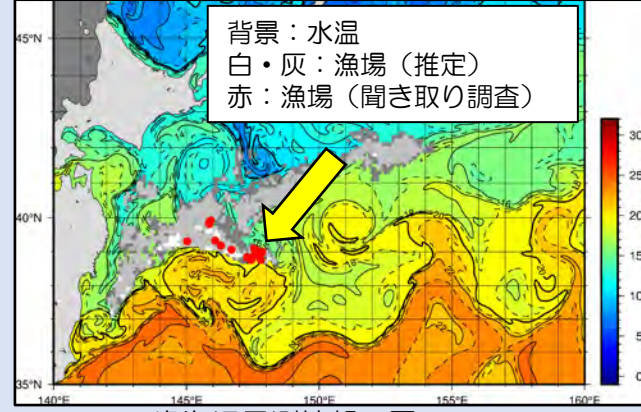
- Similar to the needs of automatic acquisition of biological data for the improvement of stock analyses
- Supports for the rapid decrease of labor at processing companies in local fishing areas

Examples for improvement of fisheries productivity (Growth strategy council Feb 9, 2021)

Fisheries forecasts for fishing boats in off-shore and high-seas



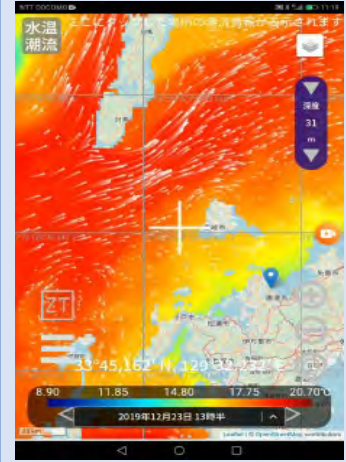
情報を基に漁場探査の様子



漁海況予測情報の図

漁獲量情報と衛星情報とあわせて、AI技術等を活用することにより、サンマの**漁場**を予測して情報提供(93隻のサンマ棒受網漁船に搭載)

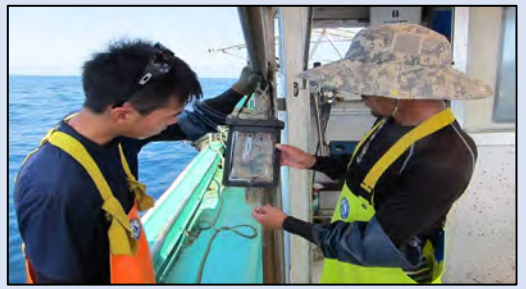
Fisheries forecasts for coastal fishermen via smartphone



水温及び潮流の予測情報 (アプリで表示)



簡易CTDでの観測



新規就業者にデータを用いて指導

- 水温・塩分の分布予測や海流の方向・流速予測の**動画**をスマホ上で表示
- **7日先**の予測を目指し九州～山陰海域において漁船100隻程度によって実証試験を実施中

Drone for searching fishing ground



海外まき網漁船

日本船(1千トン級)目視により魚群探索



魚群探索の様子

海鳥や海面の変化から、餌を追っているカツオの群れを探検・発見し操業実施



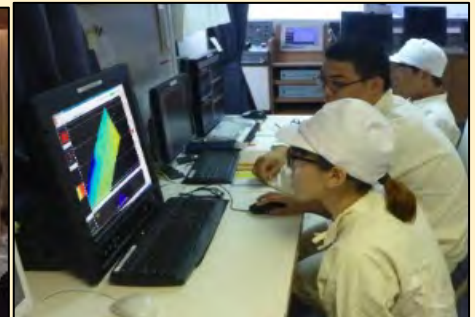
ドローン

十分な飛行性能、画像転送システムを有するドローンの開発

Education of innovative technologies in fisheries



授業風景



実習風景

教育機関において新技術に関する**授業等を実施**

- 焼津水産高校 令和2年11月、令和3年1月
 - 小樽水産高校 令和3年1月
- (令和2年度内に10県程度で実施予定)

Examples for improvement of the productivity in aquaculture

(Growth strategy council Feb 9, 2021)

Large scale off-shore mariculture



沖合養殖+自動給餌システム（鳥取県境港市）
（提供：日鉄エンジニアリング）



沖合養殖イメージ図

大型生け簀

プラットフォーム



Land-based fish culture



千葉県市原市（提供：(株)FRDジャパン）

全国的に広がりつつある循環式陸上養殖施設



循環水処理設備

飼育棟

出荷用水槽

陸上養殖センター（鳥取県米子市）（提供：日本水産(株)）

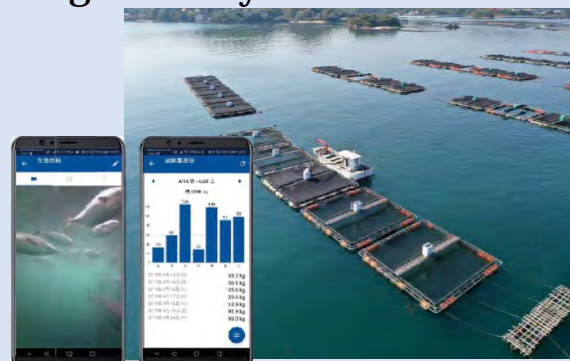


三重県津市（提供：ソウルオブジャパン(株)）

Integrated culture management system



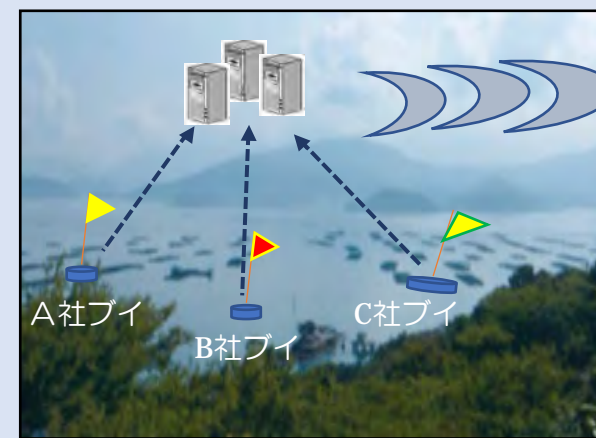
ドコモによる実証実験（提供：NTT DoCoMo）



自動給餌器（提供：ウミトロン(株)）

- スマホで養殖魚の摂餌状況を確認しながら、**遠隔給餌が可能**
- 餌代や人件費等の経費を可視化し、**養殖経営を管理**

Collection of environmental data and utilization



共通データフォーマット化したブイデータの一元的管理（イメージ）

ICTブイデータを共通フォーマット化し、赤潮発生情報を重ね合わせて、養殖業者に提供し、**迅速な赤潮防御等が可能**（有明海・八代海にて実証実験）

Measures for achievement of Decarbonization and Resilience with Innovation (MeaDRI)

Abstract

~ Innovation will enhance potentials and ensure sustainability in a compatible manner~

MAFF Japan

“MeaDRI,” the medium-long term strategy will pave the way for the future.

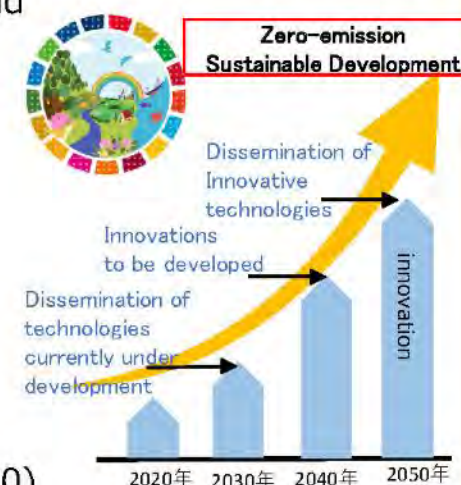
- Enhancing engagement of stakeholders at each stage of food supply chains
- Promoting innovation to reduce environmental load

Challenges

- ◆ Depopulation and aging of producers
- ◆ Stagnant rural communities
- ◆ Climate change and increasing natural disasters
- ◆ Disrupted supply chains due to the COVID-19
- ◆ Achievement of SDGs

By 2050, MAFF aims to achieve;

- **Zero CO2 emission** from the agriculture, forestry and fisheries sectors
- **50% reduction in risk-weighted use of chemical pesticides** by dissemination of the Integrated Pest Management and newly-developed alternatives
- **30% reduction in chemical fertilizer use**
- **Increase in organic farming to 1Mha** (equivalent to 25% of farmland)
- **At least 30% enhancement in productivity of food manufacturers** (by 2030)
- **Sustainable sourcing for import materials** (by 2030)
- **90% and more superior varieties and F1 plus trees** in forestry seedling
- **100% of artificial seedling rates** in aquaculture of **Japanese eel, Pacific bluefin tuna, etc.**



- which will be enabled through:**
- development and dissemination of innovative technologies
 - greening of MAFF's policy tools

MAFF endeavors to accomplish the triple win of;

Economic sustainability

Ensure robust and resilient food industry



Social sustainability

Improve livelihood, promote balanced diet



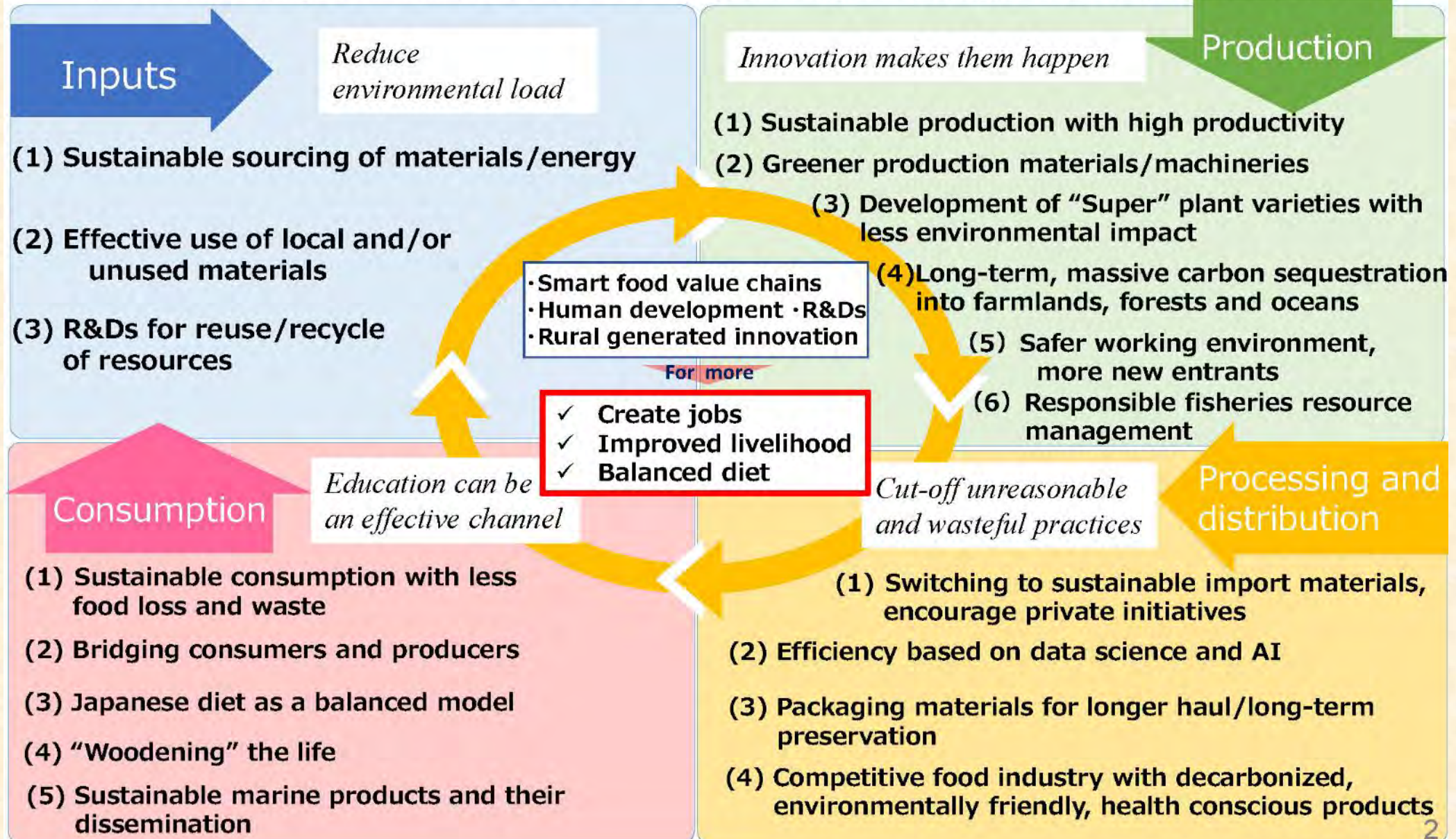
Environmental sustainability

Save global environment for the future generation



MeaDRI's Conceptual Approach

Following viewpoints are required to transform our food systems. Awareness, efforts and behavioral changes of stakeholders as well as promising technologies are the keys to success.



MeaDRI — Fisheries related items

Key performance indicators

- Establishment of technologies on electric (hygro-energetic) agriculture machines and fishing boats by 2040.
- Automation of food processing industry by 2030, to increase 30% up of labor productivity (comparing to 2018 level).
- Realization of **human-free food production process** adaptable to various materials by 2050, leading to further improvement of labor productivity in the area of Japanese traditional food culture.
- Recover the wild fisheries catch up to 4.44 MT by 2030.
- No wild seeds for eel and tuna farming after 2050.
- Accomplishment of 100% assorted feed in aquaculture for sustainable aquaculture, without damages on wild resources.

Specific items

- Development of artificial fry production for aquaculture
- Innovation of alternative ingredient of fish meal
- Application of alternative protein ingredient (insects, algae, hydro-bacteria) for fish feeds
- Recyclable fishing gears
- Decrease of environmental load in aquaculture
- Shift to energy-saving electric or hygro-energetic boats
- Promotion of carbon fixation by algae (Blue carbon)
- **Improvement of stock assessment and construction of catch data collecting system**
- Promotion of quantified fisheries management as TAC, IQ
- Shift of the co-management to the RMA scheme
- Implementation of “Proper Domestic distribution” for eliminating IUU fisheries
- Innovative fresh-freezing/unfreezing technology
- Promotion of fisheries eco-label indicating sustainability
- - - - - -
- **Construction of information collecting system at fishing ports and fishing grounds for proper management of fish resource**
- Promotion of renewable energy systems in local fishing ports and villages

4. Task committee for poor catches

➤ Analyses of the cause of poor catches

- Review analyses on major species (Pacific saury, common squid, salmon)
- Climate change different from the past, affected by the global warming
- Unpredictable changes of fisheries stock

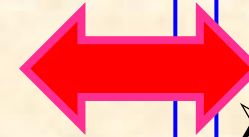
➤ Trashing out all risks and construction of contingency plans

➤ Specific items

- Continuous field monitoring and understanding of risks
- Transformation to robust fisheries system against climate change
- Maintain the sustainability of coastal fisheries
- Re-evaluation of the salmon seeds releasing program and rationalization of set-net fisheries targeting salmons
- Decarbonization/energy-saving of fishing boats and abolition of unrealistic regulations for fishing boats
- Local production for local consumption in renewable energy system

➤ Amended fishing law

- New scheme of fisheries management
- Smart fisheries
 - Digitalized data collection, labor-saving
- MeaDRI



Two Major demands for development of image sensing technology in fisheries

Automated data collection for improvement of the stock assessment

- Automatic biological data collection by image sensing technology from fishing boats, fishing ports, and fish markets
- Analyses with electric catch reports and landing reports will support rapid stock assessments on various fish species.

Automatic sorting system by cutting-edge Information and Communication Technology

- Automatic on-board species and sizes sorting and electronic catch reporting system
- Automatic species and sizes sorting system during the processing and distribution process to cope with the rapid decrease in labor force.

Difficulty for constructing the sensing system

Implementation at lots of fishing ports and various types of fishing boats

- Many fishing ports (2,839 ports @2017) exist on a different scale.
- Many fishing gear type (ca. 460)
- Various landing methods exist in different sites.



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- Accurate data for analyses
- Random sampling
- Relative slow data processing speed
- Integrated data servers with data network
- Data collecting system for various fishing gears and landing system at fishing ports

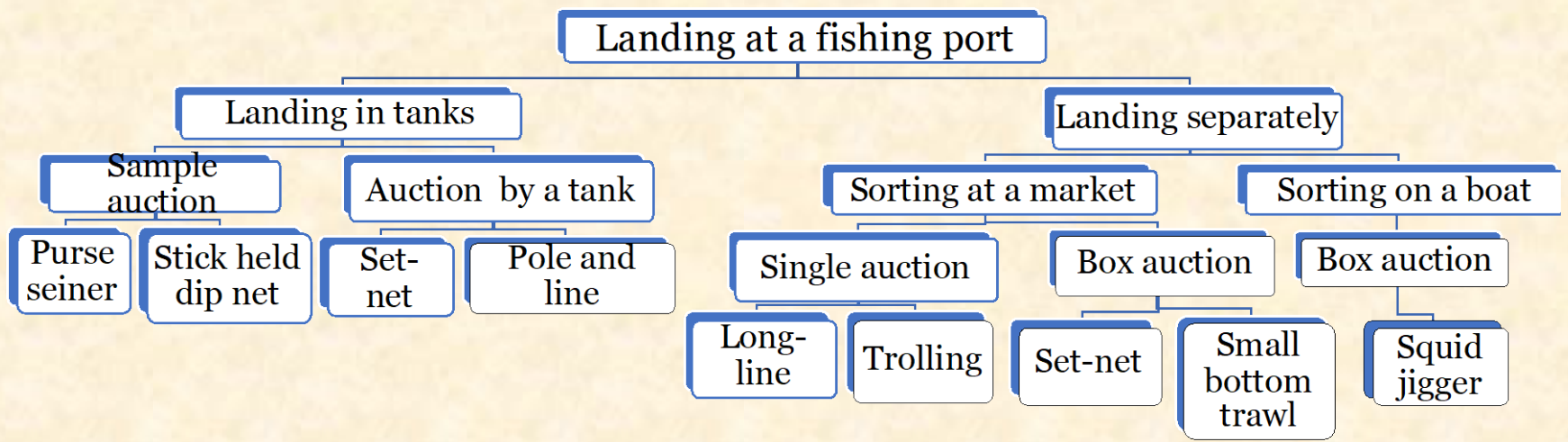
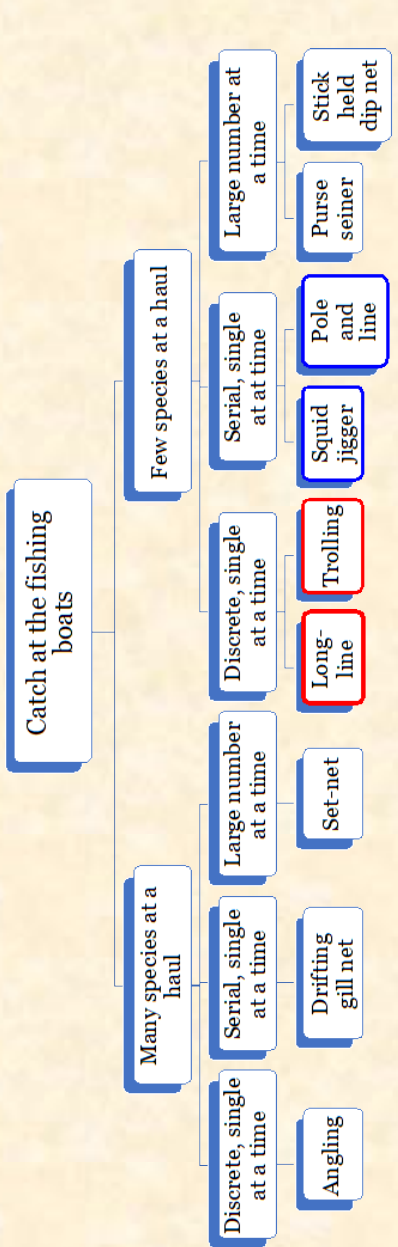
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- Rapid data processing speed for sorting devices
- Require sorting mechanical device
- Process-dependent accuracy of sensing
- Stand-alone and small-footprint system

Thank you for your attention

Fishing method - landing method matrix



Sorting on board					
				Sorting on board	
	Sorting on board				
			Sorting at market		At catching
		Sorting on board			
					on board