Case study

#13 Seabass and seabreem in the eastern Mediterranean

#14 Herring, capelin, and cod in the Barents and north-west sea

#15 Herring, sprat and cod in the Baltic Sea

Species background and economics

European sea bass (*Dicentrarchus labrax*) and Gilthead sea bream (*Sparus aurata*) are the two most widely and intensively cultured marine finfish in the Mediterranean.

Though different species, both are generally cultured in marine cage farms in separate cages.

According to FAO-FIGIS figures, with average annual growth rate of 7.3%, total production of farmed sea bass and sea bream (SBSB) in the Mediterranean region has increased from 272 691 tons in 2010 to 426 664 tons in 2017.

During the same period Value of SBSB production increased from US$ 1.579 Billion to US$ 2.127 Billion. Turkey and Greece are the major producers of farmed sea bass and sea bream in the Mediterranean.

Turkish production constituted nearly 38% of total Mediterranean production of farmed SBSB in 2017.

In 2018 Turkish production of sea bass and sea bream reached 116 015 and 76 680 tons respectively. Currently there are over 400 farms engaged in farming of SBSB in Turkey[1]

Expected projections under climate change

Sea bass and sea bream farming in the Mediterranean is generally carried out in off-shore cages.

In Turkey SBSB cage farms can only operate in marine sites with at least 30 m water depth and 0.6 mile away from nearest terrestrial point.

These operations are extremely vulnerable to changes in physical oceanographic conditions.

Increased storminess (increases in wind velocity, water currents and waves), increased sea level rise and increased frequency of extreme events (e.g. storms, floods, and drought) are all expected to have a negative impact on offshore cage aquaculture in Mediterranean[2].

Climate-driven warming (causing increased demands for oxygen by fish) and related stressors such as eutrophication, harmful algal blooms, increased incidents of diseases and parasites are some of the additional challenges facing the marine aquaculture sector in a future climate[3].

Physiological impact of climate-related changes on sea bass and sea bream and emerging operational problems at off-shore farming sites would not only mean an increase in capital investment for more sophisticated, off-shore facilities and higher production costs but could also lead to lower profitability of marine cage farms.

Projections of the future oceanographic conditions of the eastern Mediterranean are available for two future representative concentration pathways scenarios (an intermediate, ‘RCP 4.5’ and business-as-usual ‘RCP 8.5’).

Sea surface temperatures are projected to increase by up to 3°C under RCP 8.5 in the Mediterranean (Figure 1).

Increases in water temperature under RCP 4.5 are roughly half those under RCP 8.5, and differences between RCPs 8.5 and 4.5 only start to emerge after about 2040.

Net primary production is projected to increase in the western Mediterranean, be static in the eastern Mediterranean[4].

Socio-economic developments

Four socio-political storylines are developed by CERES, based partly on the IPCC SRES (Special Report on Emissions Scenarios) framework and partly on the new system of Shared Socio-economic Pathways (SSPs) together with Representative Concentration Pathways (RCPs).

The four CERES scenarios are characterised as: Global Sustainability (RCP 4.5 and SSP1), Local Stewardship (RCP 6.0 and SSP2), National Enterprise (RCP 8.5 and SSP3) and World Markets (RCP 8.5 and SSP5).

These scenarios differ in their focus on consumerism versus environmental goals and their entrenched versus international outlook[5].

Turkish aquaculture sector has been rapidly developing growing thank to steady growth in marine aquaculture sector and mainly SBSB production.

In 2018, farmed SBSB production constituted over 61% of total Turkish aquaculture production. SBSB farming in Turkey is an export-oriented sector reaching international markets and open to competition from other producing countries.

This capital-intensive farming system is also highly dependent on high off-shore technology including cages, mooring systems, feeding barges and harvesting.

On the other hand, per capita consumption of aquatic products remains to be as low as 6-7 kg which well below the world average.

Scenarios describing future society and economy

CERES uses models to estimate economic developments in Europe's fishery and aquaculture based on select, pre-defined physical and socio-economical future scenarios.

These future scenarios were specified by industry partners and stakeholders in the first year of CERES (e.g. fish prices, fuel prices, technological advancements, regional policy issues, etc.).

'World Markets'	'National enterprise'
• Personal independence, high mobility and consumerism • Reduced taxes, stripped-away regulations • Privatised public services • High fossil fuel dependency • Highly engineered infrastructure and ecosystems	• National isolation and independence • Protection of national industry • High resource intensity and fossil fuel dependency • Low investment in technological development and education • Low priority for environmental protection
'Global sustainability'	**'Local stewardship'**
• High priority for welfare and environmental protection • Cooperative local society • Intense international cooperation • Increased income equality • Low resource intensity and fossil fuel dependency	• Promotion of small scale and regional economy • Less attention for global (environmental) problems • Moderate population growth • Income of industrialised and developing countries converge • No overarching strategy to manage ecosystems

Table 1 Outline of the four social-political scenarios developed by CERES partners and stakeholders

Key research needs

One of the most important challenges for the long-term sustainability of marine aquaculture sector is to develop climate-ready mitigation or adaptation strategies for farming operations. To this end, projecting direct and indirect impacts of climate change on the spread and virulence of pathogens, productivity and financial performance of SBSB is crucial and has been the research emphasis taken in CERES.

Stakeholders surveyed by CERES in Turkey believed that physiology and performance parameters of SBSB including feed conversion ratio (FCR), fish health, survival rate and production costs, will be negatively affected by climate change[6]. Nevertheless; increase in frequency of extreme climatic events will cause stress and higher mortality rates in farmed species.

Aquatic animal diseases will be at the top of the agenda of farm managers in the future. Turkish marine aquaculture stakeholders also believe that, as wild marine stocks decline, the availability of pelagic fish for fishmeal production will be problematic resulting in higher feed costs and, hence, higher fish productions costs and less profitability.

CERES research

Since Turkish SBSB farms are located along the Turkish Aegean and at the intersection of the Aegean and Mediterranean Sea, nearly all data collection and modelling work within CERES work packages for Turkish SBSB farming and climate change interactions were focused on Muğla and İzmir provinces.

Key activities within CERES include:

- A systematic literature review was conducted for GAP analysis and a meta-analysis to examine direct effects of climate change (warming, acidification, deoxygenation) on survival and growth physiology of European aquaculture targets.
- Surveyed and compiled data from sea bass and sea bream marine cage farms in major producing regions (Muğla & İzmir). Farmers were asked to provide information on environmental conditions, farming operations and bio-technical (e.g. growth rates, mortalities, FCR, stocking densities, diseases), structural and financial data.
- Engaged stakeholders via focus group meetings and workshops with farmers, researchers, and public administrators to increase awareness of aquaculture and climate change interactions and to regionalise CERES socio-political scenarios.
- Developed biological (WinShell and FARM) models to examine the effect of climate change (temperature, salinity, dissolved oxygen, dissolved inorganic nitrogen) on the biological production (harvestable biomass) of Muğla and İzmir sea bass in the medium- (2040-2600) and long- (2090-2100) term using an intermediate (RCP4.5) and more severe, business-as-usual (RCP 8.5) scenarios.
- Quantified changes in disease risk for key pathogens under future temperature projections for key pathogens relevant to sea bass and sea bream across Eastern Mediterranean.
- Constructed typical farm models for Turkish sea bass and sea bream operations and calculated financial performance under each of the CERES scenarios including trajectories of change in future prices of fuel, fish, and fish feed components and the outputs of a global fishmeal/fish oil model.
- Engaged stakeholders to verify bio-technical, structural and financial data as well as the overall model construction for ‘typical’ Turkish sea bass & bream cage farms was assessed and verified by producers, researchers, experts through a focus-group meeting.

- Generated a conceptual (Bow-Tie) model with stakeholders to resolve the main components of risk assessment and risk management of climate change impacts on aquaculture sector.
- Built a Bayesian Belief Network (BBN) Model for the marine aquaculture sector in Turkish waters of the eastern Mediterranean based on bio-technical and structural information on sea bass and sea bream farming operations.
- Ranked the vulnerability of European aquaculture to climate change including three elements: exposure, sensitivity and adaptive capacity.

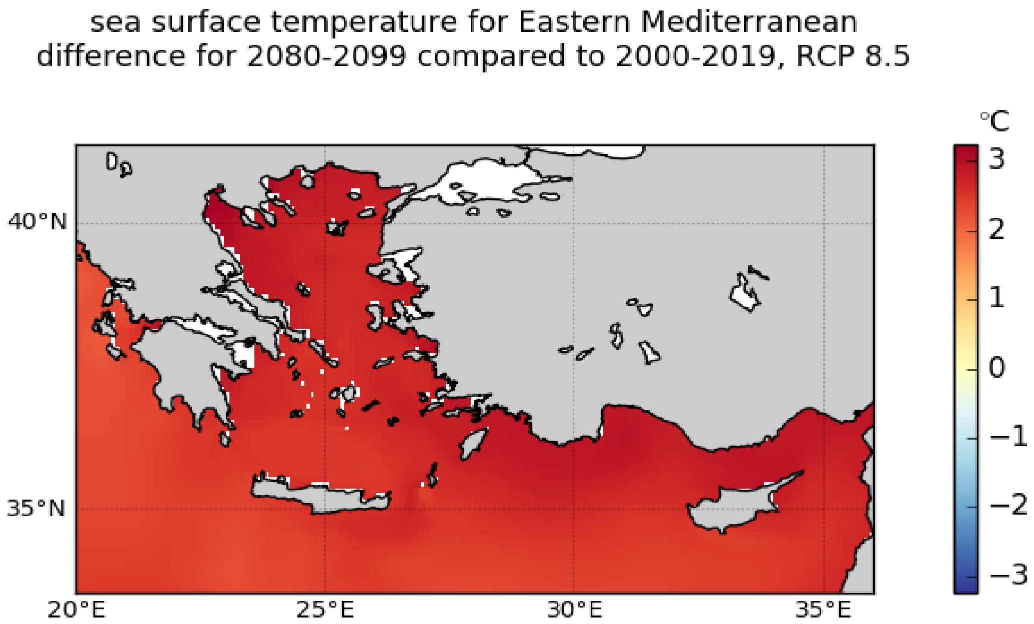
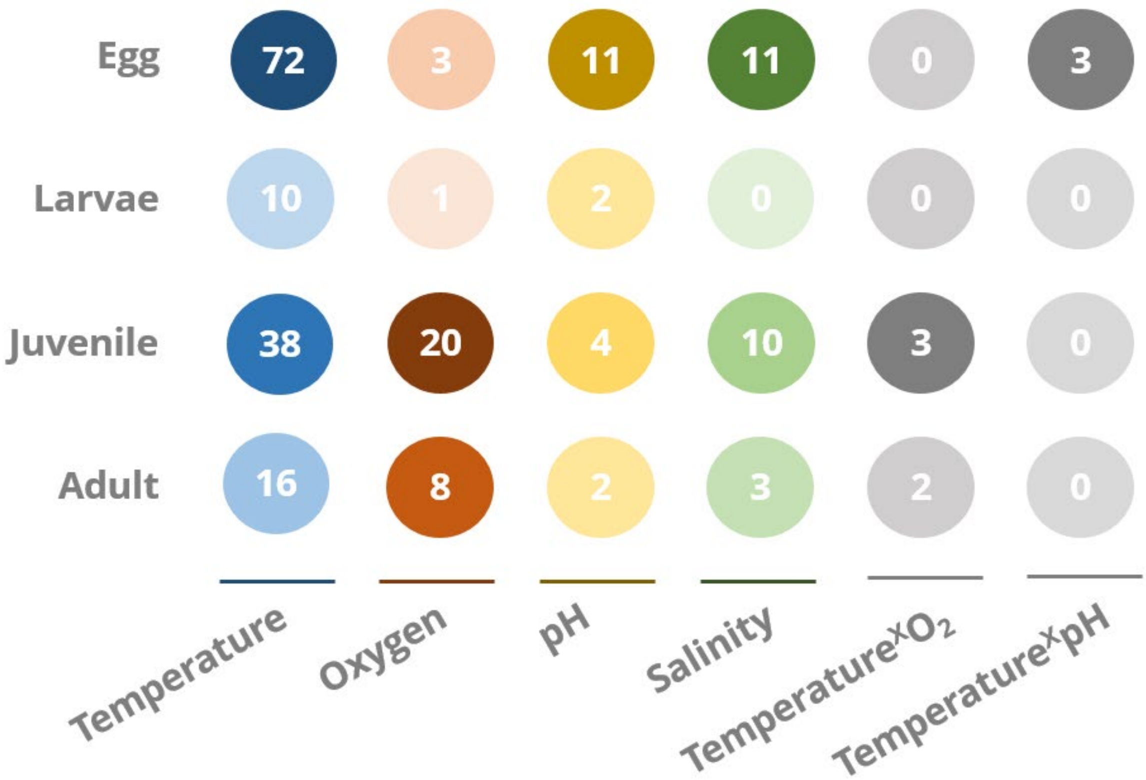


Figure 1 Projected Sea water temperatures in c under RCP 8.5 in Eastern Mediterranean. *Credit: Susan KAY, PML*

Biological consequences



- Seabass ranked 8 out of 28 European fish and shellfish genera reviewed here (12 studies). Sea bream ranked 17 out of 28 (3 studies).
- 4 studies were done in the Eastern Mediterranean, 3 of them in Turkey, one in Greece
- Most studies focused on juveniles (8) and embryos (4)
- The most common response studied was growth (14) followed by mortality (5).
- The most common stressor studied was temperature (12).

Direct effects- Aquaculture productivity

To quantify the direct impact of climate change on physiological aspects and productivity of sea bass farming in the Eastern Mediterranean region culture practice data for six cultivation sites in three different Turkish provinces (Izmir Muğla and Mersin) were collected and used to construct the typical sea bass farm in Turkey.

The environmental drivers for current conditions were collected from the Copernicus database and were used by the WinFish individual growth model and the FARM production model to validate current growth and production estimates.

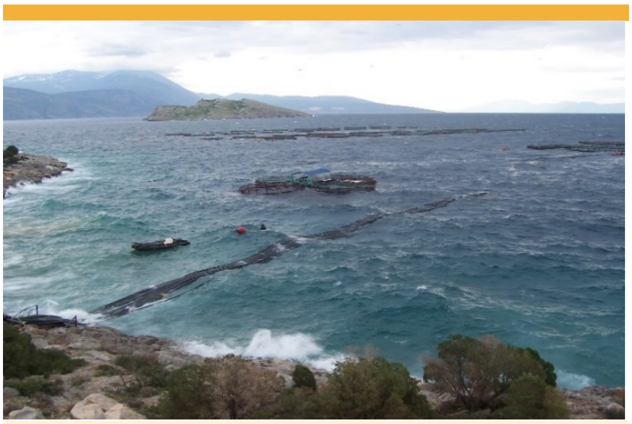


Figure 2 A SBSB cage farm in Turkey. *Credit: Ferit RAD, MEU*

The individual growth model (AquaFish™) developed for sea bass was based on the net energy balance approach, and feeding was determined by the feed conversion ratio (FCR).

FARM obtained good end-point values in live weight for sea bass and harvest live weights ranged from 301 to 630 gLW, which is within the reported range of harvest weights (300-800 g LW) for sea bass. For each time slice (2000-2019, 2040-2059, and 2080-2099) and emission scenario (RCP 4.5 and 8.5) water temperature was used to establish the boundaries of the variance in environmental drivers[7].

Model outputs for assessing the impact of two climate change scenarios (RCPs 4.5 and 8.5) on physiological aspects and productivity of sea bass culture reveal that under the low emission scenario, the greater temperatures of the near-future time slice leads to bigger animals at harvest, and therefore greater profits, while in the far-future this increasing trend stagnates and the farmer will have similar or much lower benefits than in the near-future (Figure 3A and B).

Profits relate hereby to present cost and returns without taking future price developments into account. The Feed Conversion Rate (FCR) increases as climate change progresses, meaning that the feeding efficiency of fish decreases and feed cost increase (Figure 3C and E).

Due to the effect of temperature on fish catabolism, the oxygen depletion within the cages will be more severe as time progresses (Figure 3D).

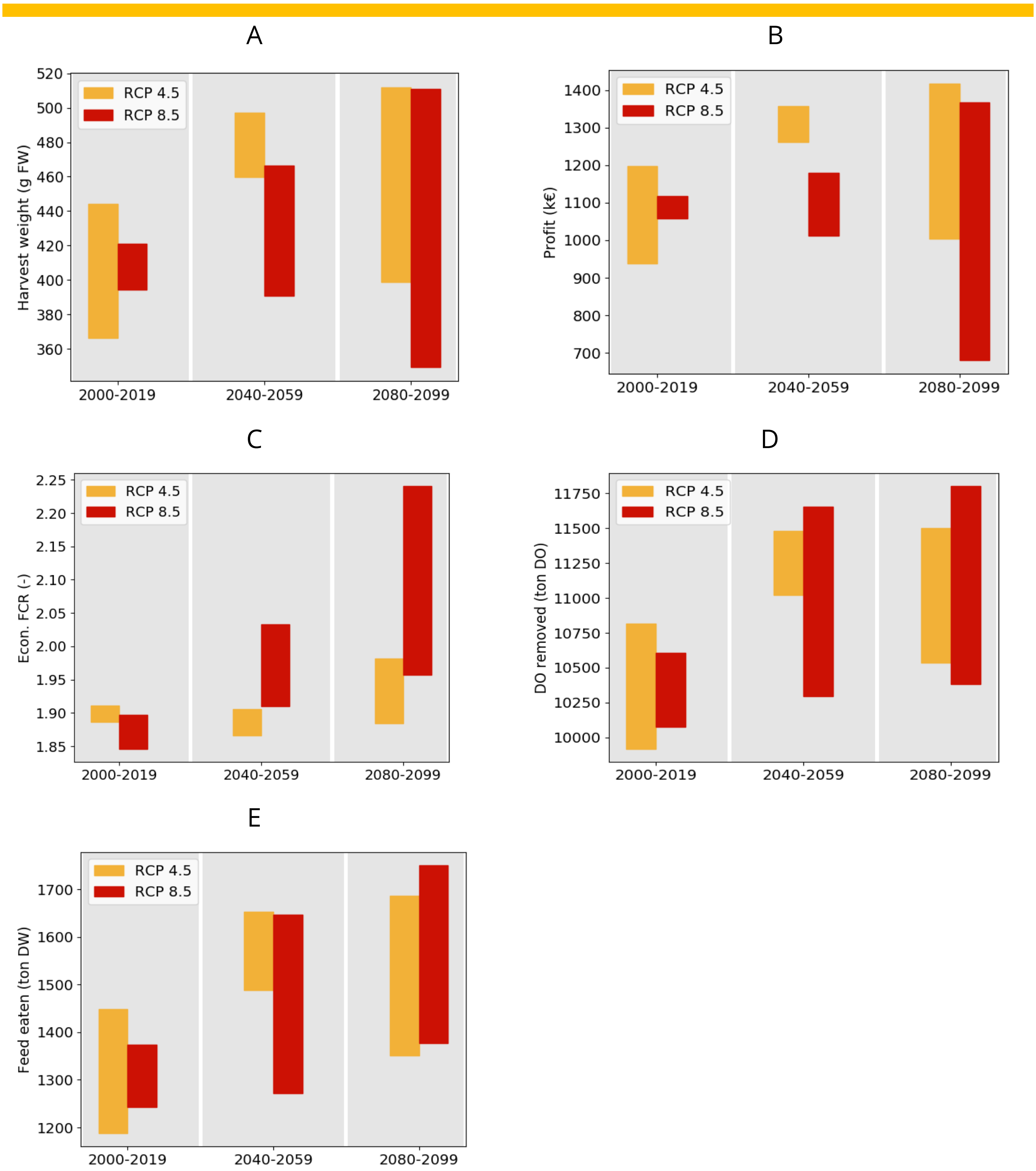


Figure 3 Range of FARM outputs for the typical sea bass farm in the Eastern Med under the different climate change scenarios. Green and red bars represent the range (spread) of simulation values for the low- and the high- emission scenario, respectively. The drivers for the different climate change scenarios were obtained from the POLCOMS model as detailed in the text. LW: live weight; DO: dissolved oxygen[7].

Indirect Effects-Fish diseases

Species / disease	Temperature Threshold (°C)	Mean proportion of days per year (period: 2000-2020) that temperatures fell within the **species** or pathogen temperature thresholds	2050 change (%) under RCP 4.5	2050 change (%) under RCP 8.5
Bass & Bream	**17-25**	**0.64**	**0.85**	**-4.46**
VNN (bass)	15-30	0.95	2.32	2.67
Lymphocystis (Bream)	16-24	0.65	-2.34	-6.39
Vibriosis (Both)	25+	0.13	51.12	85.03

Table 1 East Mediterranean. Values highlighted in red highlight highest suitability value for present day but also indicate the biggest increase in the suitability for a pathogen under the two climate projections. Green values highlight smallest change in the suitability for a pathogen under the climate projections[8].

Quantification of pathogens risk was based on the 'number of days' water temperatures across the study areas were likely to be within the permissive temperature range for each of the pathogens studied[8].

The suitability of water temperatures for the key disease for bass (Viral Nervous Necrosis (VNN)) is very high throughout the Mediterranean Sea but substantially higher in the east (95%) compared to the west (81%). Suitability is projected to further increase under both RCP's in East Mediterranean region. Lymphocystis is the key challenge for sea bream.

The suitability for lymphocystis is similar in both west and east regions but is considerably lower than the VNN suitability in sea bass.

Under both RCP's the temperature suitability for Lymphocystis reduces in the Eastern Mediterranean. The greatest chance in disease suitability is for vibriosis which is likely to increase substantially in both east and west Mediterranean regions under both RCP's (7).

Further information for Eastern Mediterranean region is provided in Table 1.

Economic consequences

Effects of climate change on farm-level profitability-Typical farm approach

A typical (Virtual) Turkish SBSB cage farm was defined and constructed as a grow-out farm (TR-SBSB-2000) in the region of Muğla producing 2,000 tons annually.

Based on 2016 figures in a typical Turkish seabream and seabass farm, feed costs make up 66% of total costs, stocking is about 12% and the rest is allocated to other operational costs. Market returns were between €0.89 and €1.12 per kg fish.

Future profitability is calculated by taking into account feed conversion ratio and total harvestable biomass under RCP 4.5 & 8.5 environmental conditions from physiological models as well as literature projection ranges of energy prices (fuel, electricity) fish prices and fish feed price assumptions under all four of the CERES scenarios, namely; World markets (WM), Global sustainability (GS), National enterprises (NE) and Local stewardship (LS) in the year 2050.

Turkish production usually combines seabream and seabass in the same operation, but is analysed here as two separate farms, each farm producing 1000 tons of sea bass (TR-BSS-1000) and sea bream (TR-SBG-1000) annually[9].

In terms of habitat suitability for SBSB farming i.e. annual portion of days with suitable water temperatures, the spatial projections show that at present, in the eastern Mediterranean around 70 to 80% of days in a year are in the optimal growing range, particularly in waters off the western Turkish coasts.

Under both RCP's the percentage of days in the optimal growing range is predicted to increase to 100% off the South west coast of Turkey. The range of this optimal growing area is predicted to be of similar size and extent similar under both RCP's (Figure 4).

As far as profitability is concerned, the Turkish sea bass farm production has a good current profit margin (33.6 %) and shows increased profit under almost all scenarios with WM being the most favourable scenario for TR-BSS-1000.

The combination of future prices with FCR and harvest weight is most promising for extreme warm years (P90), whereas for extreme cold years this combination can even lead to slightly reduced profits (NE) (Figure 5).

For the Turkish sea bass production this risk is given for most of the cold year scenarios (WM P10, NE P10, GS P10), but only with a low probability for the GS scenario, most pronounced is this risk under NE P10 with a loss of 50% of today's operating earnings under most unfavourable future price developments.

All other scenarios, and especially those for extreme warm years, show a > 95% probability to increase profitability compared to today.

As sea bream was observed to be less tolerant of cold-water temperatures than sea bass[10&11], the impact of extreme cold years could lead to even more severe declines in profitability for this species, also considering today's already lower profit margin of around 17% (Figure 5)

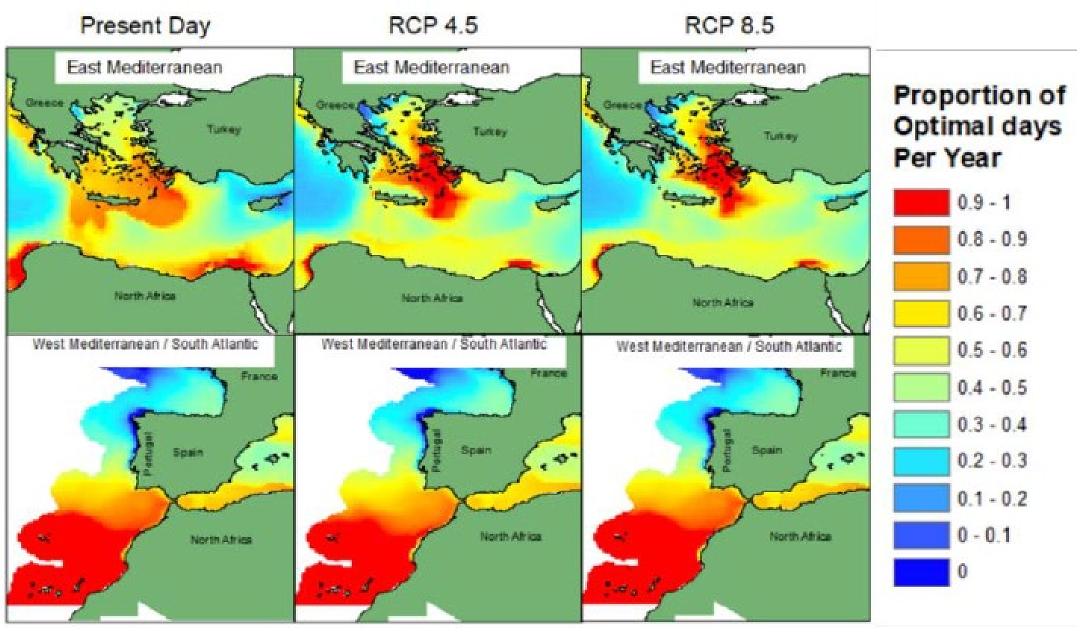


Figure 4 Predicted annual proportion of days in which water temperatures are predicted to be in the optimal growing temperature range for Sea Bass and Bream (17-25°C) under current climate and RCP 4.5 and 8.5 projections[9].

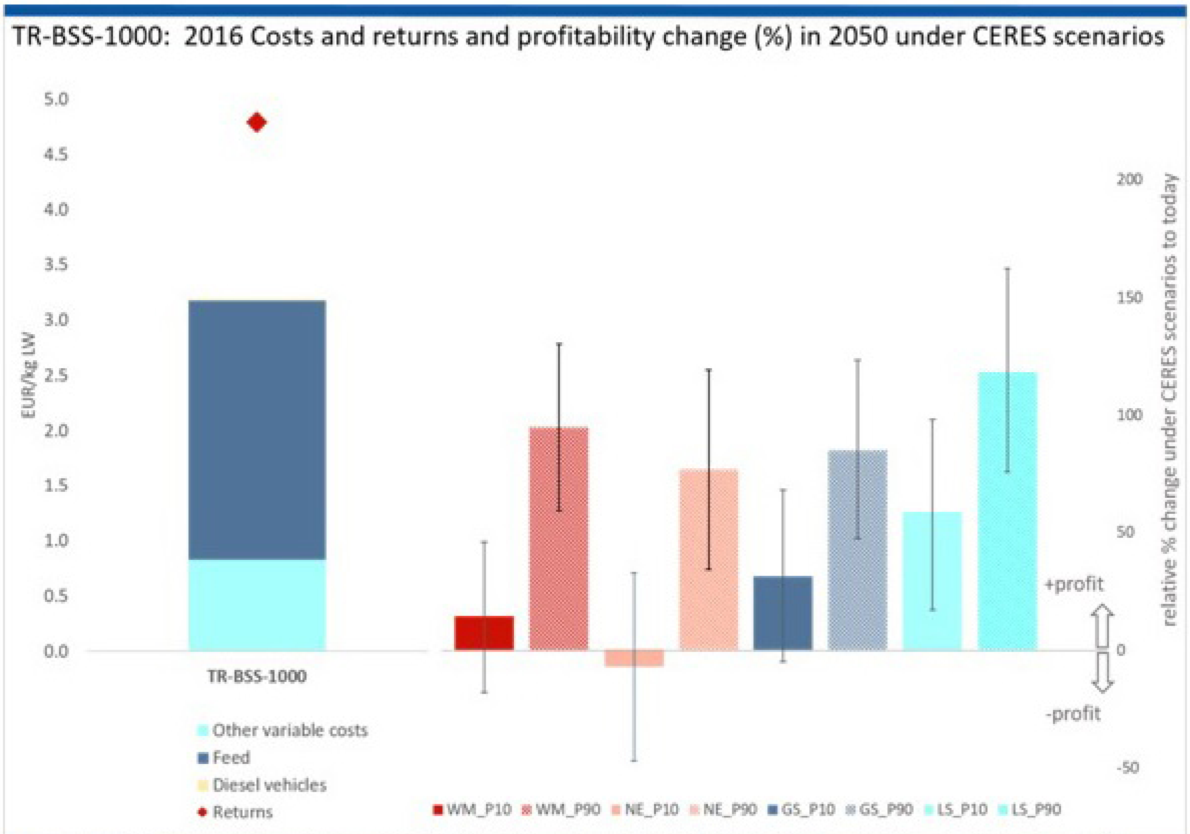


Figure 5 Stacked plot of cost and returns of typical Turkish seabass farm (TR-BSS-1000) in 2016 (left) and relative changes in profitability (returns against costs) in the year 2050 under the CERES scenarios World Market = WM, National Enterprise= NE, Global Sustainability= GS, Local Stewardship = LS compared to today (right). Error bars indicate 95% upper and lower probablity ranges from Monte Carlos simulation results. Grey lines indicate higher or lower profitability compared to 2016.
Credit: Cornelia Kresis-Thünen Institute

Sea bream production has currently almost half the profit of sea bass production (17%) and concomitantly less buffer to balance increasing future costs under the different climate change scenarios.

Lower profits for three out of four scenarios are the consequence with -45 % of today's operating earnings under the worst scenario, which is GS.

However, for WM an increase in profitability of +30% can be achieved, mostly due to more favourable future cost - return combination of fish feed, diesel and fish prices (Figure 6).

When considering future potential price variation of the uncertainty analysis, the Turkish sea bream farm has the potential to increase future profits under all scenarios in case of favourable price and cost developments, but no longer viable under the NE and GS scenario in the worst case (Figure 6).

Maps of projected profitability of sea bass and sea bream farming by 2050 including besides the economic results (Fig. 5 and &) also future temperature and disease suitability are given in Figures 7 and 8.

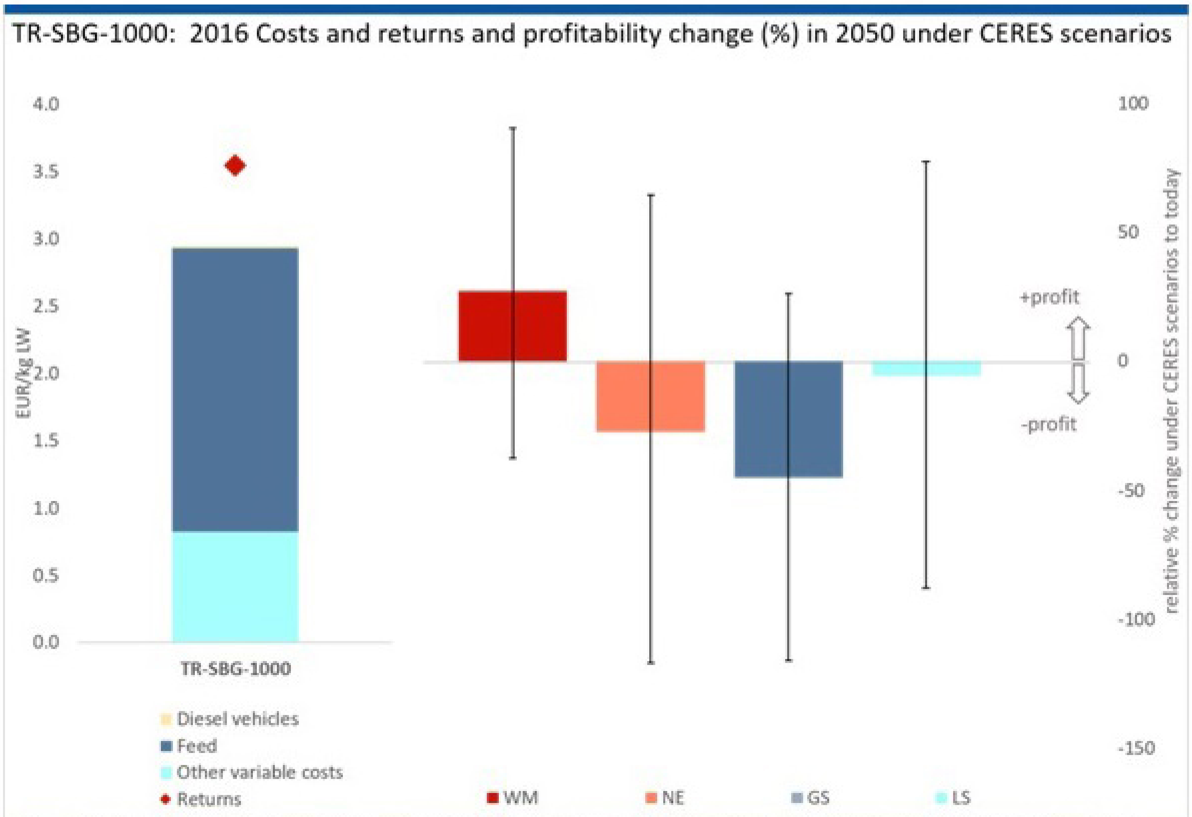


Figure 6 Stacked plot of cost and returns of typical Turkish seabream farm (TR-SBG-1000) in 2016 (left) and relative changes in profitability (returns against costs) in the year 2050 under the CERES scenarios World Market = WM, National Enterprise= NE, Global Sustainability= GS, Local Stewardship = LS compared to today (right). Error bars indicate 95% upper and lower probablity ranges from Monte Carlos simulation results. Grey lines indicate higher or lower profitability compared to 2016.
Credit: Cornelia Kresis-Thünen Institute

Projected profitability map shows the potential for increased profits across the vast majority of the mapped region under all four scenarios for sea bass in the Eastern Mediterranean (Figure 7).

For the latter it has to be kept in mind that although the averaged future temperature projections are positive, extreme cold years might lead to decreased profitability as shown for the region of Muğla. However, under the NE and GS scenarios some local effects can be seen, with areas to the east of Turkey predicted to suffer reduced profitability. This observation is far less pronounced under the WM and LS scenarios[9]. In the case of Turkish sea bream production reduced profitability is predicted across the whole mapped area under the NE and GS scenarios (Figure 8).

Under the WM scenario however the majority of the mapped area is predicted to experience increased profitability, with waters to the east of Turkey predicted to experience decreases in profitability. Under the LS scenario most of the Turkish coastline and large amounts of the offshore environment are predicted to have the potential to experienced increased profits[9].

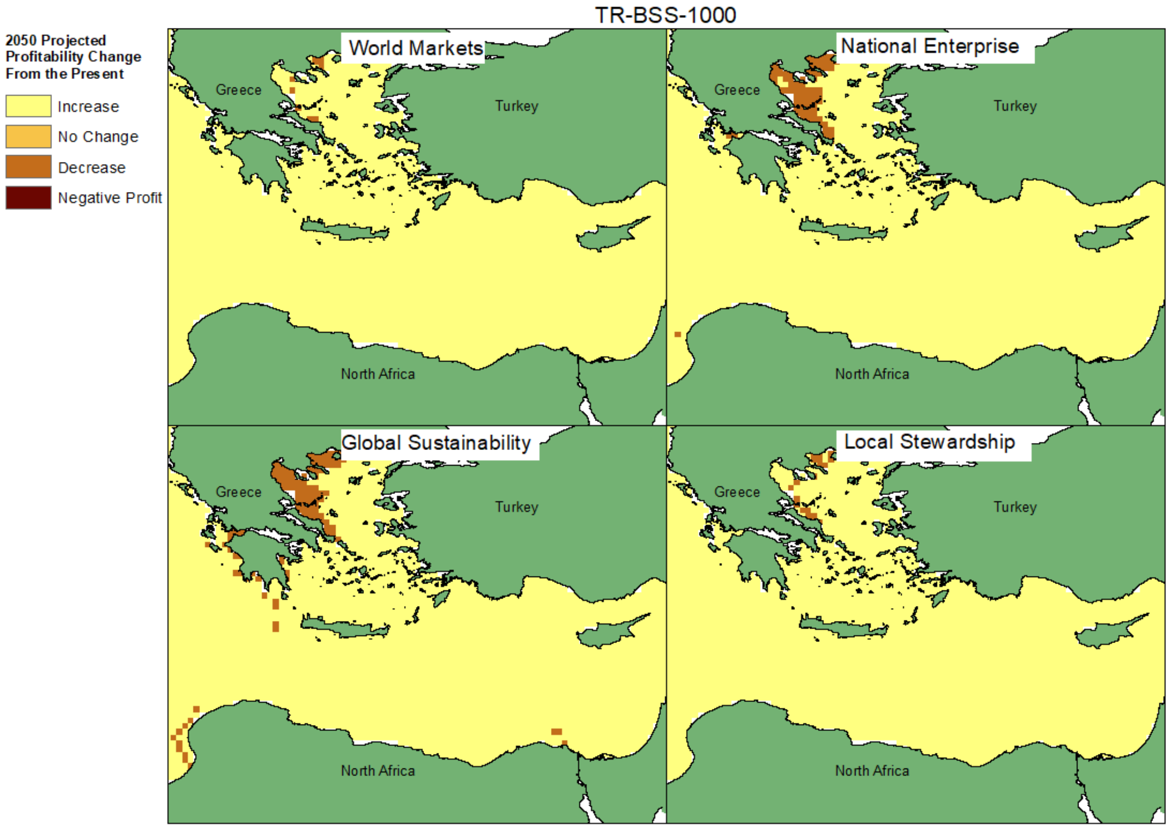


Figure 7 Map of projected profitability of sea bass farming in the Eastern Mediterranean under four CERES scenarios[9].

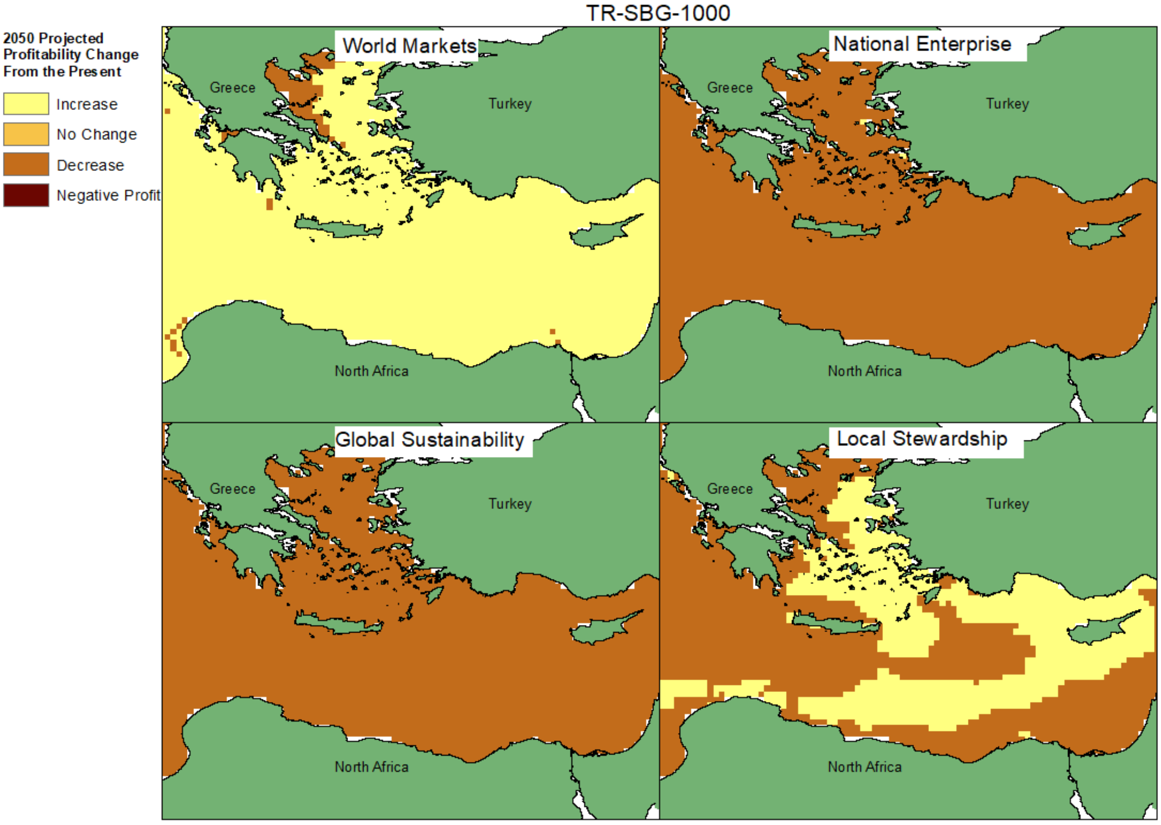


Figure 8 Map of projected profitability of sea bream farming in the Eastern Mediterranean under four CERES scenarios[9].

In general, for sea bass especially, there are many opportunities to increase profitability under all four climate change scenarios, however the picture for sea bream is more challenging as the profit margin for this species is at present considerably smaller than for bass. In average more optimal growing days around Turkey and the coast of southern Spain for both species may improve growth rates and allow increased production. Location of farms and availability of new aquaculture areas is a key concern Turkish sectors.

There are great concerns over the frequency and severity of storms under future scenarios given the resilience (or lack) of current technologies to high energy conditions. This is especially of concern to the Turkish industry which currently must produce further offshore than may be required by other countries. Obviously, the development of robust new cage and culture systems that can tolerate harsh sea states and offshore conditions are needed. The development of new aquaculture areas needs to be tackled in partnership between industry and government[9].

Fish meal and Oil Model

The fishmeal and fish oil model have been run under an initial parameterisation of the CERES scenarios.

These first run results show that under the “Global Sustainability” future scenario, fishmeal production increases by 19% by 2032, fish oil production increases by 31% and there is a relatively modest price increase (56% and 39% respectively).

In contrast, under a “National Enterprise” scenario, fishmeal production decreases by 34%, fish oil production decreases by 26% and there is a relatively significant price increase (68% and 83% respectively).

The “World Markets” scenario produces results that show fishmeal and fish oil production could potentially decrease by 94% and 92% respectively and is coupled with an exponential increase in price of 477% for fishmeal and 522% for fish oil[12].

Climate vulnerability

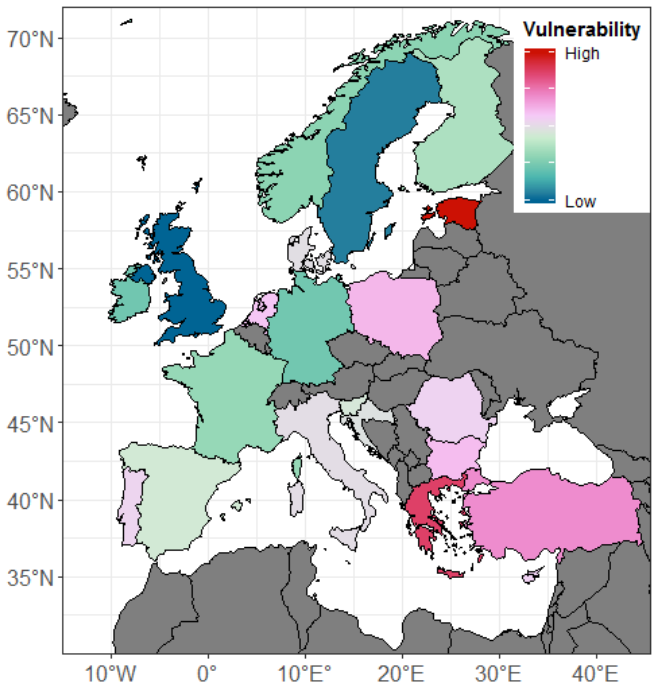


Figure 6 Climate vulnerability assessment for Europe. Colour scale is linear in the value of the corresponding score, but is presented without values, as they have little direct meaning. *Picture credit: Myron Peck*

- A climate vulnerability assessment (CVA) was conducted on the European aquaculture sector using the FAO model of Exposure + Sensitivity + Adaptive Capacity.
- The CVA included the physiological and farming methods of seven species (Atlantic salmon, sea bass, sea bream, trout, carp, mussels, oysters and clams) representing > 95% of the value for the region.
- Based on available economic data, the vulnerability of 22 countries – the top producers in the Europe28 as well as Norway and Turkey – was ranked and relative values are shown (right)
- By 2050 in RCP8.5, warming caused small reductions in the suitability of culture conditions for sea bass and sea bream in the eastern Mediterranean Sea. Direct effects of warming by 2050 were small. Indirect threats of climate change (e.g. increases in disease or jellyfish blooms) were not included in this analysis.
- Many of the firms growing sea bass and sea bream in the Mediterranean region are relatively large and, therefore, have better adaptive capacity in terms of future technological innovation.
- National-level vulnerability in the eastern Mediterranean was relatively high for a variety of reasons such as the economic importance of aquaculture and the slow progress in implementing national climate adaptation plans.

Climate-ready solutions

For bottom-up - mitigation measures

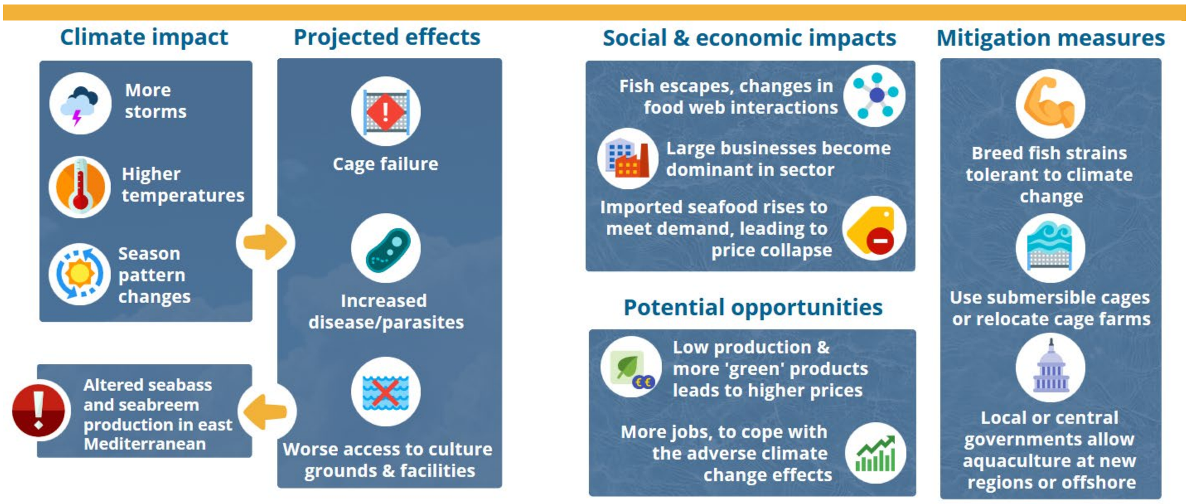


Figure 9 BowTie analysis based on stakeholder feedback. All full BowTies available http://bit.ly/CERESbowties2020 *Image: Katy Smyth*

According to Bow-tie modelling for sea bass and sea bream farming in the Eastern Mediterranean region, the key to control, enhancement and mitigation measures are as following[13]:

Ranked High:

1. Selective breeding: breeding and production of strains tolerant to climate change.
2. Other: well-designed ecosystem management, spatial planning, clustering and risk assessment.
3. Technology: Use of submersible cages, relocation of cage farms, use of better and robust mooring systems
4. Local legislation: Local or central governments should allow aquaculture at new suitable regions (both inland and offshore)
5. EU legislation: adaptation of new EU legislation on monitoring and support.
6. EU legislation: to build up & support offshore big polygons with common facilities
7. Alternative stocks: exploitation of new species could be supported if well planned and managed, but time needed to implement change.
8. Other: new companies of services with environmentalists, marine biologists, divers to measures are effective

Ranked Medium:

9. Technology: Use of better off-shore technology.
10. Technology: adaptation and promotion of new technologies
11. Technology: use of closed circuit system will increase at hatchery and fry stages.
12. Fisheries management: pre planned, active and responsive management is essential.
13. Fisheries management: should be under the control of external evaluators.
14. Government incentives: for events when farmers own insurances do not cover damages.
15. Government incentives: High valued species cultivation experiments should be supported by government.
16. Trade in marine aquatic species: must be better regulated to avoid transmission of diseases for aquatic animals including farmed species.
17. Trade in marine aquatic species: increased control and penalties on trade of especially live and invasive aquatic species.
18. Trade in marine aquatic species: the government should initially fund the tagging of all animals once they are in the culture cages...over time the farmers should adopt this extra cost as an obligation.

Ranked Low:

19. Habitat creation or offsetting: habitat offsetting alternatives need to be approached with precaution
20. Stock enhancement: Breeding selection programmes, prebiotics and probiotics
21. Catch and release: Catch and release of wild broodstock for gene pool diversification can be supported if well monitored

Not Ranked:

22. Lower stocking densities

Policy recommendations

- An aquaculture-specific action plan addressing the risks associated with impact of climate change on both inland and marine aquaculture (cage farming) accompanied with mitigation and adaptation measures need to be developed by public authorities.
- Producers do not perceive climate change an urgent issue to deal with. It is seen as a challenge which needs to be addressed in future by public institution e.g. research institutes. Awareness and capacity building actions regarding climate-change and aquaculture interactions should not be limited to private sector but needs to include technocrats/policy-makers at administrative level.
- Marine spatial planning and allocation of new sites for cage farming of marine species need to be in line with climate change scenarios to mitigate potential negative impact of CC.
- Research and technology development focusing on CC and aquaculture interactions and targeting mitigation and adaptions measures (e.g. robust off-shore technology for cage culture in tough marine conditions) should be actively supported by public in close collaboration with aquaculture producers.
- Public Universities and specifically faculties of Fisheries need to be more active in this domain.

Stakeholder Engagement

A series of stakeholder meetings (focus-group and seminars) were conducted in Muğla and Ankara with external stakeholders namely, sea bass and sea bream farmers, researchers and policy makers.

These events were often co-sponsored by the aquaculture industry and public institutions.

These activities have substantially contributed to the awareness-building of marine finfish producers on how climate change will potentially impact their sector and business. Focus-group meetings also shed light on perceptions of Turkish stakeholders regarding climate change and on four socio-political scenarios and their regionalisation.

As far as regionalization of CERES socio-political scenarios are concerned, stakeholders from the Turkish aquaculture sector identified '**World Markets**' (RCP 8.5, SSP5) as the most likely future pathway of the four CERES socio-political scenarios.

Based on growth patterns, characteristics and market dynamics, this scenario was believed the best match to the economic growth and regional socio-political environment

What has been evident from interviews with producers regarding their perception on climate change and aquaculture interactions is that that the marine aquaculture sector has developed in.

Turkish producers see climate change as a long-term challenge which needs to be dealt with in future. For this reason, only few producers have any mitigation strategy to meet this challenge[14].

Further reading

CERES publications

[1]Anonymous (2019). Fisheries Statistics. Ministry of Agriculture and Forest. Ankara.

[2]Kay, Susan; CERES deliverable 1.3. Projections of physical and biogeochemical parameters and habitat indicators for European seas, including synthesis of Sea Level Rise and storminess. [internet]. 2018. [cited, 2019 July 12]. Available from: http//ceresproject.eu/deliverables/

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