Food and Agriculture Organization of the United Nations

منظمة الأغذية والزراعة للأمم المتحدة

Celebrating a Quarter of Century of Responsible Fisheries and Aquaculture

Lionel Dabbadie

Senior Fisheries and Aquaculture Officer
FAO Subregional Office for the GCC States and Yemen
Abu Dhabi, United Arab Emirates

Asian Institute of Technology
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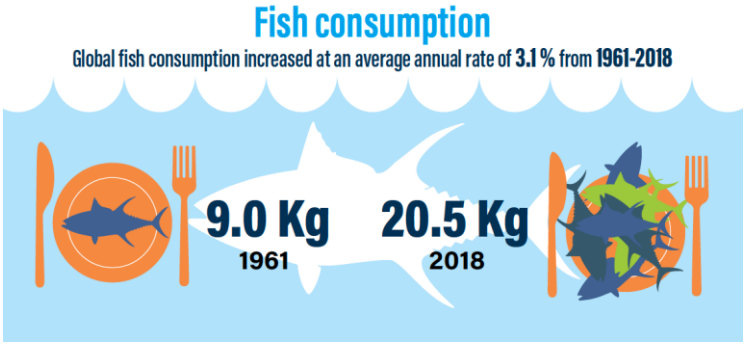
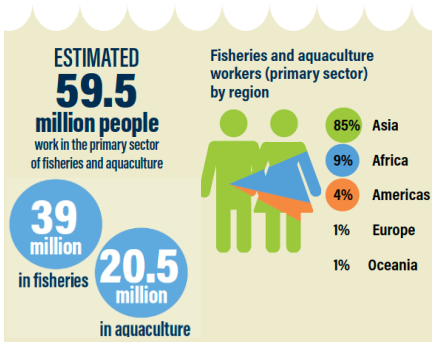
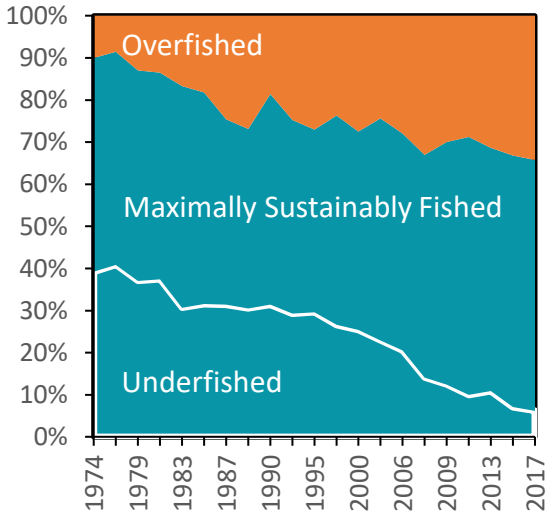
On 31 October 1995, over 170 countries adopted the Code of Conduct for Responsible Fisheries

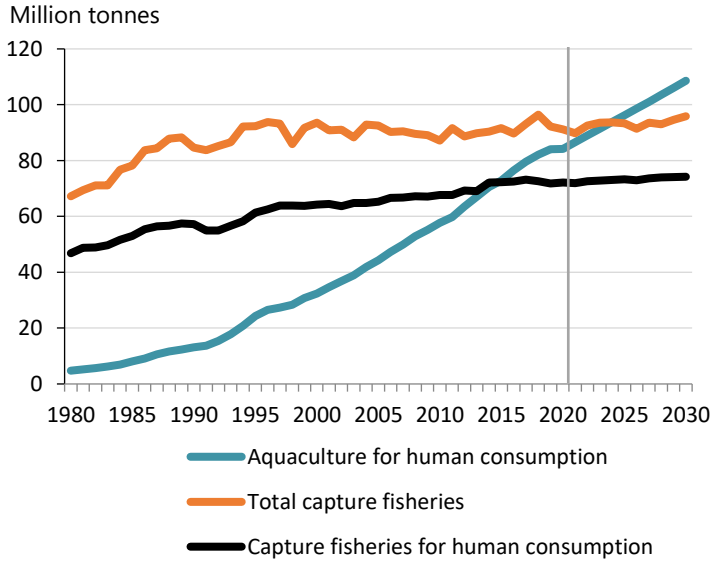
1982	United Nations Convention on the Law of the Sea
1989	*Our Common Future*, the Brundtland Commission
1991	The Committee on Fisheries (COFI) recommends the development of the concept of responsible fisheries
1992	Declaration of Cancún during the International Conference on Responsible Fisheries calling for a Code of Conduct on Responsible Fisheries
1993	Agreement to Promote Compliance with International Conservation and Management Measures by Fishing Vessels on the High Seas
1993 - 1995	FAO organized a series of technical meetings to formulate the Code of Conduct, which resulted in an agreement being reached on the text of the Code of Conduct for Responsible Fisheries
1995	The 28th Session of the FAO Conference adopts the Code of Conduct for Responsible Fisheries

Why is CCRF so important ?

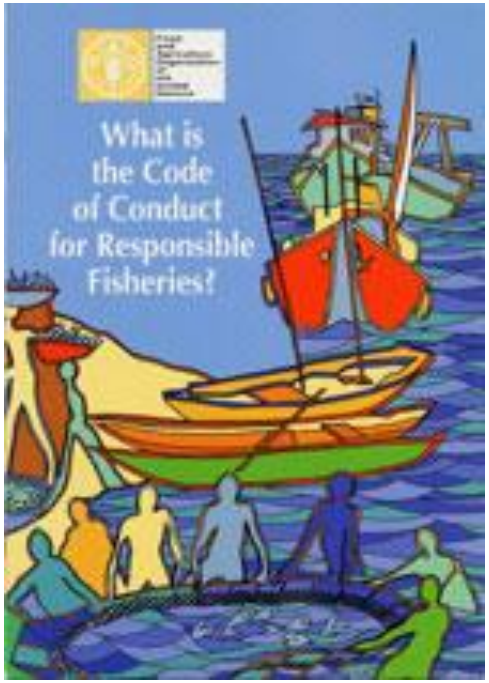






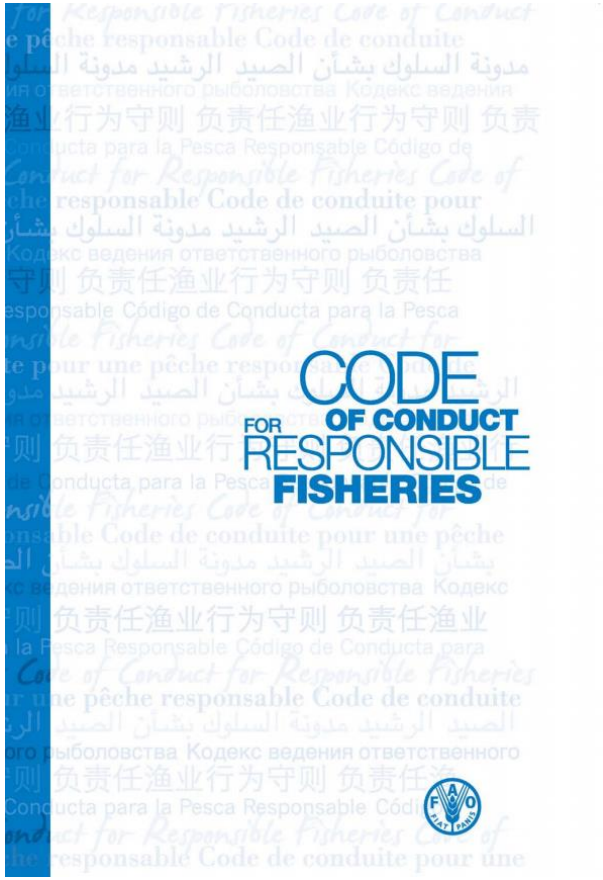


What is the Code of Conduct for Responsible Fisheries (CCRF) ?



- The CCRF is a collection of principles, goals and elements to support sustainable fisheries and aquaculture;
- It represents a global consensus on a wide range of fisheries and aquaculture issues;
- It is voluntary;
- It is currently available in 27 languages on: http://www.fao.org/documents/card/en/c/e6cf549d-589a-5281-ac13-766603db9c03/
- Its implementation is monitored by FAO.

How does it look like?



Twelve articles

- Article 1 / Nature and scope of the Code
- Article 2 / Objectives of the Code
- Article 3 / Relationship with other international instruments
- Article 4 / Implementation, monitoring and updating
- Article 5 / Special requirements of developing countries
- Article 6 / General principles
- Article 7 / Fisheries management
- Article 8 / Fishing operations
- Article 9 / Aquaculture development
- Article 10 / Integration of fisheries into coastal area management
- Article 11 / Post-harvest practices and trade
- Article 12 / Fisheries research

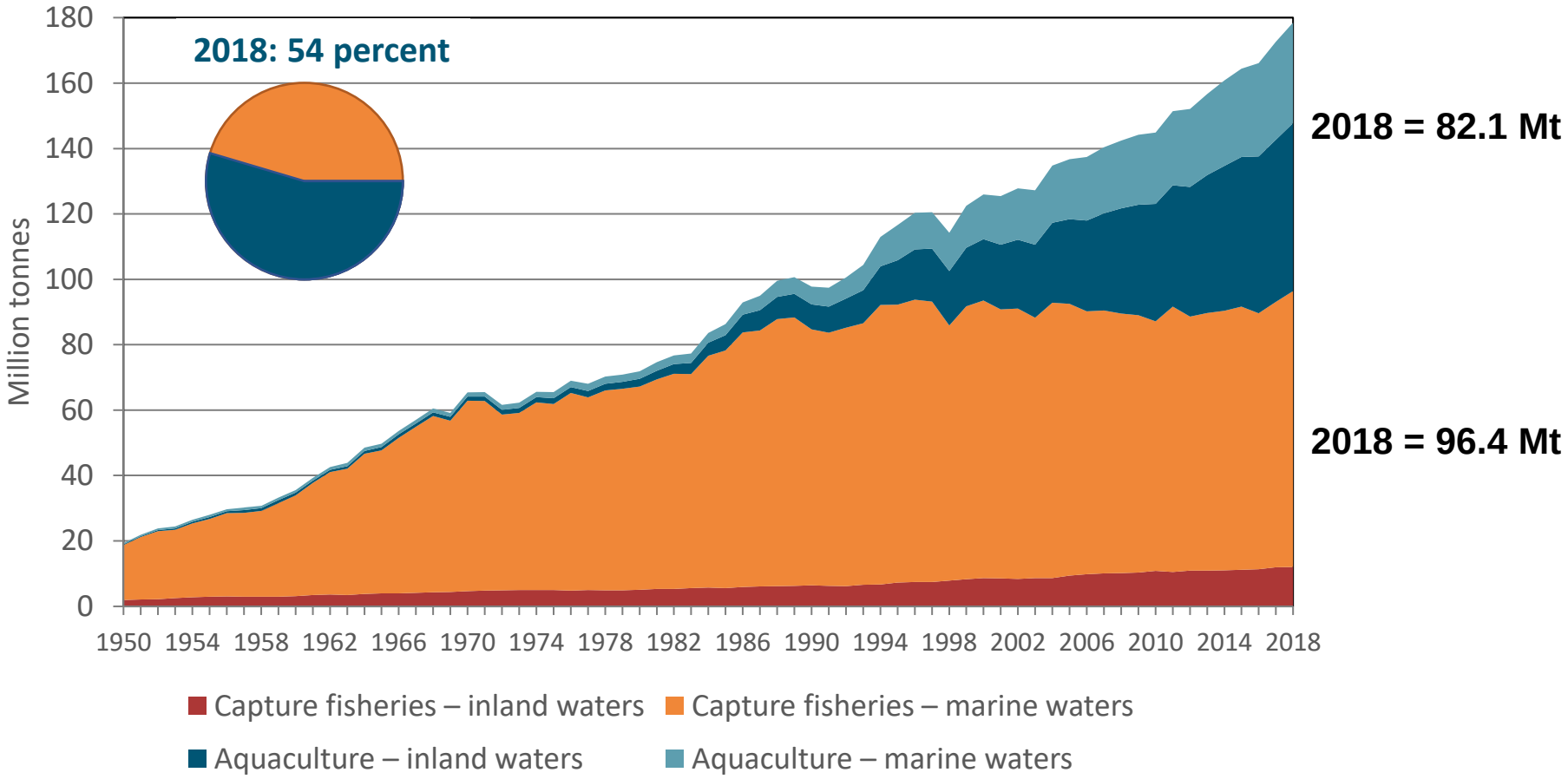
Two annexes

- Annex 1 / Background to the origin and elaboration of the Code
- Annex 2 / Resolution 4/95

Nineteen general principles and many specific ones

1. Effective conservation.
2. Fisheries management.
3. Prevention of overfishing.
4. Decisions based on scientific evidence, data and traditional knowledge.
5. Precautionary approach.
6. Selective and environmentally safe fishing gear and practices.
7. Harvesting, handling, processing and distribution of fish must maintain the nutritional value, quality and safety of the products, reduce waste and minimize negative impacts on the environment.
8. Protection of habitats.
9. Integrated coastal area management, planning and development.
10. Monitoring and control of vessels.
11. Effective control over vessels flying under a country's flag.
12. Sub-regional, regional and global cooperation.
13. Transparent, participatory and timely decisions.
14. Compliancy with the principles, rights and obligations established in the World Trade Organization (WTO)
15. Peaceful handling of disputes
16. Education and training, and involvement of fishers and fish farmers in policy formulation and implementation
17. Safe, healthy and fair working and living conditions
18. Protection of the rights of fishers and fish workers, particularly those engaged in subsistence, small-scale and artisanal fisheries, to a secure and just livelihood, as
19. Aquaculture, including culture-based fisheries, promote diversification of income and diet. Resources must be used responsibly and adverse impacts on the environment and on local communities must be minimized.

A flexible and evolving framework, in line with the changes in fisheries and aquaculture



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A series of Technical Guidelines for Responsible Fisheries and Aquaculture to implement the CCRF

etc.

http://www.fao.org/fishery/topic/166351/en

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FAO Technical Guidelines for Responsible Fisheries available in support to Sustainable Aquaculture Development

Integration of fisheries into coastal area management. FAO Technical Guidelines for Responsible Fisheries. No. 3. http://www.fao.org/docrep/003/W3593E/w3593e00.htm

Aquaculture development. FAO Technical Guidelines for Responsible Fisheries No.5. http://www.fao.org/tempref/docrep/fao/003/W4493e/W4493e00.pdf

Aquaculture development. 9. Development of aquatic genetic resources: A framework of essential criteria FAO Technical Guidelines for Responsible Fisheries No. 5 Suppl. 9. http://www.fao.org/3/ca2296en/CA2296EN.pdf

Aquaculture development. 7. Aquaculture governance and sector development FAO Technical Guidelines for Responsible Fisheries No. 5 Suppl. 7. http://www.fao.org/3/a-i7797e.pdf

Aquaculture development. 6. Use of wild fishery resources for capture-based aquaculture FAO Technical Guidelines for Responsible Fisheries No.5 Suppl. 6. http://www.fao.org/docrep/014/ba0059e/ba0059e.pdf

Aquaculture development. 5. Use of wild fish as feed in aquaculture FAO Technical Guidelines for Responsible Fisheries No.5 Suppl. 5. http://www.fao.org/3/a-i1917e.pdf

Aquaculture development. 4. Ecosystem approach to aquaculture FAO Technical Guidelines for Responsible Fisheries No.5 Suppl. 4. http://www.fao.org/docrep/013/i1750e/i1750e.pdf

Aquaculture development. 3. Genetic resource management FAO Technical Guidelines for Responsible Fisheries No.5 Suppl. 3. http://www.fao.org/3/a-i0283e.pdf

Aquaculture development. 2. Health management for responsible movement of live aquatic animals FAO Technical Guidelines for Responsible Fisheries No.5 Suppl. 2. http://www.fao.org/3/a-a1108e.pdf

Aquaculture development. 1. Good aquaculture feed manufacturing practice FAO Technical Guidelines for Responsible Fisheries No.5 Suppl. 1. http://www.fao.org/3/a-y1453e.pdf

Responsible fish utilization. FAO Technical Guidelines for Responsible Fisheries No.7 http://www.fao.org/tempref/docrep/fao/003/w9634e/w9634e00.pdf

Responsible fish trade. FAO Technical Guidelines for Responsible Fisheries. No. 11. http://www.fao.org/3/a-i0590e.pdf

Information and knowledge sharing. FAO Technical Guidelines for Responsible Fisheries No.12. http://www.fao.org/tempref/docrep/fao/011/i0587e/i0587e00.pdf

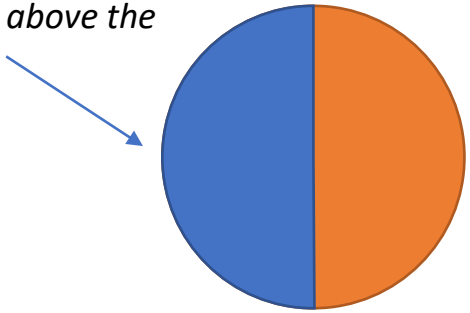
Existing FAO tools in support to implementation of CCRF in aquaculture

Aquaculture Feed and Fertilizer Resources Information System (AFFRIS)	http://www.fao.org/fishery/affris/affris-home/en/
Aquatic Genetic Resources - A valuable and unexplored reserve of biodiversity for food and agriculture	http://www.fao.org/aquatic-genetic-resources/home/en/
Database on Introductions of Aquatic Species	http://www.fao.org/fishery/introsp/search/en
Documents published by the Fisheries and Aquaculture Department	http://www.fao.org/fishery/publications/search/en
EAA toolbox	Available soon on the model of the EAF toolbox http://www.fao.org/fishery/eaf-net/toolbox/en
FAO Aquaculture Newsletter (FAN)	http://www.fao.org/fishery/publications/fan/en
FAO Aquaculture portal	http://www.fao.org/aquaculture/en/
FAO yearbook. Fishery and Aquaculture Statistics	http://www.fao.org/fishery/publications/yearbooks/en
Fishery and Aquaculture Statistics	http://www.fao.org/fishery/statistics/en
Global Gateway to Geographic Information Systems (GIS), Remote Sensing and Mapping for Aquaculture and Inland Fisheries	http://www.fao.org/fishery/collection/gisfish/en
National Aquaculture Legislation Overview (NALO)	http://www.fao.org/fishery/collection/nalo/en
National Aquaculture Sector Overview (NASO)	http://www.fao.org/fishery/naso-maps/naso-home/en/
National Aquaculture Sector Overview (NASO) Aquaculture Fact Sheets	http://www.fao.org/fishery/naso/search/en
National Aquaculture Sector Overview (NASO) Maps	http://www.fao.org/fishery/naso-maps/naso-maps/en/
Regional Aquaculture Networks	http://www.fao.org/fishery/statistics/networks/en
The African Water Resource Database (AWRD)	http://www.fao.org/fishery/gisfish/id/2389
World Aquaculture Performance Indicators (WAPI)	http://www.fao.org/fishery/statistics/software/wapi/en

The way forward: expand and implement

FAO Sub-Committee on Aquaculture (2019):
113 or 57 percent of the total number of FAO Members have answered the bi-annual survey

"Half of the responding Members had a relatively high performance, i.e. above the global average."



"Of the other half, which had a lower performance, some had low and very low scores and these include some of the aquaculture producers classified as low-income food-deficit countries."

FAO. 2019 Progress reporting on the implementation of the Code of Conduct for Responsible Fisheries (CCRF) provisions relevant to aquaculture and culture-based fisheries http://www.fao.org/3/mz970en/mz970en.pdf

Fisheries management works
Sustainable aquaculture is now a reality

But the support to the implementation of the CCRF principles needs to be pursued

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Aquaculture in the desert: the example of GCC countries

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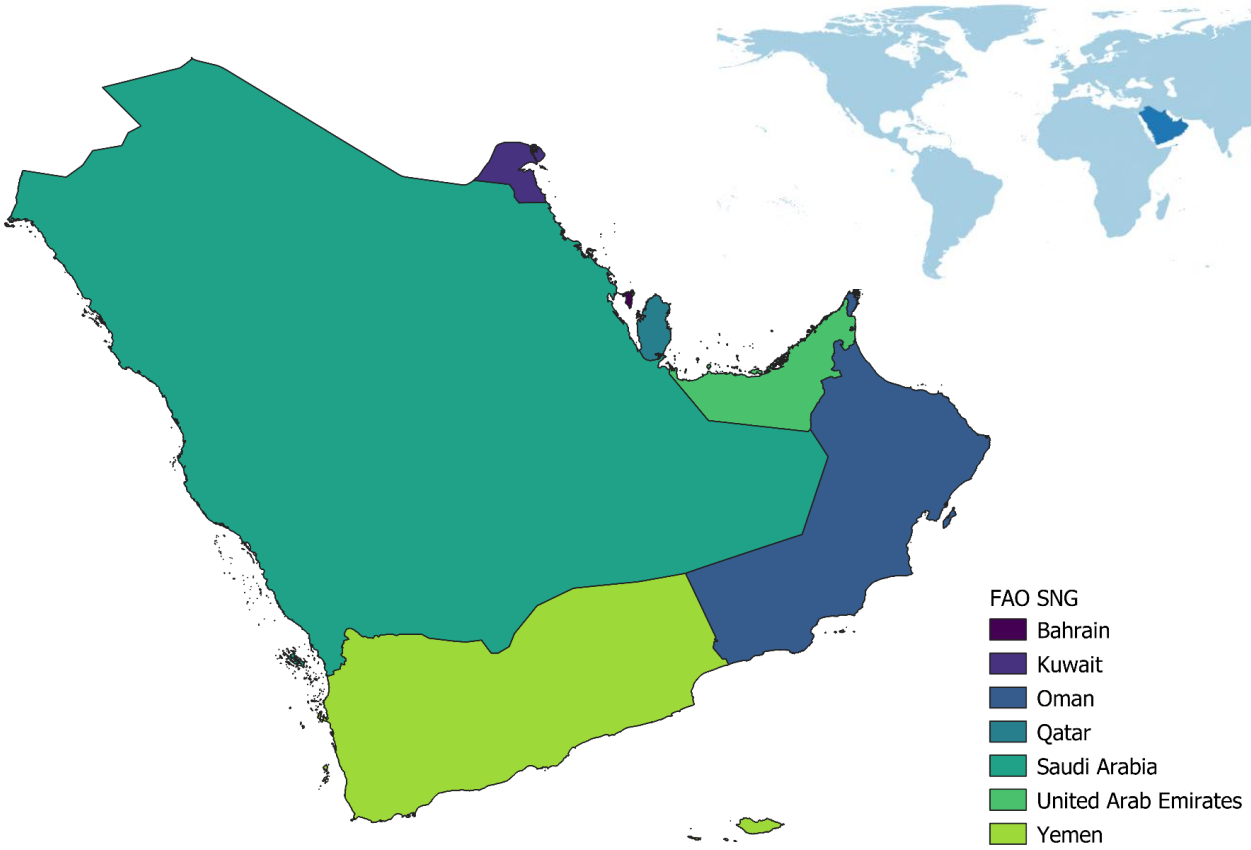
The Gulf Cooperation Council States & Yemen



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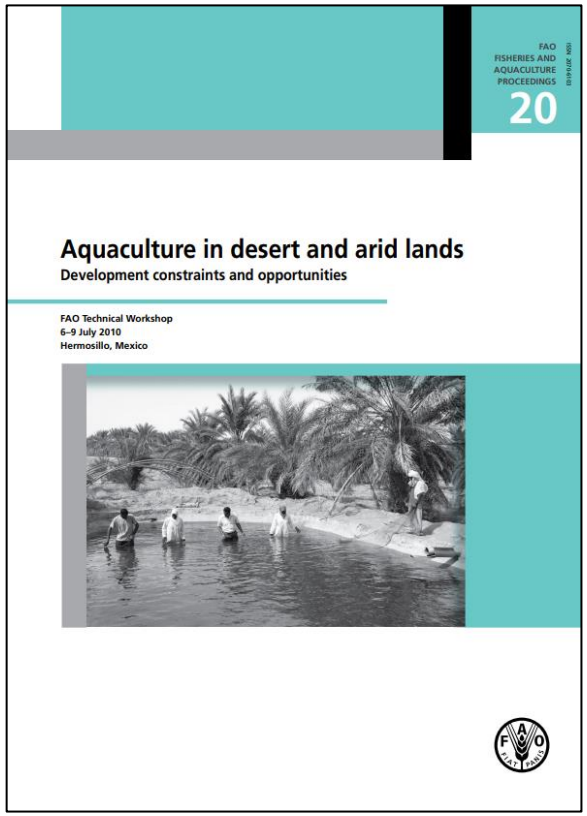
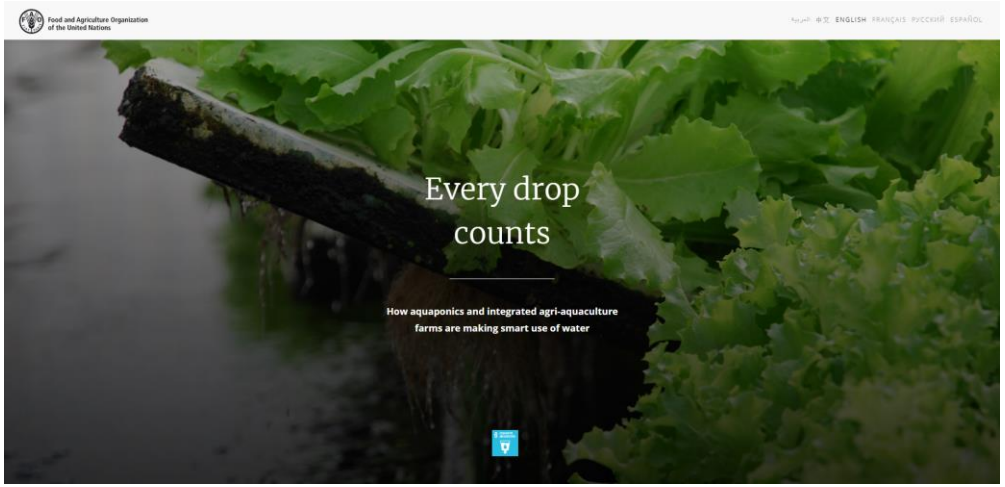
للأمم المتحدة

Farming fish in the desert?

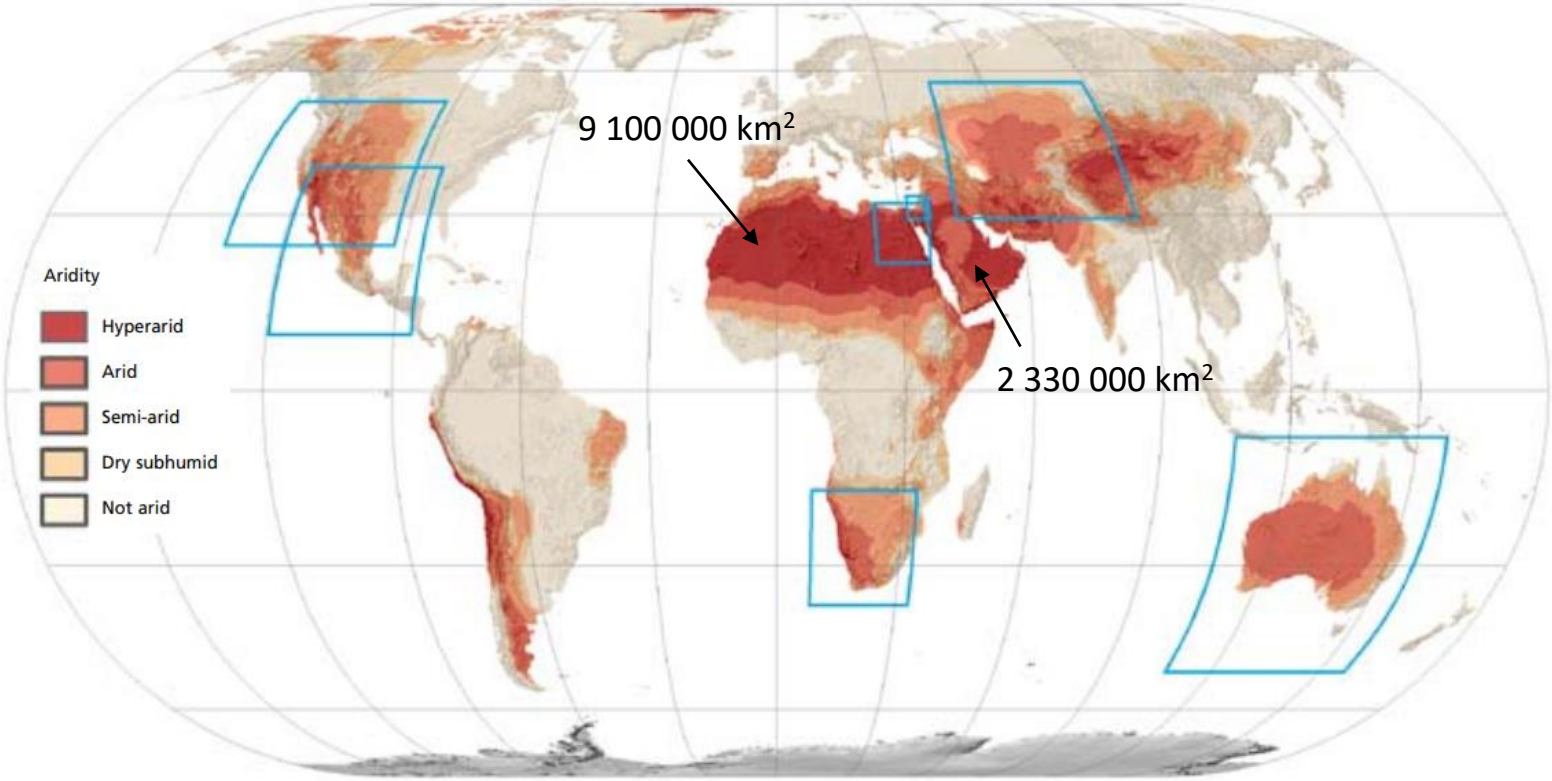
Farming fish in the desert is not a mirage!



- The idea emerged in 1963-1965
- FAO organized a global technical workshop in 2010, covering seven regions
- FAO supported the *Water Scarcity Initiative* in North Africa-Near East region



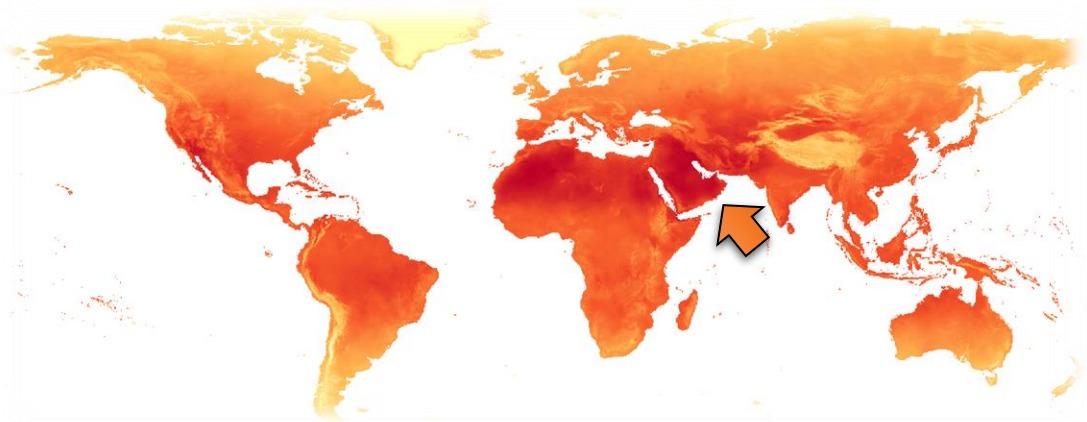
20 485 310 km² of deserts



<u>For comparison</u>:

Russia=17 098 242 km², Canada=9 984 670 km²,
China=9 706 961 km² and USA=9 372 610 km²

Deserts in the world



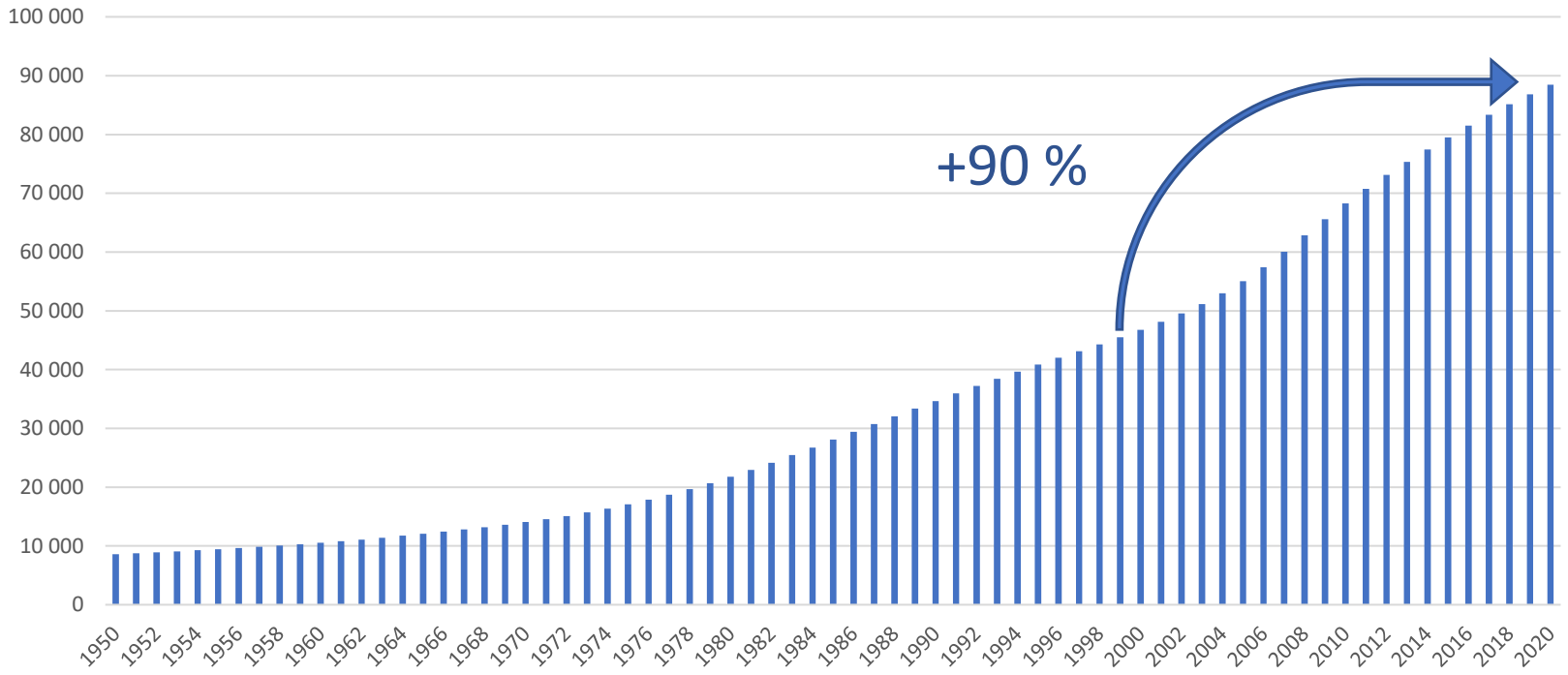
Hot

and dry

A fast growing population:

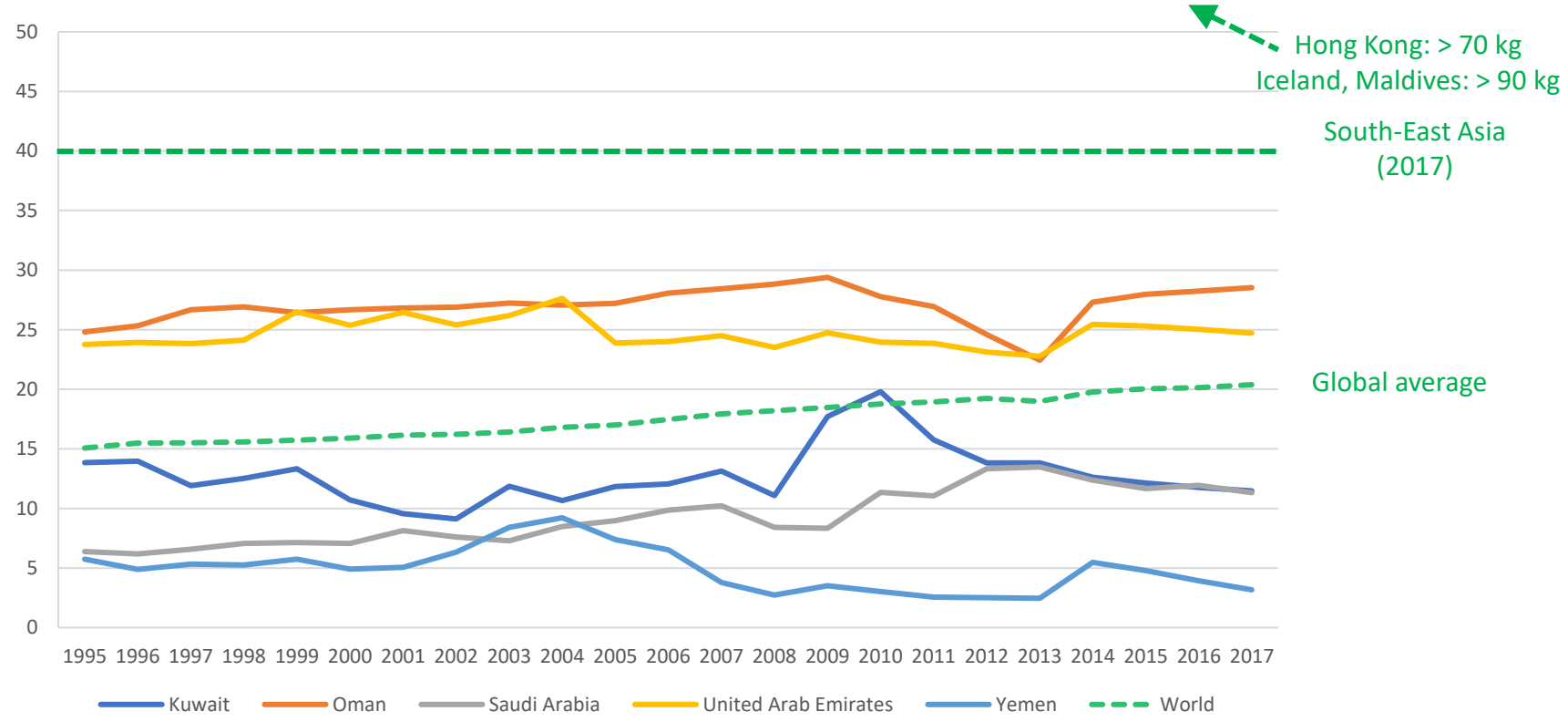
the desert is not desert

(x 1000)



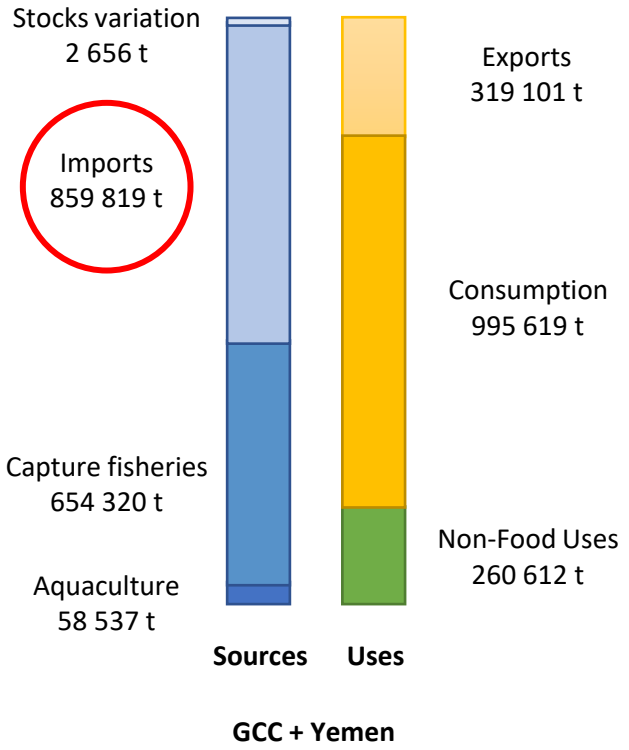
United Nations, Department of Economic and Social Affairs, Population Division (2019). World Population Prospects 2019, Online Edition. Rev. 1.

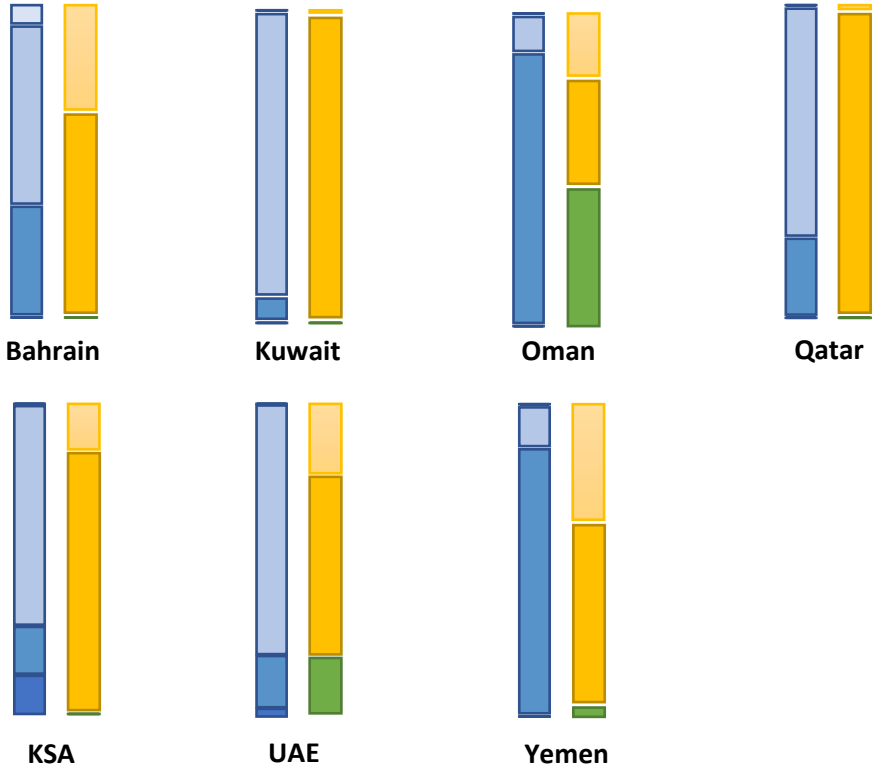
Fish consumption
(kg/capita/year)



(FAO, 2020)

Food Balance Sheet in 2017





(FAO, 2020)

All countries have access to sea, with ancient cultural values associated to it

https://thegamming.org/2014/04/15/sailing-on-dhows-and-working-in-the-auto-industry/

The fishing profession has been inherited from our parents and grandparents, so we must preserve it and support its continuity

H.H. Sheikh Hamdan

Pearl oyster fishing in the UAE

- Started 7000 years ago and ended in 1920s, with the discovery and development of pearl oyster aquaculture in Japan

- In the beginning of the XXth century, more than 1,200 boats carried over 20,000 men for each annual pearling season

- Recommended movie
  https://www.youtube.com/watch?v=aWJhzsWHVQ8

Mikimoto Kōkichi
(wikipedia)

https://www.danat.bh/timeline/board-3/

Break

Importance of the Gulf for GCC countries

Sea area	Country	Coastline (km)	Total (km)
Gulf	Bahrain	161 (100%)	**3121** (30%)
	Kuwait	499 (100%)	
	Oman	50 (2%)	
	Qatar	563 (100%)	
	Saudi Arabia	580 (22%)	
	UAE	1268 (96%)	
Others	Oman	3115 (98 %)	**7131** (70%)
	Saudi Arabia	2060 (78%)	
	UAE	50 (4%)	
	Yemen	1906 (100%)	

The World Factbook, 2020

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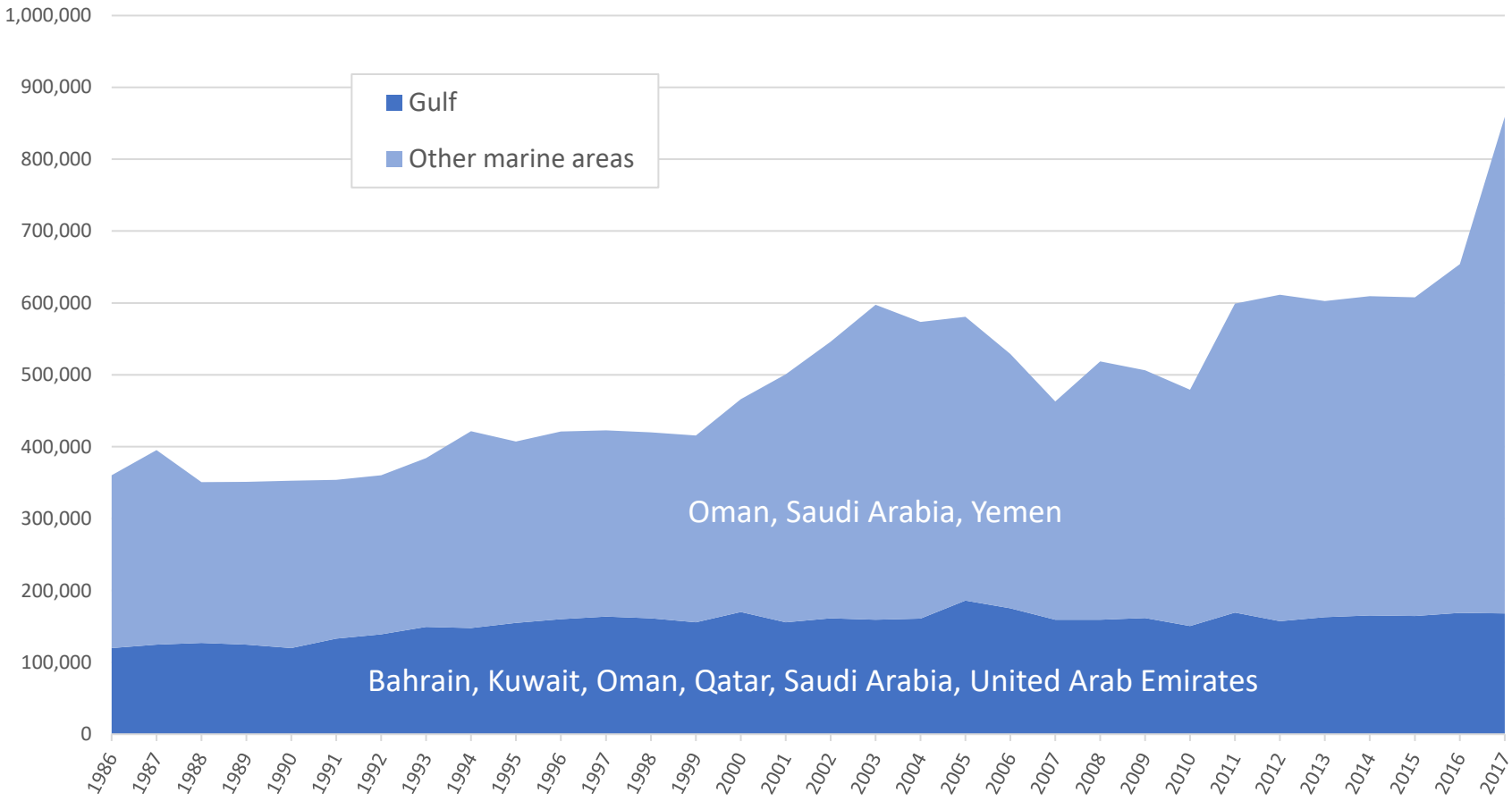
Capture fisheries in the GCC States and Yemen

MT (FAO and RECOFI, 2020)

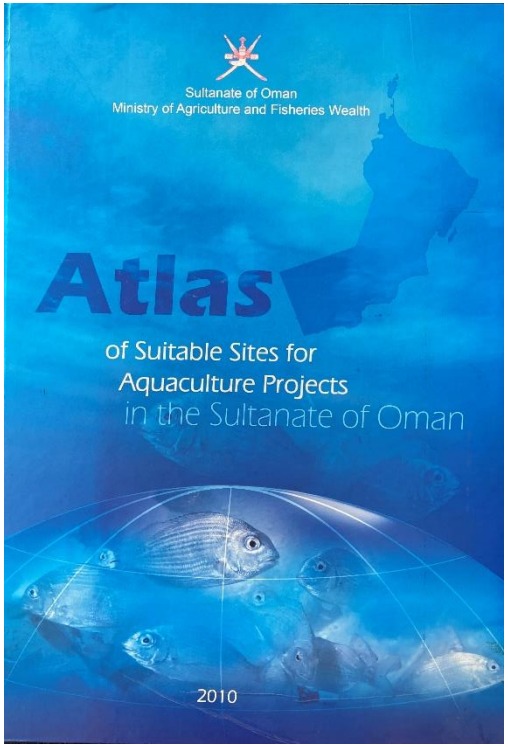


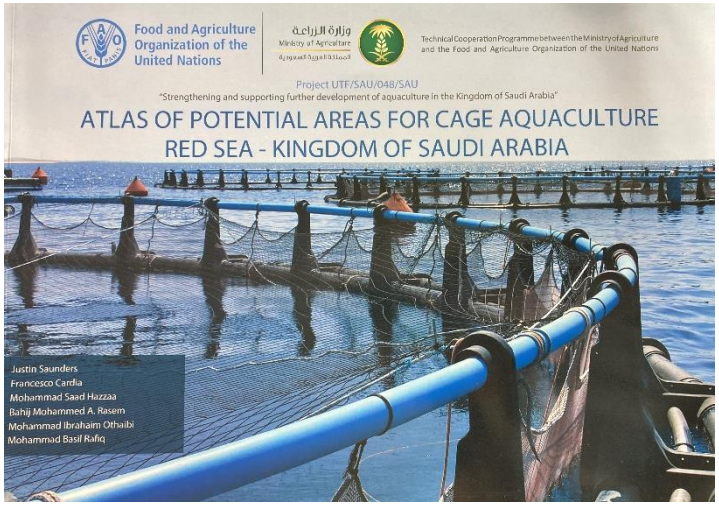
Sustaining the consumption of native/endangered species

- Accurate information on the ecology and state of individual stocks and species continues to remain difficult
- Fears of over-exploitation on several emblematic species such as kingfish (*Scomberomorus commerson*), shrimps and a range of percid fishes, particularly groupers.

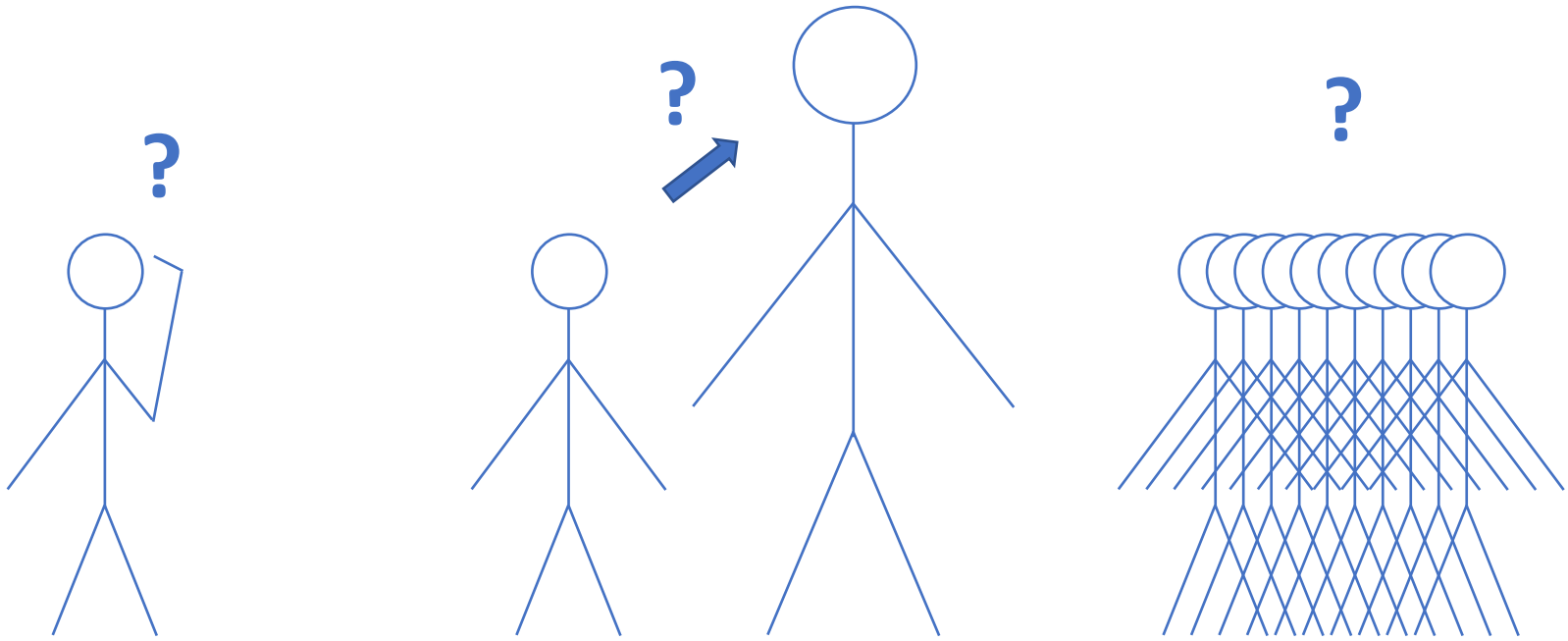
REGIONAL COMMISSION FOR FISHERIES
RECOFI
اللجنة الإقليمية لمصايد الأسماك

Developing aquaculture is now a priority for all GCC countries





Different countries, different challenges

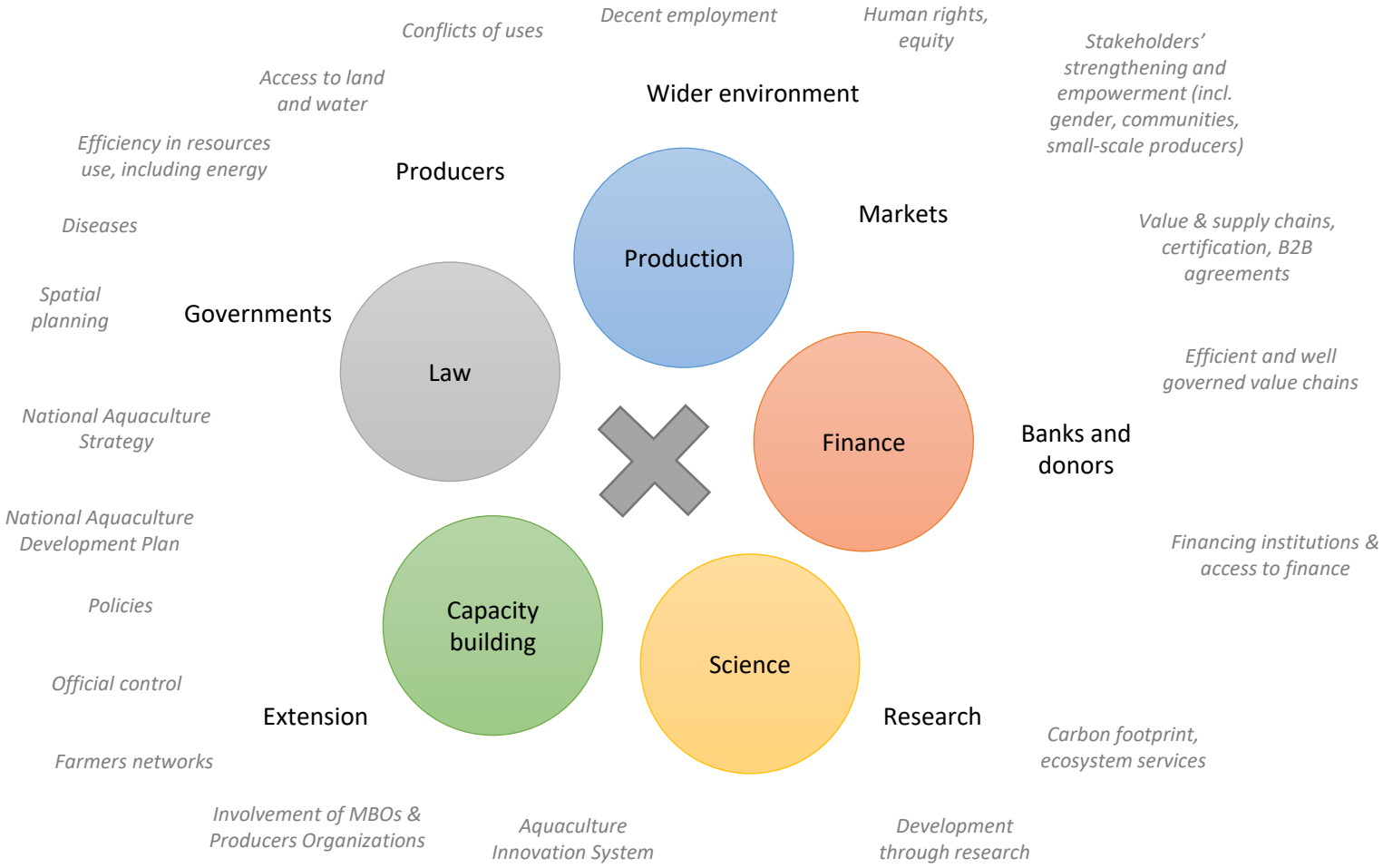


New entrants

Emerging aquaculture countries

Advanced aquaculture countries

Operationalizing an enabling environment



The complexity of development and the panaceas

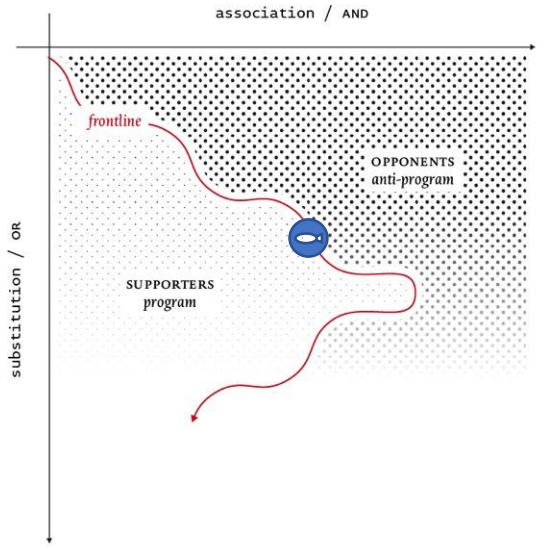
« *To explain the world of interactions and outcomes occurring at multiple levels, we also have to be willing to deal with complexity instead of rejecting it* »

Elinor Ostrom
Nobel Prize Lecture
(December 8, 2009 & 2007)

« *We call attention to perverse and extensive uses of policy panaceas in misguided efforts to make social-ecological systems […] sustainable overtime. It is not enough, however, just to call attention to the inadequacy of the panaceas that are prescribed as simple solutions to complex SESs. […] Unfortunately, the preference for simple solutions to complex governance problems continues to be strong* »

The development process

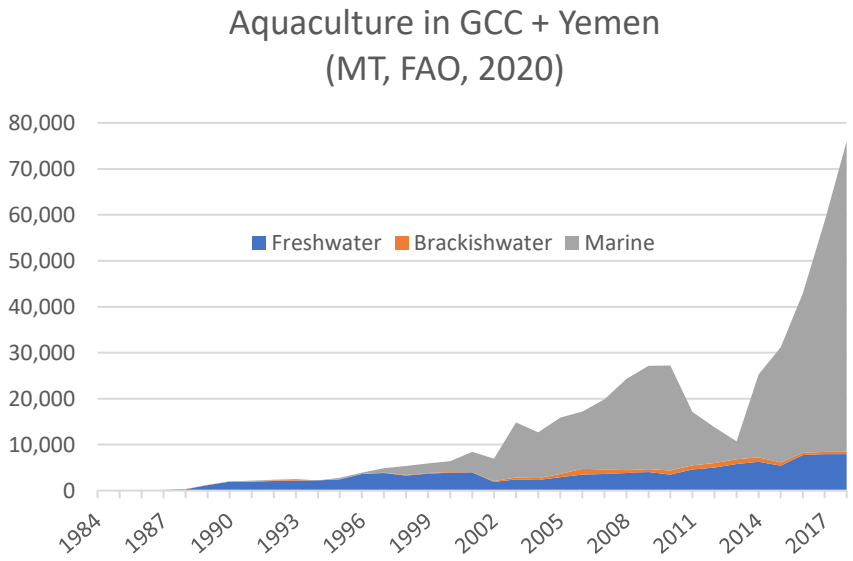
- Aquaculture development is not a linear process
- Disabling factors can defines the effectivity of enabling environment
  - "Remove" the disabling factor
  - And/or shift to "avoid" the disabling factor

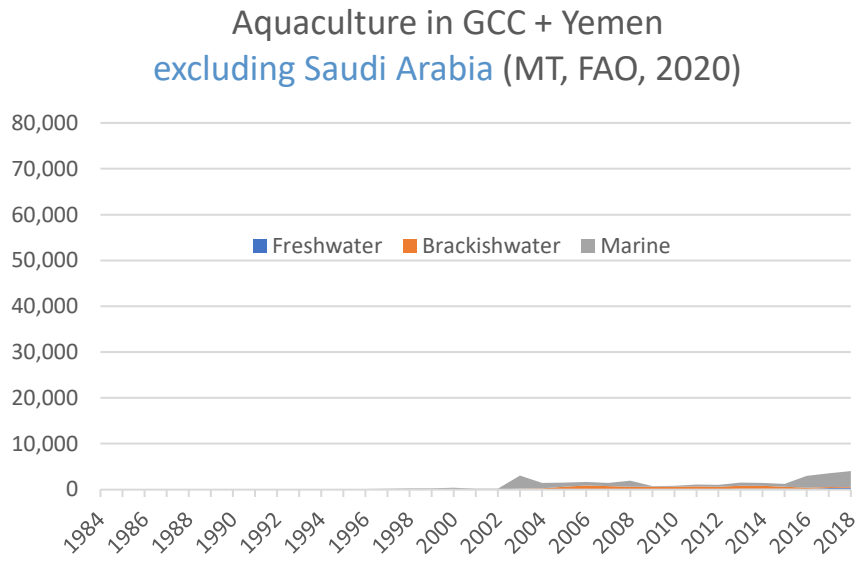


***Bruno Latour**, MOOC Scientific Humanities (2014)*

Aquaculture in the GCC States and Yemen

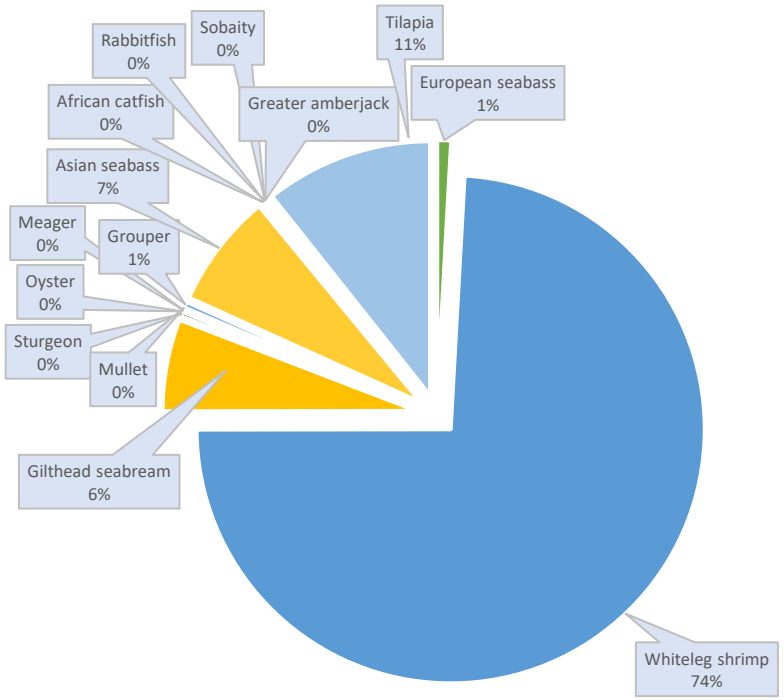
MT (FAO, 2020)

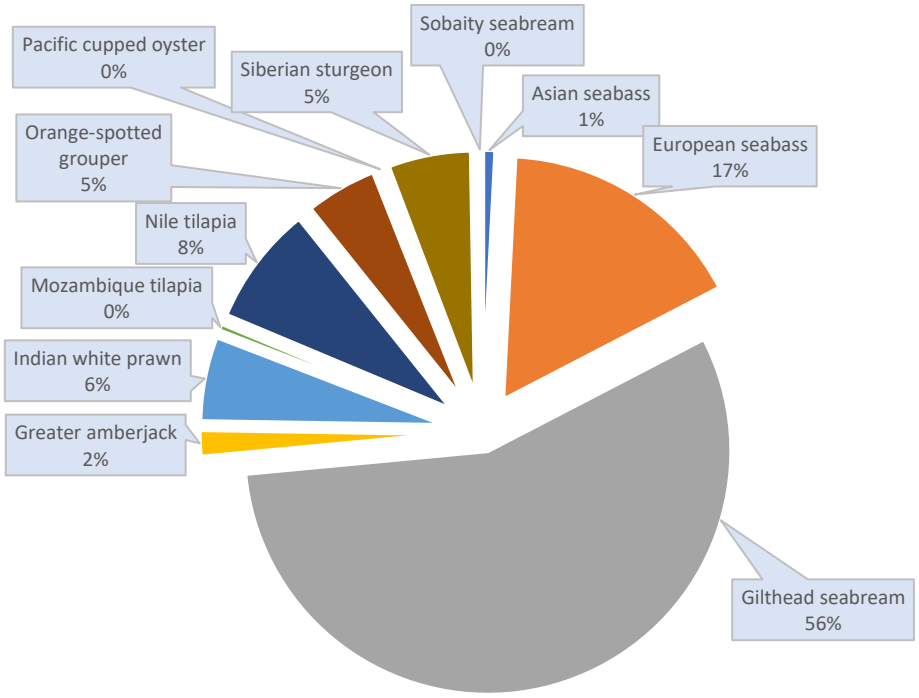




Species farmed in the GCC states + Yemen

39 species have been reported as being farmed between 1950 and 2018:
23 marine finfish; 10 freshwater finfish; 4 shrimps; 1 oyster; 1 sea cucumber





Excluding Saudi Arabia

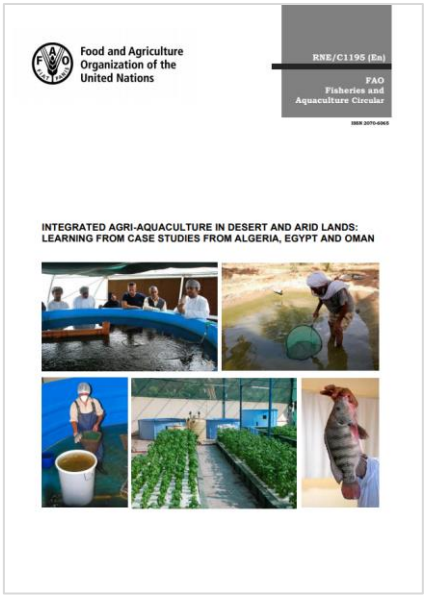
(FAO, 2020)

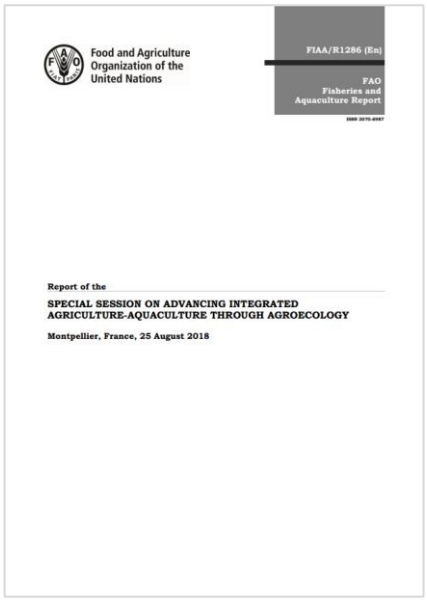
Freshwater aquaculture in the desert

GCC countries have an ancient expertise in managing water

The resource is *scarce* and *valuable*, but not *inexistent*

Freshwater aquaculture in the desert





- Integrated or recirculated aquaculture are the main venues
- Irrigation-Aquaculture integration (cages in water storage dams)
- Aquaponics

Aquaponics experiment at SQU Oman (Dr. Wenresti Gallardo)

Integrated agriculture-aquaculture farm in Al Ain (Swing Farm, UAE)

Azola and duckweed

Irrigated crops (upper level)

Irrigated crops (lower level)

Fish growing-out

Forestry

Hatchery

Irrigated crops (lower level)

Animal production (eggs, chicken, goats)

Economic analysis of an integrated tilapia farm in Oman

1. Total area under fish production: 1200 m^2
2. Annual production: 36 tons
3. Production per cycle and per tank is 3.6 tons
4. Ten harvests per year
5. 120 000 fingerlings per year (1 g ABW)
6. Mortality rate: 15 percent per culture cycle
7. Grow-out in tanks until until 250-350 g ABW at a stocking density of 16.6 kg/m^3
8. 260 days from fingerling to 350 g ABW
9. Water is exchanged at a rate of 20-30 percent weekly and replaced waste water is used for plant irrigation purposes
10. One Omani Rial = 2.6 USD

Economic analysis of an integrated tilapia farm in Oman

Item	Cost (USD)	Shelf life (years)	Depreciation (USD/year)
Fish tanks	28600	15	1905
Plumping work	1560	15	104
Shade	12470	15	850
Water pumps (2)	5200	7	744
Air pumps (2)	5200	10	520
Air pipes and stones	1430	5	286
Water heater	3900	10	390
Sedimentation tanks and filters	36400	15	1734
Plastic boxes for water filtration	6760	10	520
Electrical generator	7410	10	741
Total fixed costs (USD)	**109 200**		
Depreciation (USD/year)	**8 281**		

Item	Quantity	Cost (USD)
Fish fingerlings (Male 100 percent)	120 000	15 600
Fish feed (FCR 1.5:1)	54 tons	40 040
Labour		5720
Electricity		611
Other costs		4160
Total variable costs	**66 131**	

Item	Quantity
Fish production (350 g ABW)	36 000 kg
Revenue (price: 2,3 USD/kg)	84 240 USD
Net income	**18 109 USD**
Annual return on assets	20 percent
Payback period	**5 years**

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منظمة الأغذية والزراعة للأمم المتحدة

Aquaponics farms in UAE

Zayed Agricultural Center for Development and Rehabilitation

Aquaponics farms in UAE

Emirates International Agricultural Advanced Company LLC farm

Saline ground water (reverse osmosis)
Eight independent units of:

- Four fish tanks
- One filtration unit

Hatchery (mixed sex)
Hydroponic crops

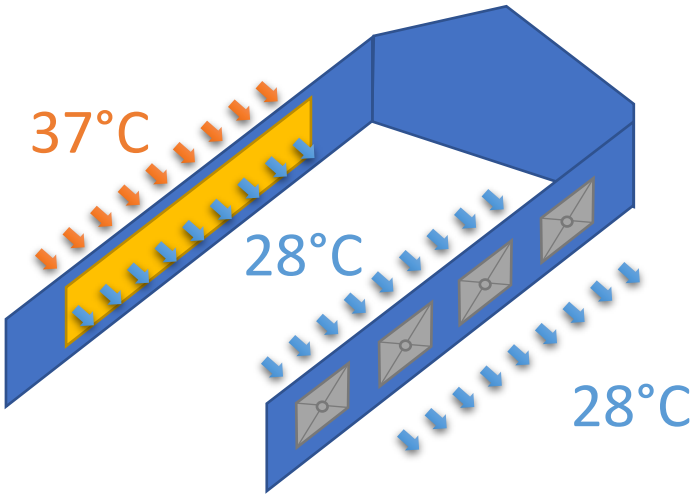
Some aquaponics technico-economic data

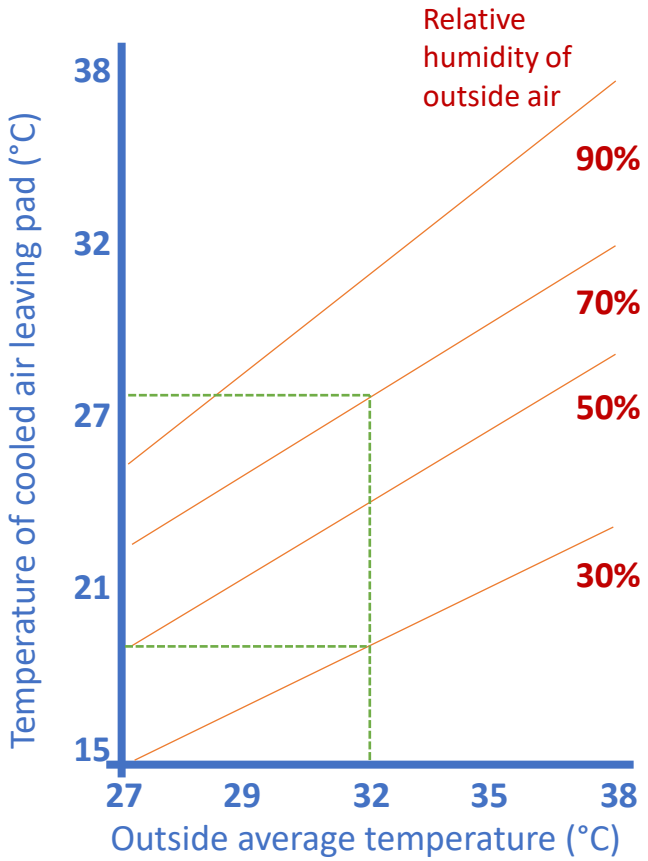
- Commercial size: 0.5-0.8 kg ABW
- Final stocking density: 25-50 kg/m^3
- Production cost is 1.7-1.9 USD/kg
  - ✓ Feed accounts for 1 USD/kg
  - ✓ FCR: 1.5-1.8
- Farm gate price: 3-3.5 USD/kg

Evaporative cooling system

Evaporative cooling system

- Evaporating 1 g of water at 25 °C requires 2400 joules (580 calories) – 6 times more energy than to warm it from 0 to 100°C
- Air flow: 2.5 m^3/minute/m^2 of greenhouse
- Pad area depends on material
- Water flow depends on material
  Generally between 3-9 l/min/m





https://ag.umass.edu/greenhouse-floriculture/fact-sheets/fan-pad-evaporative-cooling-systems

Freshwater aquaculture in the desert

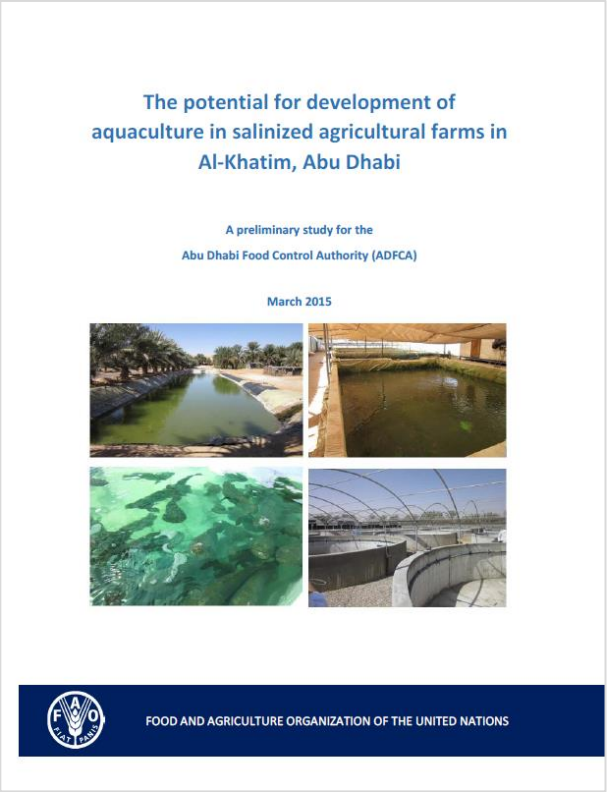
United Aquaculture Company – The Fish Farm, Bahrain




https://www.picuki.com/profile/uac.bh

- Aqua-tourism has proven to be a major driver for aquaculture development in many parts of the world
- One company in Bahrain @uac.bh

Aquaculture in salinized agriculture farms



1. **Tilapia production in an indoor intensive recirculation system**
   - In saline groundwater or desalinated freshwater using aquaponics;
   - Large-scale (100 MT per year; estimated capital investment 680 000 USD) or small-scale (25 MT per year; estimated capital investment 170 000 USD).
2. **Marine finfish production in an indoor intensive recirculation system**
   - Gilthead seabream or Asian seabass;
   - Needs to be large-scale to be economic: 110 MT per year; estimated capital investment 1.4 million USD;
   - Can be reached by combining several smaller projects.
3. **Shrimp production in an indoor biofloc system**
   - Needs to be large-scale to be economic: 18 MT per year; estimated capital investment 330 000 USD;
   - Can be reached by combining several smaller projects.
4. **Stand-alone aquaponics or hydroponics system**
   - The main crop is vegetables and aromatic/medicinal herbs.

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منظمة الأغذية والزراعة للأمم المتحدة

Marine aquaculture in the desert

Recirculated Aquaculture Systems United Arab Emirates

https://www.queenslandcountrylife.com.au/story/6020391/fish-farm-in-the-desert-has-queensland-connection/

Emirates Fish Farm, Al Wathba

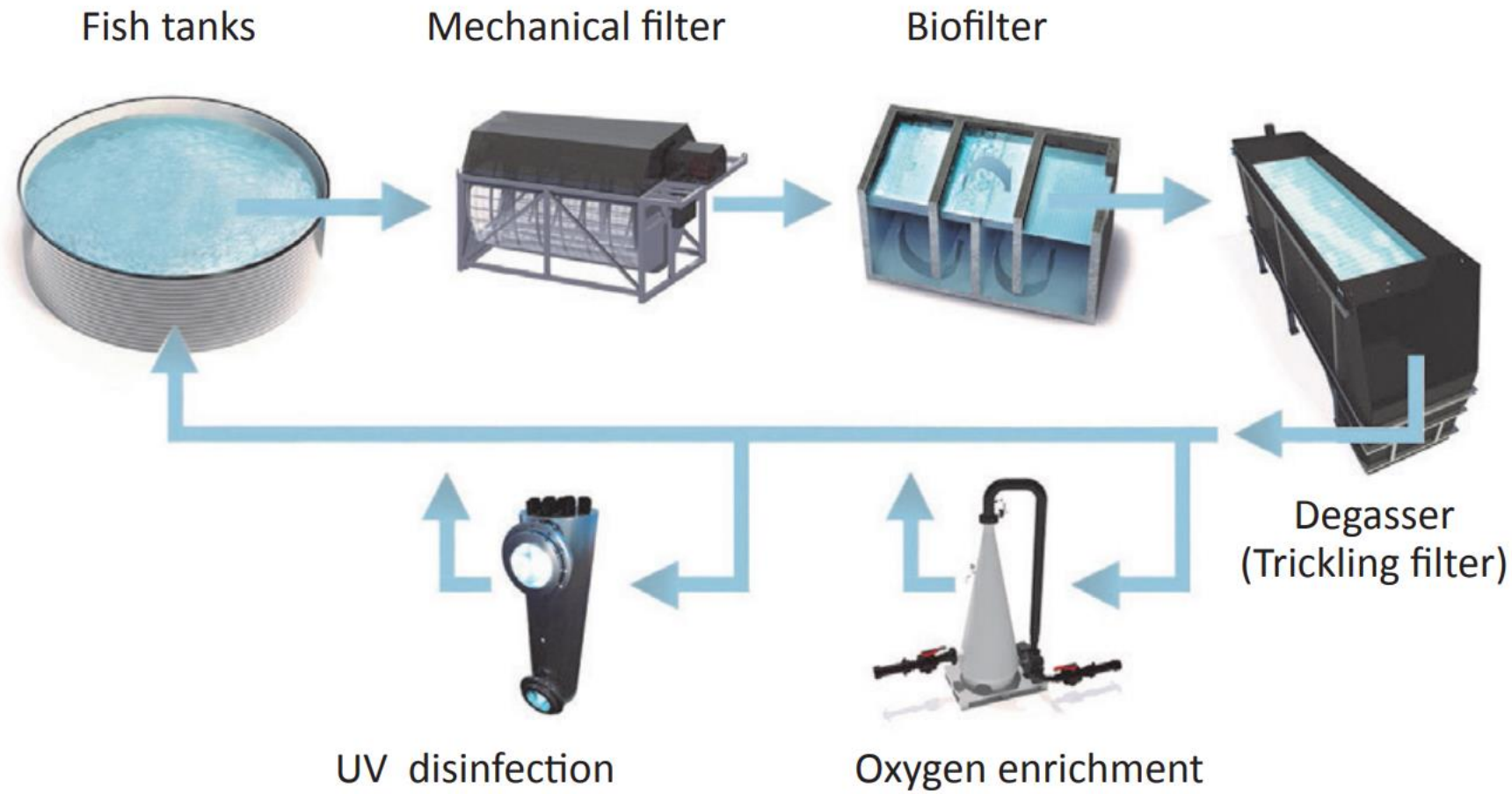
https://www.arabianbusiness.com/tags/fish-farm-0

Fish Farms UAE

https://www.pressreader.com/uae/khaleej-times/20180530/282930976037096

Al Jaraf Fisheries

Recirculated Aquaculture Systems

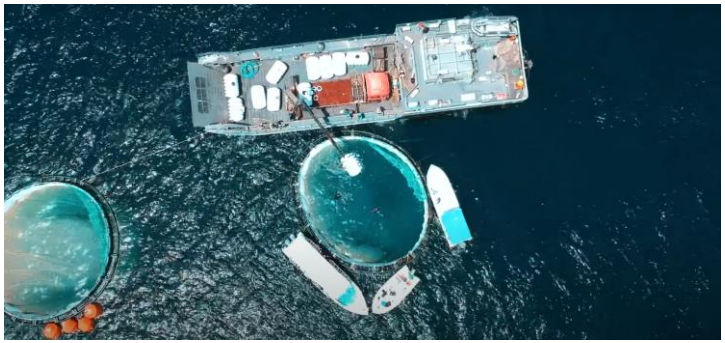


Recirculated Aquaculture Systems

- Cost of cooling/chilling
- Feed
- Equipment maintenance
- Commercial scale and limited economies of scale
- Markets and traceability
- Competition from imports
- Some specific challenges with species farmed, especially the new ones

Marine aquaculture in the desert

Finfish cage culture, Musandam, Oman



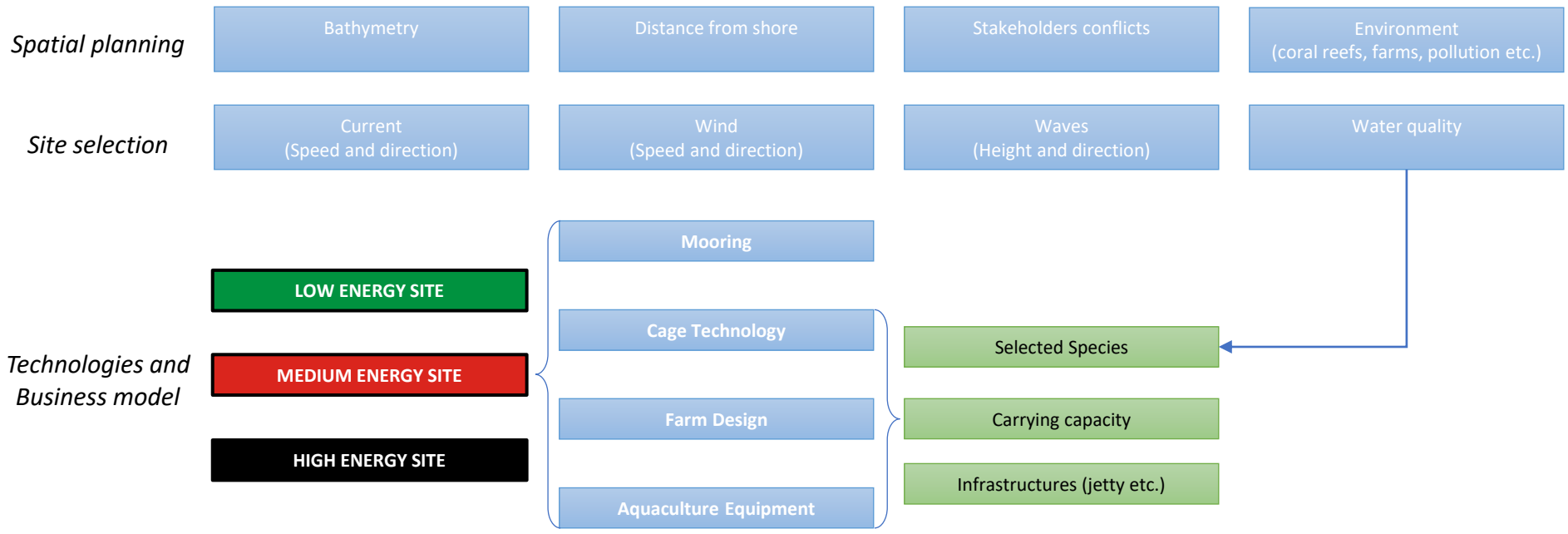
Marine aquaculture in the desert

Dibba Oysters, Fujairah, United Arab Emirates

https://edition.cnn.com/travel/article/oysters-uae/index.html

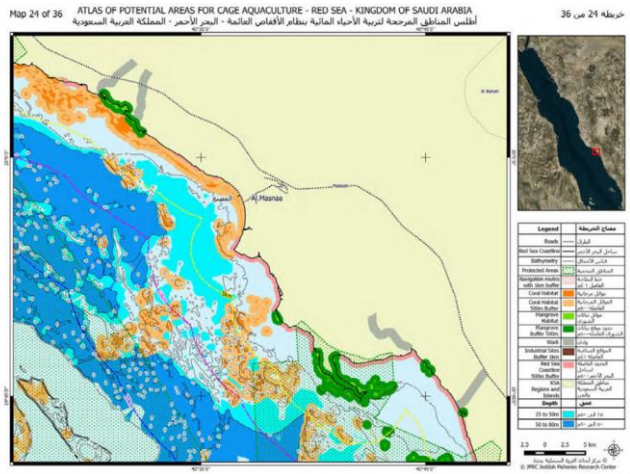
https://life.intercontinental.com/sg/vision-sg/taste-arabian-waters-uaes-first-oyster-farm-fujairah/

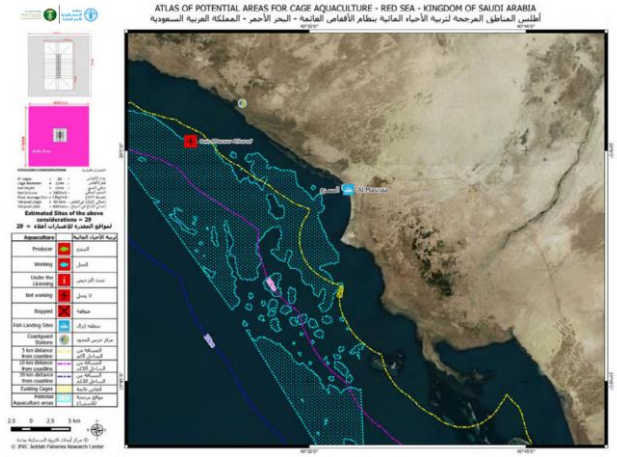
Identifying the suitable technologies



From Alessandro Ciattaglia & Patrick White (adapted)

Marine aquaculture in the Red Sea



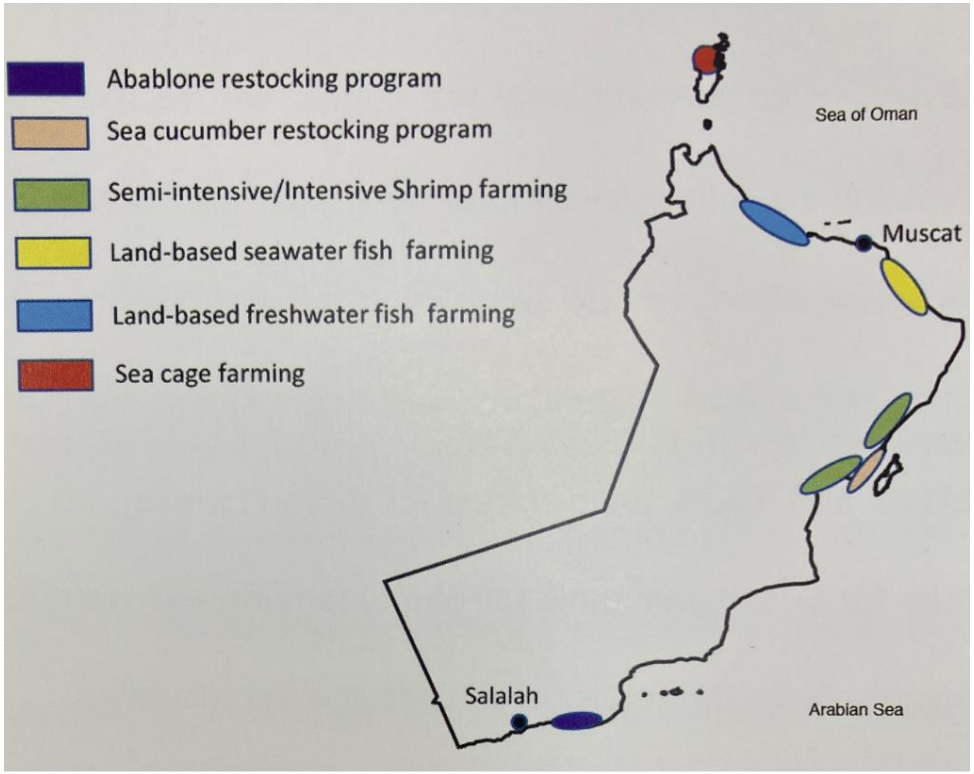


Main criteria used:

- Bathymetry
- Wadis (Rivers)
- Navigation routes
- Protected Areas
- Sensitive habitats and species
- Mangroves
- Corals
- Industrial/desalination plants
- General potential conflicts
- Other offshore cage farms
- Fish landing sites
- Coast guard stations
- Distance from shore

http://www.fao.org/3/a-c0046b.pdf

Arabian Sea and Sea of Oman

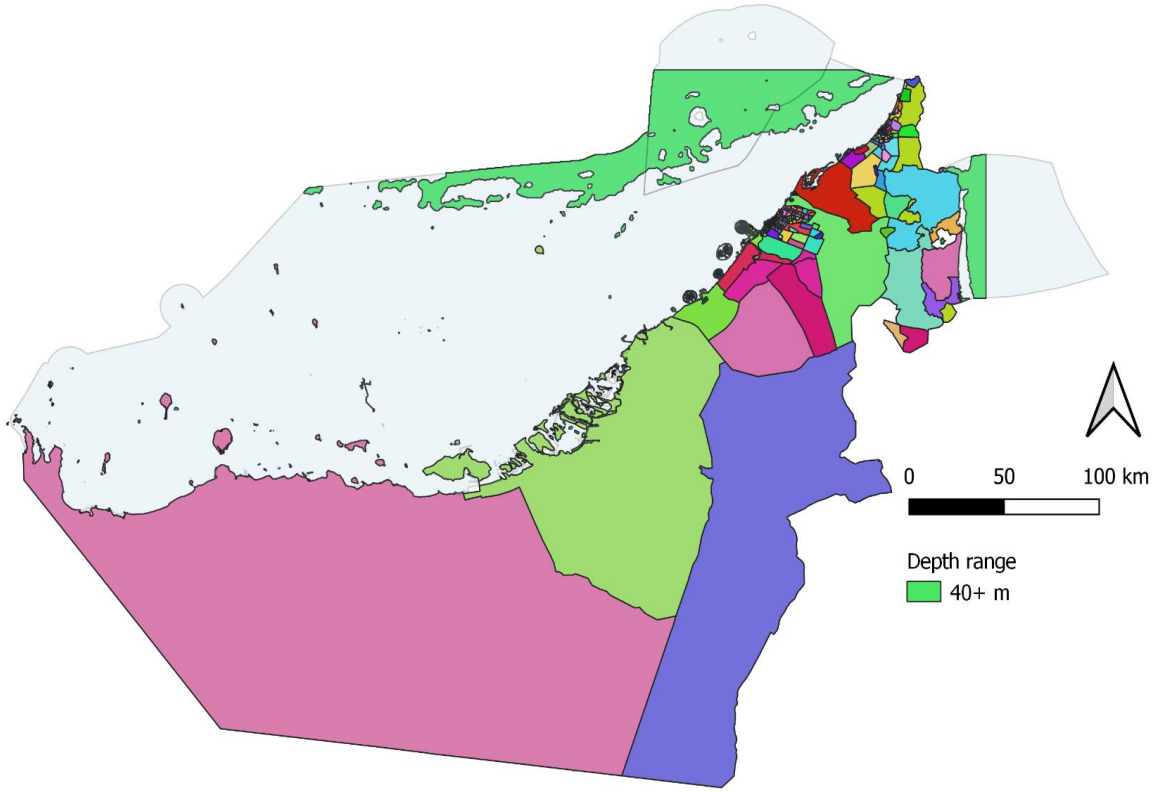


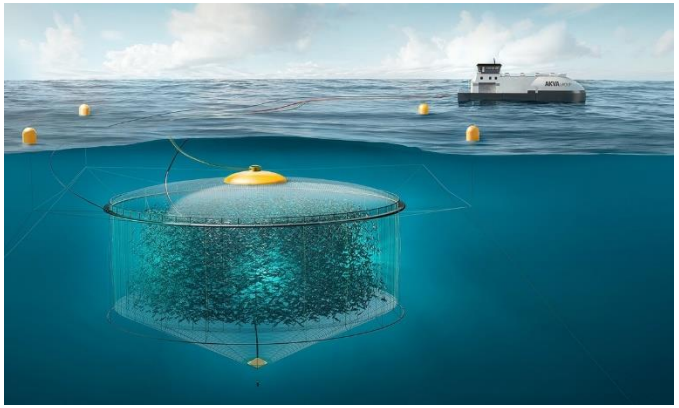
https://www.mynewsdesk.com/om/documents/atlas-of-suitable-sites-for-aquaculture-projects-17343

Main criteria used:

- Weather
  - Precipitation
  - Temperature
  - Wind
- Bathymetry
- Regional circulation
  - Principal currents
  - Surface current intensities and direction
- Tide
- Sea surface temperature
- Sea surface salinity
- Waves
- Phytoplankton
  - All photosynthetic pigments
  - HAB
- Environment
  - Seagrass and algae
  - Mangrove
  - Corals and marine invertebrates
  - Marine turtles
  - Coastal and marine birds
  - Coastal protected areas
- Seawater survey
- Soil survey
- Regional ports, public and investment services
- Aquaculture survey

Marine aquaculture in the Gulf



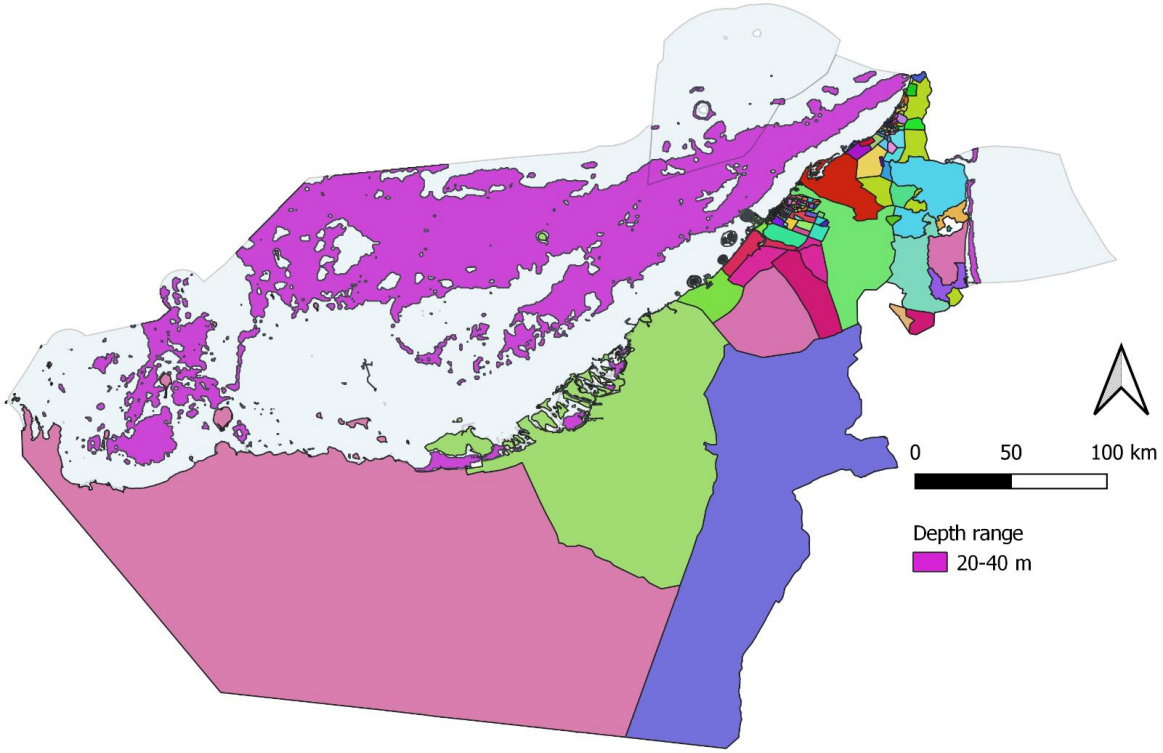


https://www.atlantisfarming.no/home

https://newsroom.ucla.edu/releases/ocean-seafood-farming-aquaculture

Martin Van Brakel, Patrick White, Alessandro Ciattaglia

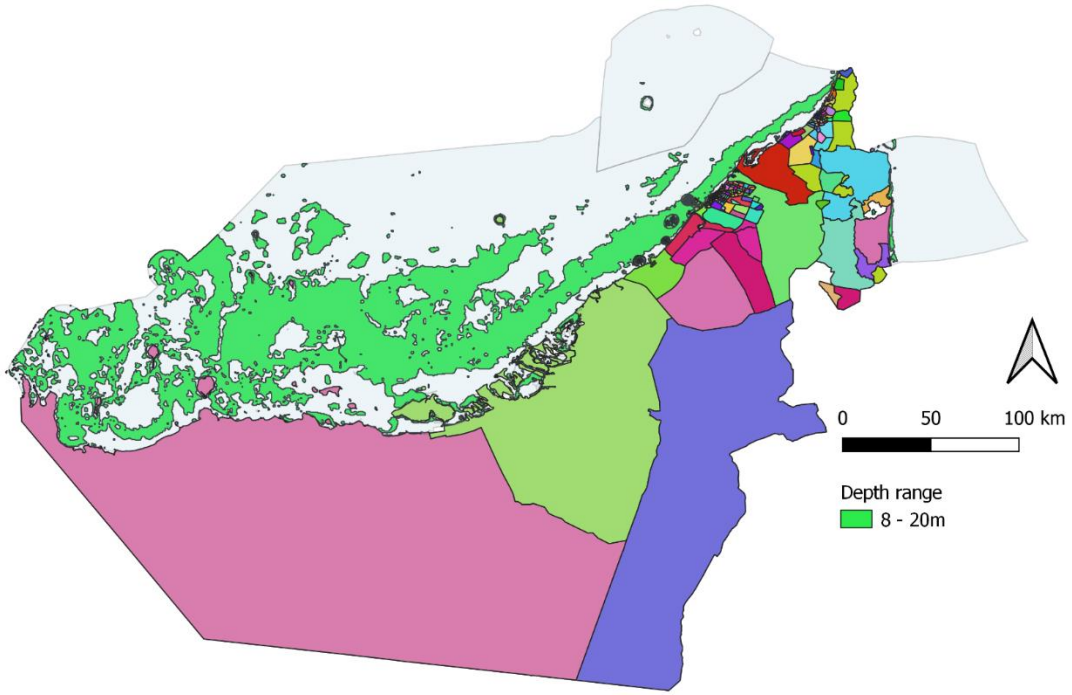
Marine aquaculture in the Gulf



https://www.arabnews.com/node/1561216/saudi-arabia

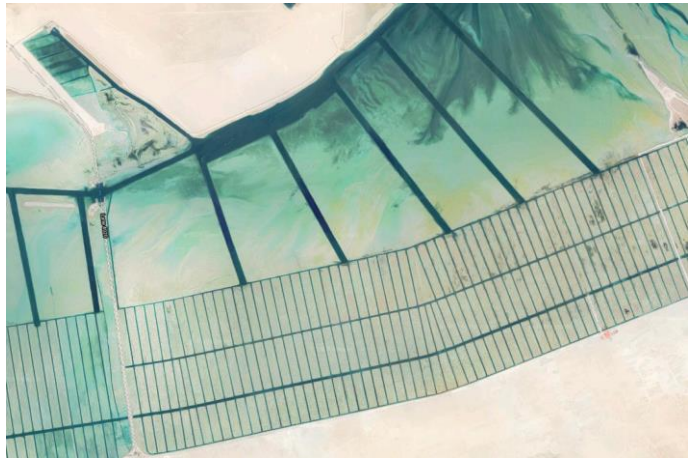
Martin Van Brakel, Patrick White, Alessandro Ciattaglia

Marine aquaculture in the Gulf



Martin Van Brakel, Patrick White, Alessandro Ciattaglia

https://www.todayonline.com/singapore/new-floating-fish-farm-changi-aims-produce-more-seafood-traditional-coastal-ones



https://wmaps.google.com/

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منظمة الأغذية والزراعة للأمم المتحدة

Desert coastal pond aquaculture

National Aquaculture Group (NAQUA), Al Leith, Saudi Arabia

Food and Agriculture Organization of the United Nations

منظمة الأغذية والزراعة للأمم المتحدة

Desert coastal pond aquaculture

Al Jaraf Fisheries, Abu Dhabi

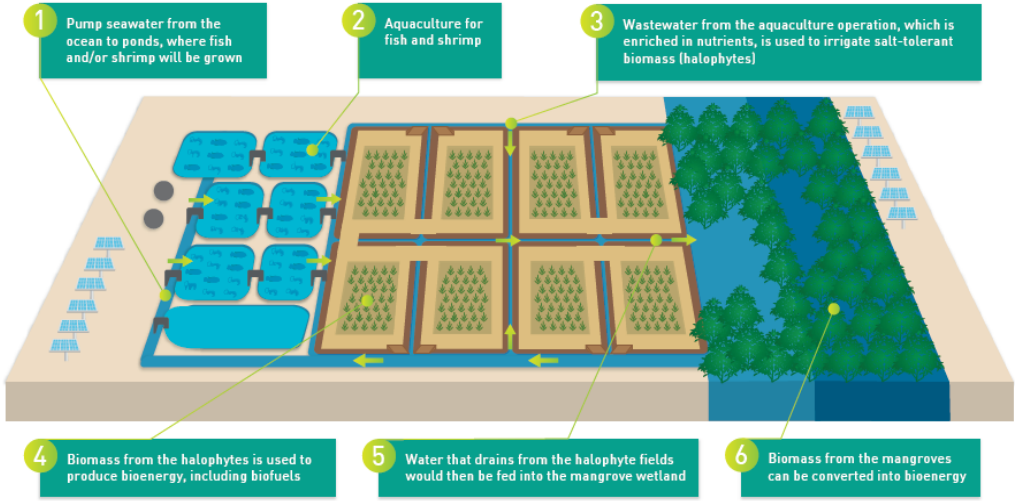
Food and Agriculture Organization of the United Nations

منظمة الأغذية والزراعة للأمم المتحدة

Seawater Energy and Agriculture System

Khalifa University, Etihad Airways, Boeing, ADNOC, Safran, GE and BAUER Resources

- Integrated Tilapia/Shrimp-Salicornia-Planted mangrove in brackishwater
- The main crop is salicornia for biofuel production but the integrated system ultimately aims to support food and fuel security while conserving the UAE's natural resources
- On January 16, 2019 an Etihad Airways Boeing 787 flight from Abu Dhabi to Amsterdam was the world's first commercial flight using locally produced biojet fuel value chain based on Salicornia



Some hatcheries in the GCC states

Name	Species	Quantity
Aquaculture and Marine Studies Center-Abu Al Abyad, UAE	Safi (*Siganus canaliculatus*), Sikil (*Rachycentron canadum*), Sheri (*Lethrinus nebulosus*), Hamour (*Epinephelus coioides*), Sobaity (*Sparidentex hasts*), Shaam (*Acanthupagrus latus*), Biyah (*Valamugil seheli*), Gabit (*Rhabdosarus sarba*)	5 million
Sheikh Khalifa Marine Research Centre and Marine innovation Park, UAE	Seabream, Seabass, Shrimp, White-spotted rabbitfish, Hamour, Red snapper	30 million
National Mariculture Centre, Bahrain	Rabbitfish (*Siganus canaliculatus*), Sobaity seabream (*Sparidentex hasta*), Gilthead seabream (*Sparus aurata*), Mangrove red snapper (*Lutjanus argentimaculatus*), Hamour (*Epinephelus coioides*)	5 million
Tabuk Fisheries, KSA	Seabream, seabass, cuttlefish	
NAQUA, KSA	Shrimp Barramundi	
Jeddah Fisheries Research Centre, KSA	Marine species	
PAAFR hatchery, Al-Wafra, Kuwait	Tilapia	
Al Bustan finfish hatchery, Oman	Seabream	15 million
Khuwemah and Al Jazar shrimp hatcheries, Oman	Shrimp	

Food and Agriculture Organization of the United Nations

منظمة الأغذية والزراعة للأمم المتحدة

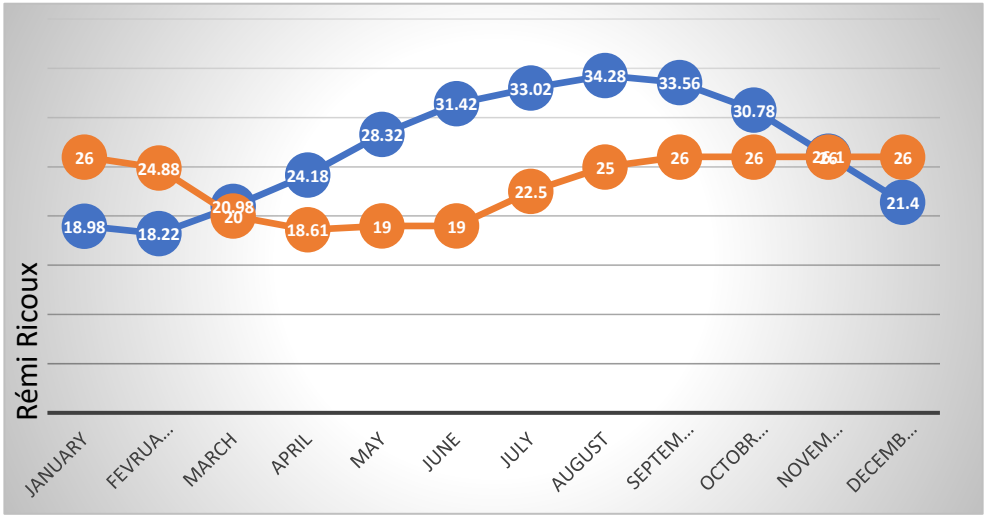
Finfish hatchery in the desert

National Mariculture Center, Ras Hayyan, Bahrain

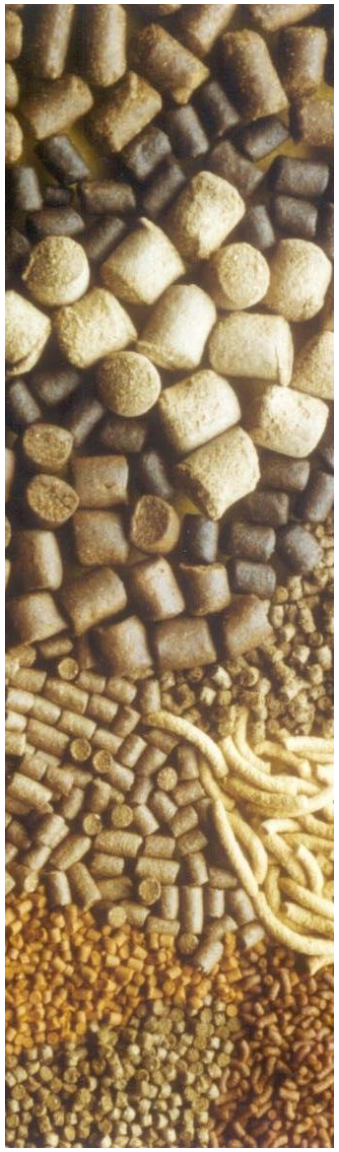
- A unique expertise in breeding native species
  - Rabbitfish (*Siganus canaliculatus*)
  - Sobaity seabream (*Sparidentex hasta*)
  - Gilthead seabream (*Sparus aurata*)
  - Mangrove red snapper (*Lutjanus argentimaculatus*)
  - Brown-spotted grouper (*Epinephelus coioides*)
- Undergoing a modernization of the facility for improved quantity and quality of fry

Photoperiod control

- Most local species farmed are seasonal and cannot be produced throughout the year without photoperiod and water temperature control;
- Feed can be adjusted too;
- Principle is simple: through artificial lighting and temperature control, recreate the seasonal variations with a time lag.



Empty fish tank with artificial lighting to control photoperiod
© Rémi Ricoux



Feed: the limiting factor?

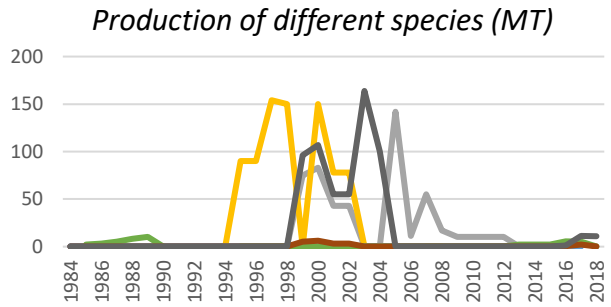
- FCR > 2 for many species
- Biggest companies have their own feed plants
- Saudi Arabia
  - o Hamour, seabream and seabass
  - o Tilapia, catfish and carp
  - o Vannamei shrimp
- Needs to be imported in most countries
  - High cost
  - Preservation issue (nutritional value)

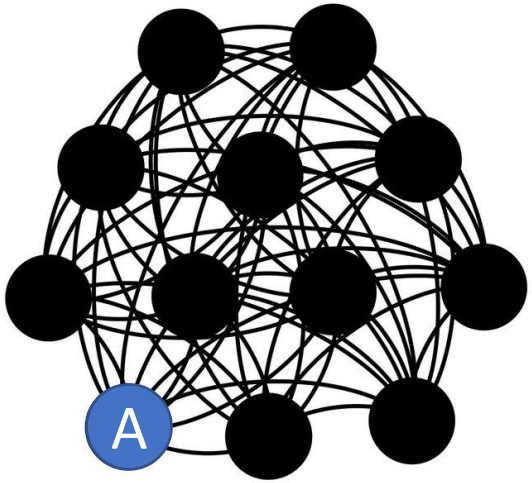
Future challenge: the COVID-19 crisis

- Covid-19 had a major impact on fish supply chains, globally and locally;
- Despite their high reliance on International trade, GCC countries managed so far to handle the crisis – at a cost;
  - Consumers little affected;
  - Exporters affected;
  - HORECA market reoriented;
  - Some small producers benefitted from reduced competition.
- Many digital innovations observed;
- Improving the bottlenecks in global and regional supply chains must go together with domestic production of fish.

Future challenges – National level

- Consolidate and upscale the sector
  - Avoid the "boom and bust" dynamics
  - Protect and support existing operators
  - Attract new ones to create economies of scale
- Implement a sustainable food system
  - Supply chain: feed, fry, equipment, vaccines, drugs etc.
  - Research: native vs. introduced species; selective breeding for key traits;
  - Training and education
  - Extension and consulting firms
  - Professional organization
  - Regulatory framework and official control
  - Financing and insurance
  - Marketing: market differentiation/quality certification schemes; communication; fair trade for producers etc.

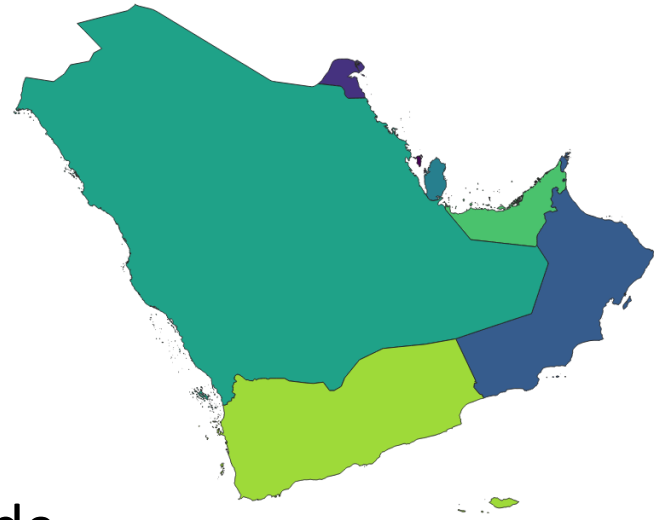




At national level, aquaculture development must be tackled holistically

Future challenges – Regional level

- Mutualisation of costs
  - Expertise
  - Research
  - Training
  - Knowledge sharing
  - Genetic improvement
- Regional trade
  - Biosecurity and fry trade
  - Non-tariff barriers to trade



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منظمة الأغذية والزراعة للأمم المتحدة

Working Group on Aquaculture of RECOFI

Ali Mohammad Alshaikhi, RECOFI chair

Dawood Al-Yahyai, WGA chair

Ahmed Al-Mazroui, Secretary of RECOFI

http://www.fao.org/fishery/rfb/recofi/en

REGIONAL COMMISSION FOR FISHERIES
RECOFI
اللجنة الإقليمية لمصايد الأسماك

Future challenges – Operator level

- At technical level
  - Reduce production costs (esp. feed, energy)
  - Generate economies of scale
  - Adopt the right technologies
- At market level
  - Fair price for domestic fresh products
  - Market segmentation through certification

50 USD/kg (retail)

Market segmentation

Example of salmon at retail in UAE

Organic certification

Not certified

Domestic: 50 USD/kg

Ireland: 54 USD/kg

Norway: 27 USD/kg

Scotland: 33 USD/kg

Regional Review

- Every five years, FAO publishes six *Regional Reviews of Aquaculture Development, Status and Trends*
- The 2020 batch will be released next week: http://www.fao.org/fishery/regional-aquaculture-reviews/aquaculture-reviews-home/en/
- This batch was intended to coincide with the Fourth Global Conference on Aquaculture, now to be held in Shanghai, 22-27 September 2021. More on: https://aquaculture2020.org/

Useful FAO publications

- Aquaculture in desert and arid lands
  http://www.fao.org/3/ba0114e/ba0114e.pdf
- Integrated agri-aquaculture in desert and arid lands: Learning from case studies from Algeria, Egypt and Oman (2020)
  http://www.fao.org/3/ca8610en/CA8610EN.pdf
- Advancing Integrated Agriculture Aquaculture through Agroecology
  http://www.fao.org/3/ca7209en/CA7209EN.pdf
- FAO Aquaculture Newsletter (2020)
  http://www.fao.org/fishery/publications/fan/en
- FAO Blue Blog
  http://www.fao.org/blogs/blue-growth-blog/en/
- A Guide to Recirculation Aquaculture
  http://www.fao.org/3/a-i4626e.pdf
- Atlas Saudi Arabia
  http://www.fao.org/3/a-c0046b.pdf

Other publications mentioned

- UAE Aquaculture Pulse https://foodsecurity.gov.ae/
- Atlas Oman https://www.mynewsdesk.com/om/documents/atlas-of-suitable-sites-for-aquaculture-projects-17343

Thank you very much

شكرا جزيلا