CGS MUN

Committee: Environmental Commission (Sub-commission 2)

Issue: The role of artisanal fisheries and aquaculture in global food security

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Position: Deputy President

INTRODUCTION

"The quest for food security can be the common thread that links the different challenges we face and helps build a sustainable future." (José Graziano da Silva, United Nations Food and Agriculture Organization (FAO) Director-General)

Seafood is currently one of the most highly traded food commodities, contributing to the livelihoods of more than half a billion people, however global seafood supplies are threatened by the lack of coordinated policy.[1] In this way, aquaculture is threatened when regulations fail to preserve the supporting ecosystems, even though it has a great promise for enhancing food security.[2] Nevertheless, artisanal fisheries are often undermined compared to marine fisheries. The reason for that is that marine fisheries have a huge industry behind them and thus their financial impact can be tracked like any industry, whereas in artisanal fisheries there is no centralized management, they are important mostly in subsistence and recreational context, while the fisheries are usually diffuse, making them difficult to track.

All the aforementioned, make artisanal fisheries liable for under-appreciation and mismanagement.[3] Currently, investments in aquaculture are prone to feeding wealthier consumers rather than the hundreds of millions of people in developing nations, as to feed them aquaculture would need to minimize impact on natural

[1] Ctsa.org, Duke University, published on esciencenews.com February 11, 2010
[2] Martin D. Smith, Sustainable fisheries needed for global food security, 2010
[3] Peter B. McIntyre, Catherine A. Reidy Liermann, and Carmen Revenga, Linking freshwater fishery management to global food security and biodiversity conservation, 2016

habitats and wild fisheries.[4] To sum up, even though aquaculture and artisanal fisheries have made impressive efficiency gains, challenges such as but not limited to water pollution, competition for water with other human needs and social conflicts over resource use, remain.[5]

DEFINITION OF KEY TERMS

Artisanal fisheries

Traditional fisheries involving fishing households -as opposed to commercial companies-using relatively small amount of capital and energy, relatively small fishing vessels -if any any-, making short fishing trips, close to shore and mainly for local consumption. They can be for subsistence or commercial fisheries, providing for local consumption or export.[6]

Aquaculture

Aquaculture is the farming of aquatic organisms, including fish, mollusks, crustaceans and aquatic plants. Farming implies some form of intervention in the rearing process to enhance production, such as regular stocking, feeding, protection from predators, etc. Farming also implies individual or corporate ownership of the stock being cultivated. For statistical purposes, aquatic organisms which are harvested by an individual or corporate body which has owned them throughout their rearing period contribute to aquaculture, while aquatic organisms which are exploitable by the public as a common property resources, with or without appropriate licenses, are the harvest of fisheries.[7]

Food Security

[4] Matthew L. Miller, The Surprising Importance of Freshwater Fisheries to Global Food Security, 2016
[5] FAO, Fisheries and Aquaculture technical paper, 2009
[6] Fao.org, Artisanal Fisheries, http://www.fao.org/docrep/003/x2465e/x2465e0h.htm
[7] Fao.org, Aquaculture, http://www.fao.org/docrep/003/x6941e/x6941e04.htm

When all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food which meets their dietary needs and food preferences for an active and healthy life. [8]

Invasive Species

A species that is non-native -or alien- to the ecosystem under consideration and whose introduction causes or is likely to cause economic or environmental harm or harm to human health.[9]

Destructive fishing

A practice that uses fishing gear and technique, such as bottom-trawling, cyanide fishing, and fish bombing, that destroy fisheries habitat and inflict damage to marine environment.[10]

Polychlorinated Biphenyls (PCBs)

A group of organic chemicals which can be odorless or mildly aromatic solids or oily liquids. They are more commonly used as hydraulic fluids, plasticizers, adhesives, fire retardants, way extenders, de-dusting agents, pesticide extenders, inks, lubricants, cutting oils, in heat transfer systems and carbonless reproducing paper.[11]

BACKGROUND INFORMATION

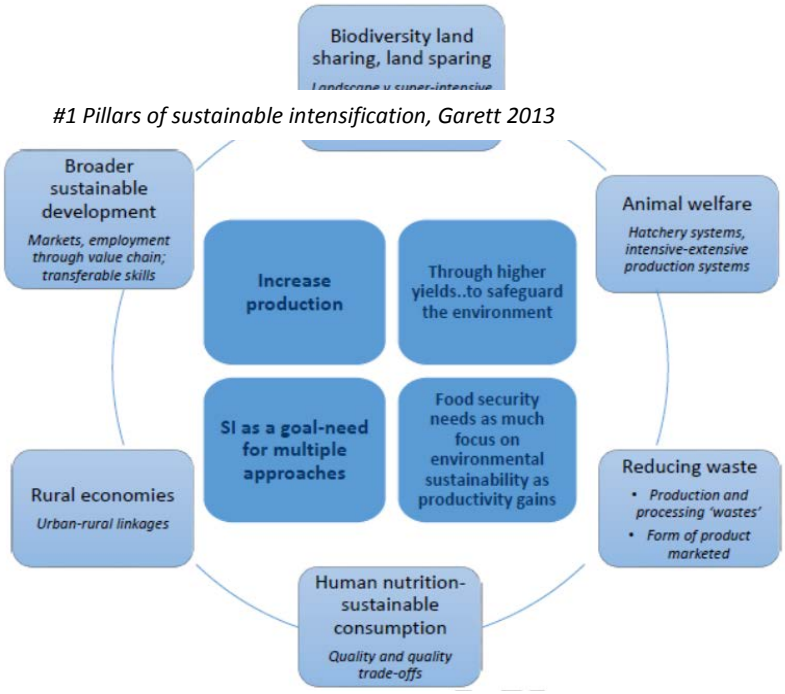
Fish' contribution to food security

Fish has always been an important component of human food, especially in areas surrounded by water, such as lakes, rivers, deltas and coastal areas, even small islands. With the development of trade, the importance of fish has been spread worldwide. Fish can contribute to global food security, both directly and indirectly, as a source of essential nutrients and as a source of income, respectively. Due to its

[8] Fao.org, Food security, http://www.fao.org/docrep/005/y4671e/y4671e06.htm
[9] Ivasivespeciesinfo.gov, Invasive Species, https://www.invasivespeciesinfo.gov/whatis.shtml
[10] Igi-global.com, Destrtuctive Fishing, https://www.igi-global.com/dictionary/destructive-fishing/52628
[11] Medicinenet.com, Polychlorinated Biphenyls, https://www.medicinenet.com/script/main/art.asp?articlekey=19548

contribution both to the total global output and the numbers of people involved in fishing, fishing pays a substantial role in the following respects.

Firstly, fish as a food is a highly nutritious, rich in essential micronutrients, minerals, essential fatty acids and proteins, supplement to nutritionally deficient cereal-based diets. It makes up for at least 20% of the average per capita intake of animal protein for more than 1.5 billion people, especially in LEDCs.[12]



#1 Pillars of sustainable intensification, Garett 2013

Then, concerning fish as a source of livelihood, the fisheries and aquaculture sector contribution to gross domestic product (GDP) typically ranges between 0.5-2.5%, although it may even exceed 7% in some countries. Almost 42 million people work directly in the fishing industry, the vast majority in LEDCs, while adding to that all relative activities, the fishing sector is estimated to sustain and support more than 500 million livelihoods.[13] On the other hand, the fishing sector can also incur substantial costs to the society and even direct subvention, including capital support and fuel subsidies, costing tens of billions of US dollars per year.[14]

Moreover, concerning the fishing sector's relation to poverty, poverty has been one of the causes of fishery resources degradation in many rural areas of

[12] FAO, The state of world fisheries and aquaculture, 2008
[13] Worldfish, Fish and aquaculture in a changing climate, 2009
[14] World Bank, The economic justification for fisheries reform, 2009

LEDCs, an obvious constraint to achieving global food security. Well-managed fisheries can contribute to the reduction of poverty by means such as the generation of revenues and wealth creation, which will operate like a socio-economic "lift" at community level and will contribute to economic growth at a national and international level. They can maintain a sustainable stream of economic benefits in the community and even operate as a safety net when needed, i.e. people internally displaced due to a drought or a civil war.[15]

Opportunities in aquaculture

Despite challenges and externalities the development of aquaculture has come with, experts are confident that the time of severe environmental problems has passed and that aquaculture is becoming more and more environmentally sustainable.

To give an illustration, aquatic animal production systems are considered to have a lower carbon footprint per kilogram of output compared with other terrestrial animal production systems and in the same way, phosphorus and nitrogen emissions from aquaculture production systems are considerably lower compared to beef and pork production systems, although slightly higher than poultry production systems.[16]

Furthermore, the past 30 years, aquaculture has increased its size by 12 times, at an average annual growth rate of over 8 percent. This makes aquaculture the fastest growing food production sector and essentially foresees that the growing demand for fish has to be satisfied through aquaculture production.

Finally, the importance of aquaculture is evident from the strong interest both in the private and in the public sector in many countries to engage in the specific activity.

Challenges in aquaculture

[15] Christopher Béné. Gavin Macfadyen , Edward Allison, Increasing the contribution of small-scale fisheries to poverty alleviation and food security, 2007

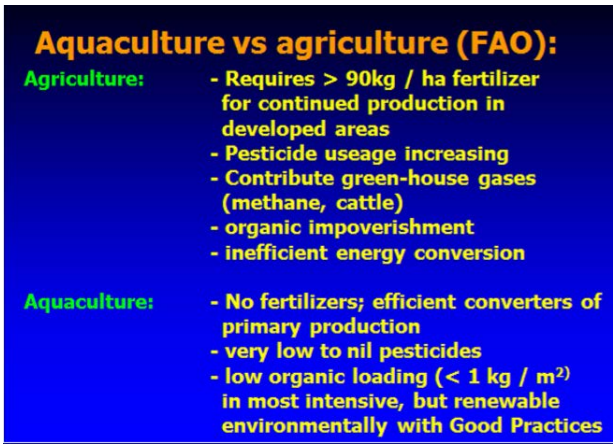
[16] High Level Panel of Experts on Food and Nutrition, Sustainable fisheries and aquaculture for food security and nutrition, 2014

First of all, conflicts usually take place when aquaculture is brought into a locale where other fishing exercises are already settled, particularly at subsistence level, since aquaculture takes up a lot of space and thus, the space allocated for other fishing activities in the areas remaining open for wild harvest is limited.

Second of all, as far as livestock production goes, a constant threat to production and thus, to local livelihoods are fish diseases i.e. the early mortality syndrome. Another concern is the use of antibiotics, drugs and chemicals in intensive systems, as even though many countries have implemented regulations on the use of the aforementioned chemical products, there is no standard international policy concerning aquaculture production.

In addition, if aquaculture stock is released in the environment, it can cause a risk for wild population i.e. invasive species, genetically modified fish becoming invasive or crossing with wild varieties and ecosystems etc.

Opportunities in artisanal fisheries



#2 Comparison between agriculture and aquaculture, FAO

Firstly, artisanal fisheries can contribute to a country's economic growth at a national level. Keeping in mind that the past 20 years international trade in both fish and fishery products has grown rapidly, artisanal fisheries can contribute significantly to a nation's economy by generating foreign exchange derived from international trade. A simple example is the one of LEDCs, where artisanal fisheries play a growing role in the fish exports and thus, the profits of the nations.

Secondly, artisanal fisheries contribute to the economic growth of a nation by generating a wide range of taxes. Especially for countries where either fish landings

are mostly concentrated in a limited number of sites or there is the process of decentralization, collection of revenues is easy. The aforementioned revenues are the key in eradicating poverty and adopting poverty prevention initiatives, as they enable national treasuries to invest in infrastructure and services that facilitate socio-economic development.

Finally, in the case that artisanal fisheries don't generate economic returns that are that high, they at least manage to sustain one's livelihood and prevent on from falling deeper in deprivation. To give an illustration, in the occasion that one loses one's job, that person can turn to artisanal fisheries as a source of not only income, but also food and employment.

Challenges in artisanal fisheries

One of the biggest threats to artisanal fisheries is illegal, unreported and unregulated (IUU) fishing, as it undermines both national and local endeavors to oversee fisheries sustainably and preserve marine biodiversity. IUU fishing, which is estimated to cost between 11 and 26 million tons of fish per year, affects all kinds and dimensions of fisheries, happens not only on the high seas but also in areas under national jurisdiction, concerns every aspect and every stage of the utilization and even the exploitation of fish, while it can go as far as to be associated with organized crime. What's more, keeping in mind that fishery resources are poached in a ruthless manner by IUU fishing, it is a common result that artisanal fisheries in Less Economically Developed Countries (LEDCs) collapse, as they are the most vulnerable. Furthermore, concerning the economic issues IUU fishing-derived products cause, when they illegally find their way into local or overseas trade markets, they undermine the local fisheries and thus, they deprive local communities from food security.

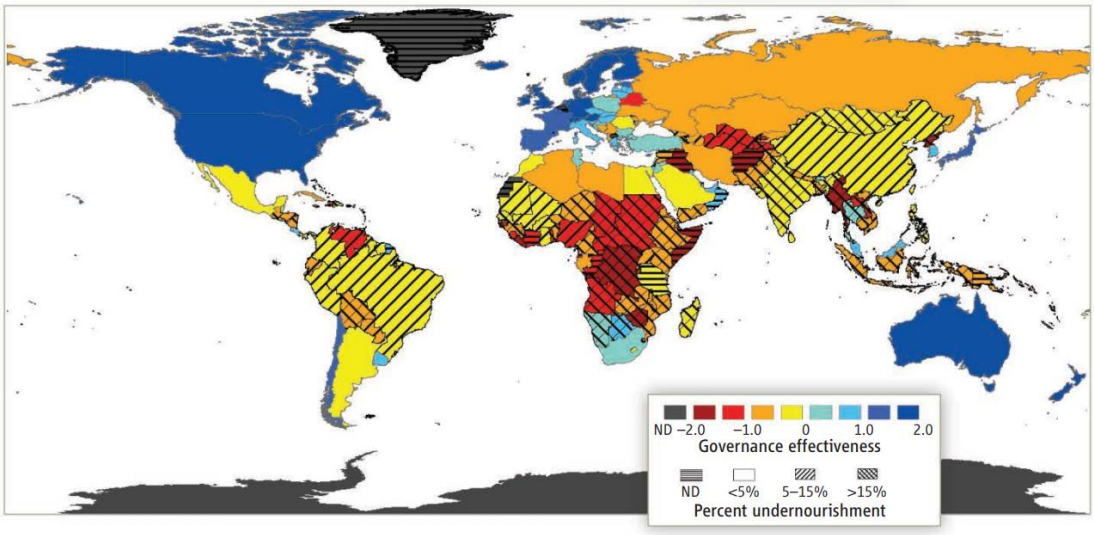
Additionally, IUU fishing enables big-scale fishing companies and hence big vessels to increase their input by exploiting areas reserved for relatively smaller vessels. This is compounded mainly by the inadequate monitoring and surveillance efforts of the fishing sector by LEDCs' governments due to lack of funds and the complexity in the relationships between ministries in charge of regulating fishing and

foreign fishing companies. This is very harmful to the availability of fish, since as a result of trade dynamics having shifted toward higher levels of exports and thus, a greater reliance on imports, a crucial food security net has been eliminated.

Moreover, not only are destructive fishing and generally new fishing practices inherently destructive, but also commonly used fishing gears have large potential for negative impacts on ecosystem functions and thus, artisanal fisheries and food security.

Governments' role in the problem

The role of the government is of high importance, as it stands to determine access to the fisheries resources, their integrity and the distribution of fish benefits. In most countries, there isn't much attention given to how both individuals and groups, which often include not only poor and marginalized people in the fisheries and aquaculture supply chains, but also low-paid consumers, will gain, lose or be barred from access to fish resources, other profitable supply chain assets and fish as a nourishment item. In this way, according to evidence, human rights instruments are believed to be essential and powerful tools in the road of guaranteeing that states satisfy their obligations notwithstanding those pertaining to the right of food.



#3 Relativity between fisheries' governance and undernourishment

Additionally, just protecting our resources isn't enough, we need to protect those who provide the aforementioned resources. In the case that there aren't any

independent fishermen, because they are replaced by big firms' employees, there is no fishery, and without fisheries, there is no seafood. In other words, human interests and economic systems are vitally important to managing our resources, an idea with environmentalism has not come to terms with.[17] Likewise, fisheries are subsidized commodities, as fisheries operate over capacity with armadas substantially bigger than expected so as to achieve catching the allowable quota, thus constraining a very diverse ecosystem into an economic and efficiency model which demands consistency. However, instead of subsidizing the fisheries, governments should be working towards subsidizing the access points to regionalized or direct-from-source products. In that way, fishermen would be able to participate diversely in an ecosystem and to offer consumers what the oceans give, not just take from the oceans what the consumer and market wants. Market demand determines the value of products and in this way ensures that only a few species are profitable and thus are landed and brought to market

MAJOR COUNTRIES AND ORGANISATIONS INVOLVED

Mediterranean Countries

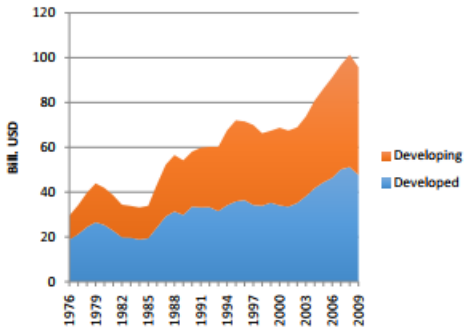


Figure 3. *Global seafood exports in real terms, 2009 = 1. (Source: FAO, 2013)*

#4 Seafood exports in real terms on a global scale, 2009

Both artisanal fisheries and aquaculture are crucial to the social and the economic sector to most of the countries in the Mediterranean, as they supply the people with the biggest source of protein and thus, support food security in a great level. About a third of the population, lives close to coastal areas, so they rely on fish not only as a nourishment but also for their livelihoods.[18] Countries of the Mediterranean can roughly be divided into levels of development with Greece, Turkey, Spain, France, Italy, Malta and Egypt

[17] Barton Seaver, Putting the world on a fork
[18] Naji M., Referred to Sauzade and Rousset, Enhancing Small-Scale Fisheries Value Chains in the Mediterranean and Black Sea, 2013

having large and organized industries, Morocco, Tunisia, Algeria, Albania, Montenegro, Croatia and Israel having a small industry but with growth potential and Lebanon, Syria and Libya having no significant marine aquaculture to date.[19]

East Asia[20]

This subregion of Asia is one of the greatest fish producing areas on a global scale, as the East China Sea, the Yellow Sea, the Sea of Japan and the eastern offshore waters of Japan are all some of the most exploited seas of the world, while aquaculture makes up for the vast majority of the total global production. Consumption of seafood is very common and as the countries of the region are all active international traders, the sub-region as a whole is a net importer of fish and fishery products.

Oceania[21]

Although embracing large areas of marine waters, the region of Oceania accounts for only about 2% of the world's total seafood production. On the other hand, the fishery sector has a big economic impact on all the territories, as fish consumption is relatively high, particularly in some of the Small Island Developing States (SIDS), while of big importance are also the exports of fish and mainly tuna.

South and Southeast Asia[22]

This region includes some of the most productive fishing waters on an international level, with a bigger production every year. The consumption of fish, however, varies from country to country, as there are high-per-caput supplies in the coastal areas that make up Southeast Asia, opposite to the lower consumption levels in the northern inland regions in South Asia. More than 10 million people are thought

[19] Acquaculture in the Mediterranean, the Fish site, https://thefishsite.com/articles/aquaculture-in-the-mediterranean

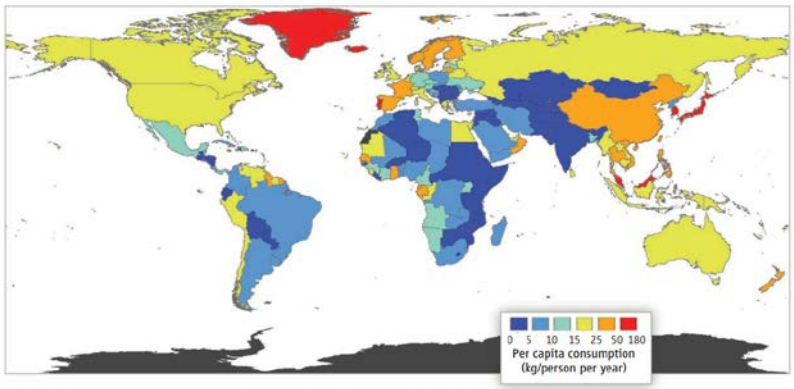
[20] Meaning the marine and inland water jurisdictions of the Democratic People's Republic of Korea, Hong Kong SAR, Japan, Macao, Mongolia, the People's Republic of China, the Republic of Korea, the east coast of the Russian Federation and Taiwan Province of China.

[21] Western and central parts of the southern Pacific Ocean, there are 16 independent states, two of which are developed (Australia and New Zealand) while the remaining states, together with a number of dependent territories of France, the U.K. and the U.S.A., are SIDS

[22] Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan and Sri Lanka in South Asia and Brunei Darussalam, Cambodia, Indonesia, Laos, Malaysia, Myanmar, the Philippines, Singapore, Thailand and Vietnam

to be employed in the fishery sector and due to that, fish trade has expanded significantly over the last decade.

Scandinavian Countries



In the Scandinavian countries, aquaculture has always been an important and necessary industry for both sustainable food production and food security. Seafood is a huge part of the people's' everyday meals, while the demand for fish and other fishing products is growing daily. At the moment, however, the fishing

#5 per capita consumption of fish on a global scale per year

sector in Scandinavia is facing a number

of challenges, related to climate change, industrial structure and increased international competitiveness.

Table 1. World fisheries and aquaculture production and utilization (FAO, 2014)

	2007	2008	2009	2010	2011	2012*
PRODUCTION (in million tonnes)						
Capture fisheries						
Inland	10.1	10.2	10.4	11.2	11.1	11.5
Marine	80.7	79.9	79.6	77.7	82.4	79.5
Total capture fisheries	***90.7***	***90.1***	***90.0***	***89.0***	***93.5***	**91.0**
Aquaculture						
Inland	33.4	36.0	38.1	40.9	43.9	46.4
Marine	16.6	16.9	17.6	18.1	18.8	20.1
Total aquaculture	***49.9***	***52.9***	***55.7***	***59.0***	***62.7***	***66.5***
Total fish production	**140.7**	**143.0**	**145.7**	**148.0**	**156.2**	**157.5**
UTILIZATION (in million tonnes)						
Human consumption	**117.4**	**120.8**	**123.8**	**128.1**	**132.3**	**135.4**
Non-food uses	23.3	22.3	21.9	19.9	23.9	22.1
Population (billions)	6.7	6.8	6.8	6.9	7.0	7.1
Per capita food fish supply (Kg)	**17.6**	**17.9**	**18.1**	**18.5**	**18.9**	**19.1**

#6 World fisheries and aquaculture production and utilization, 2014

United States of America (USA)

In the United States, aquaculture sustains the economic activity in coastal communities, supports commercial fisheries, aids with seafood supply and helps restore habitats and species that are at risk. The United States may be a minor aquaculture producer on a global scale, however it is the leading importer when it comes to fish and fishery products.

Africa[23]

Most of the African countries practice some form of aquaculture, but it's usually at a very low level. Nevertheless, there are many benefits in the development of aquaculture and artisanal fisheries in Africa, namely, the improvement of food security, the increase of domestic fish production, which will substitute the imports

[23] The 48 Sub-Saharan nations including the 5 islands nations

that are at this point necessary, the generation of employment, the promotion of diversification and thus the reducing of risk, the promotion of economic development and the improvement of the utilization of resources and in particular water.

Latin America and the Caribbean

The seas of Latin America and the Caribbean are both a source of healthy food and a source of income for thousands of families. To give an illustration, more than 100.000 rural families in the specific region depend either directly or indirect on aquaculture and artisanal fisheries for their livelihood as well as food for private consumption. The development of the specific sector is expected; however, it is essential that it takes place in a manner that will be environmentally sustainable, socially just and that the sector will generate products that will be healthy and secure.

Committee on World Food Security (CFS)

The proposals the CFS has made concerning the maintenance and the enhancement of the contribution of artisanal sustainable fisheries and aquaculture to nutrition and food security can be summed up by the following. The CFS believes that fish should be given the position it deserves in the road for food security and nutrition strategies, policies and programs, artisanal fisheries and aquaculture policies that will be adapted to the climate change should be promoted, the opportunities and challenges of aquaculture should be seized and addressed respectively, the contribution of artisanal fisheries should be underlined, the fish market's and trade's contribution to food security should be enhanced, social protection and labor rights should be improved, the gender dimension of the fisheries and the aquaculture sector should be fully addressed and finally, that food security

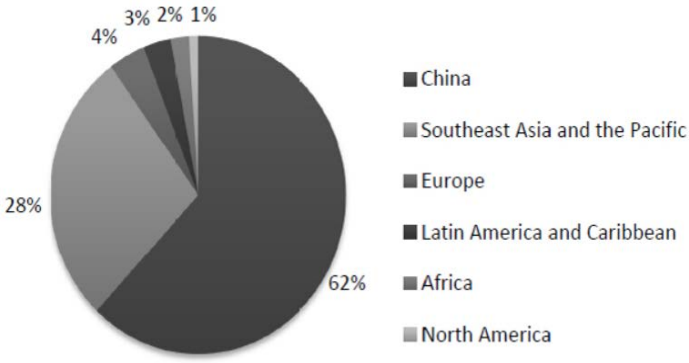


FIGURE 4-1 World fisheries and aquaculture production

SOURCE: Main, 2012. Data from FAO, 2012.

#7 World fisheries and aquaculture production by region,2012

and nutrition concerns should be integrated into fisheries and aquaculture-related policies and programs.

Food and Agriculture Organization(FAO)

FAO recognized the importance of artisanal fisheries and aquaculture in achieving global food security and thus, provided the technical assistance needed by the implementation of the Code of Conduct for Responsible Fisheries. In that way, sustainable aquaculture advancement especially in LEDCs is promoted through better environmental performance of the division, health administration and biosecurity, regular analysis and reporting of aquaculture development status and trends at global and regional levels is provided thus facilitating the exchange of information and efficient policies and legal frameworks which promote sustainable and equitable aquaculture development with improved socio-economic benefits are developed and implemented

TIMELINE OF EVENTS

Date	Description of Event
1879	The fish commission initiates a landmark study on the composition of fish to determine their food and nutritive values.
1966	The Sea Grant College Program granted funding to land grant colleges for aquaculture research
1977	With the Food and Agriculture Act of 1977 the Congress designated aquaculture as a basic mission of the Department of Agriculture
1980	The National Aquaculture Act of 1980 allowed for the establishment of the National Aquaculture Development plan in the United States
1986	The funding available for aquaculture increases as four regional aquaculture research centers are established

November 16th 1994	UN Convention on the Law of the Sea comes into force
1995	The FAO Conference adopts the FAO Code of Conduct for Responsible Fisheries.
October 31st 1996	FAO adopts Code of Conduct for Responsible Fisheries
February 1999	FAO IPOA on fishing capacity becomes the first multilateral instrument to address fisheries subsidies
2001	FAO Members adopt an International Plan of Action to Prevent, Deter and Eliminate Illegal, Unreported and Unregulated Fishing (IPOA-IUU).
September 2007	UNEP and WWF publish Sustainability Criteria for Fisheries Subsidies
2008	Approval of the FAO Technical Guidelines for Responsible Fish Trade. They focus on market and trade issues as outlined in Chapter 11 of the Code of Conduct.
2009	A Strategy for Sustainable Aquaculture Development in Ontario was published (Canadian Aquaculture Systems Inc. 1997). It provided a blueprint to guide research, development investment, and policy pertaining to aquaculture
December 5th 2017	The UN declare 2022 as the International year of Artisanal Fisheries and aquaculture

UN INVOLVEMENT: RELEVANT RESOLUTIONS, TREATIES AND EVENTS

- Draft Resolution A/57/L.49 (2002)

This draft Resolution talks about many issues related to fishing, however the ones more relevant to the topic are the topics of IUU fishing, fisheries by-catch and discards and generally other developments in the fishing sector[24]

- Report of the Secretary-General, A/69/71 (2014)

The report is about recent developments and issues that relate to ocean affairs and the law of the sea that ought to be discussed at the 69th session of the General Assembly. Prepared pursuant to paragraph 284 of the General Assembly Resolution 68/70 (2013), the report aims to aid in the discussions at the 15th meeting of the UN Open-ended Informal Consultative Process on Oceans and the Law of the Sea, on the topic of "The role of seafood in global food security"[25].

- Plenary of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem services, IPBES/2/16/Add.7 (2013)

This document is the initial scoping for the thematic assessment of agriculture, food security, biodiversity and ecosystem services. More specifically, it talks about how global food security will be achieved without compromising ecosystem services and in particular biodiversity.[26]

- Report by The High Level Panel of Experts on Food Security and Nutrition

This report addresses the role and importance of seafood in achieving global food security. Further topics this report includes are the role of sustainable fisheries and aquaculture for better food security and nutrition and the governance of fisheries and aquaculture to achieve the aforementioned goals.[27]

[24] Draft Resolution A/57/L.49, UN General Assembly, 25 November 2002, https://documentsddsny.un.org/doc/UNDOC/LTD/N02/709/19/pdf/N0270919.pdf?OpenElement
[25] "Report A/69/71 of the Secretary-General- Oceans and the law of the sea", UN General Assembly, 21 March 2014, https://documentsddsny.un.org/doc/UNDOC/GEN/N14/272/55/pdf/N1427255.pdf?OpenElement
[26] "Note by the Secretariat IPBES/2/16/Add.7 - Initial scoping for the thematic assessment of agriculture, food security, biodiversity and ecosystem services", UN Environment Programme, 2 October 2013, https://documentsddsny.un.org/doc/UNDOC/GEN/K13/533/46/pdf/K1353346.pdf?OpenElement
[27] "Sustainable fisheries and aquaculture for food security and nutrition", Report by The High Level Panel of Experts on Food Security and Nutrition, June 2014, http://www.fao.org/3/a-i3844e.pdf

POSSIBLE SOLUTIONS

Fisheries' management

As mentioned before, the government's role in fisheries' management is vital. Keeping that I mind, there are several measures governments must take in order to ensure the most efficient management of the fisheries. A good idea would be the introduction of Total Allowable Catch (TAC) systems to some of the fisheries, including but not limited to offshore bottom trawling for crab and Alaska pollack, purse seining, stick-held dip net for saury. Of course, there would need to be monitoring of catches under TAC systems and in order to ensure the fishermen report promptly on their catches to fish markets, probably some form of educational activities for them to partake. Finally, a good idea would be the establishment of a computer network for the collection and analysis of data.

Community-based fisheries management

Another major aspect of fisheries management is the community. Taking that into consideration, community-based fisheries management should be promoted on a global scale, simultaneously noting the importance of close coordination between the fisheries' cooperatives and both the prefectural and central government. In addition, there is an immediate need for a comprehensive management plan by means such as but not limited to the expand of the kind of species and types of fishing, conducting resource surveys and the building infrastructure facilities that are related to the conservation of the aforementioned resources. Moreover, fish propagation projects for community-based fisheries management should be implemented, so as to reduce the number and size of vessels that commensurate to the state of the resources. To conclude, another good idea would be the development of quantitative forecast methods to calculate the migration of pelagic species.

Expansion of aquaculture

As mentioned before, the greatest problem with the use of aquaculture is the fact that current regulations fail to preserve

#8 An aquaculture production system

the supporting ecosystems. This is the reason why, a development plan covering management from production to marketing needs to be formulated, which will suit specific local conditions so as to make aquaculture businesses stronger and thus, more competitive. In this way, costs will be reduced, feeding efficiency will be increased and labor-saving equipment will be installed under common use so that the productivity of the businesses is increased. Then, aquaculture installations need to be appropriately deployed, so that there is a rational use of the farming grounds and an effective utilization of the underdeveloped waters, something like pilot test operations for cultivating fish species suitable for that specific area.

Moreover, aquaculture should be protected by establishing environment indicators, through inspection and monitoring methods and systems, while as mentioned above pilot tests could be conducted so as to develop the techniques necessary for the appropriate treatment of residual waste products in the aquaculture farms and the production of new species, which will require feeding. As a result, another cheap and effective composite food needs to be developed, which will replace species including but not limited to sardines, stocks of which have declined dramatically in the last few years.

In addition, an efficient idea would be the application of biotechnology in producing new species, resistant against disease, as it is deemed to have high feeding efficiency and improved taste. Finally, studies should be conducted on the possible contamination of fish both by intensive farming and normal fishing methods.

Seafood safety assessment program

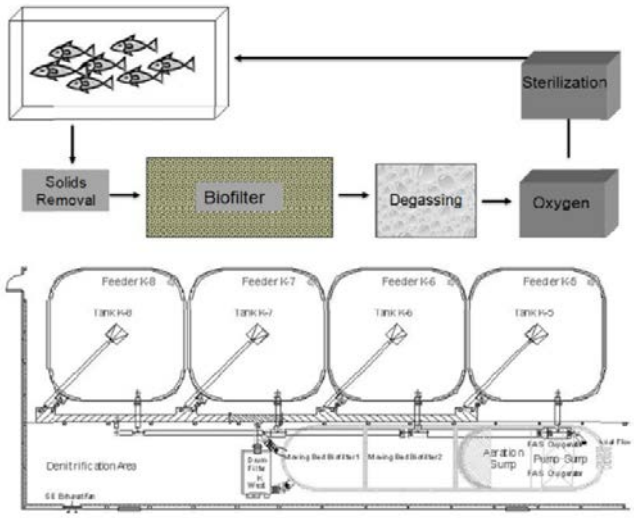


FIGURE 4-2 Recirculating aquaculture system: schematic of a module

SOURCE: Main, 2012.

As underlined above, there is a dire need for a seafood safety assessment program, that could provide better and more timely information to both consumers and regulators. This program should directly address the "dilemma" most citizens face, while simultaneously enhancing the benefits from the increased seafood consumption and the people's' confidence in the seafood market. Moreover, it should conduct an endorsed monitoring effort that will systematically collect representative samples of both commercially and recreationally domestically harvested fish and imported wild and cultured seafood. There is also need to increase the frequency of market surveillance in order to facilitate spotting banned and harmful substances as well as species substitutions. What's more, it should help in the development of consistent regulatory criteria between the different state, deferral and local regulatory agencies. In addition, it must be able to provide data that will be easily understood by the public, informing them about the health benefits and risks each species of fish comes with, while the aforementioned data should also be linked to more technical syntheses of this information for public health agencies, regional environmental managers and health care providers. With this in mind, a seafood tracking system should be developed for the source of seafood from catch waters to end consumer to be identified. Finally, it should routinely convene an independent advisory panel that will consist of representatives from the seafood and aquaculture industries, environmental interest groups and the public health community to aid in the monitoring of the progress, to the coordination between federal agencies with

seafood safety programs, the setting of priorities and in the better communication of the results.

Establishment of relative legislation

All countries should develop and establish a legal framework that will on the one hand protect artisanal fisheries and set out some terms for their operation and on the other hand determine where big vessels and fishing companies can fish and where not.

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