HLPE REPORT 7

Sustainable fisheries and aquaculture for food security and nutrition

A report by

The High Level Panel of Experts

on Food Security and Nutrition

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CFS Committee on World Food Security

HLPE High Level Panel of Experts

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This report is dedicated to the memory of Chandrika Sharma

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FOREWORD

Sustainable Fisheries and Aquaculture for Food Security and Nutrition

This report addresses a frequently overlooked but extremely important part of world food and nutrition security: the role and importance of fish in seeking food and nutrition security for all. Fisheries and aquaculture have often been arbitrarily separated from other parts of the food and agricultural systems in food security studies, debates and policy-making. I applaud the Committee on World Food Security for its decision to bring fisheries and aquaculture fully into the debate about food and nutrition security.

The report presents a synthesis of existing evidence regarding the complex pathways between fisheries and aquaculture and food and nutrition security, including the environmental, economic and social dimensions, as well as issues related to governance. It provides insights on what needs to be done to achieve sustainable fisheries and aquaculture in order to strengthen their positive impact on food and nutrition security.

The ambition of this compact yet comprehensive report is to help the international community to share and understand the wide spectrum of issues that make fisheries and aquaculture such an important part of efforts to assure food security for all.

I am particularly glad that this HLPE report, prepared for the CFS to serve as basis of the debates at CFS 41 in October 2014, can be launched during the week of the 31st Plenary session of the FAO Committee on Fisheries (COFI), 13 June 2014. COFI brings together stakeholders in the fisheries and aquaculture sectors around the world. I hope this report will provide a basis for a productive dialogue amongst COFI and CFS stakeholders.

The High Level Panel of Experts on Food Security and Nutrition (HLPE) was created in 2010 to provide the United Nations' Committee on World Food Security (CFS) with evidence-based and policy-oriented analysis to underpin policy debates and policy formulation. While specific policy interventions should be based on context-specific understanding, HLPE reports provide evidence relevant to the diversity of contexts, with recommendations aiming to be useful to guide context-specific policy interventions.

The HLPE works on topics identified by the CFS. This is the seventh HLPE report to date. Past reports have covered six topics related to food security and nutrition considered by the CFS for their importance in relation to the world policy agenda, including price volatility, land tenure and international investments in agriculture, climate change, social protection, biofuels, and investment in smallholder agriculture. A report on Food losses and waste in the context of sustainable food systems will be published this year. Work is underway for an HLPE report on water and food security to feed into CFS's policy debates in 2015.

The Steering Committee of the HLPE consists of 15 members including a Chair and a Vice-Chair. In addition, the HLPE includes a wide range of researchers who work on the various reports. A large number of other experts, including many peer reviewers, contribute to our work. The tenure of the first Steering Committee ended in the fall of 2013. I praise the wisdom of the CFS for having reappointed four of the outgoing members, including the Vice-Chair, Ms. Maryam Rahmanian, to provide the necessary continuity.

It was an honor and a pleasure to be elected by the Steering Committee members to succeed M. S. Swaminathan as Chair of the Steering Committee. I want to take this opportunity to express by great appreciation to M. S. Swaminathan who, before leaving his seat, marked the first 1 000 days of the HLPE with his vision and energy.

I would like also to pay my tribute to all the members of the first Steering Committee as well as the many individuals who contributed to the high quality of the work by the HLPE. I also want to thank my colleagues currently serving on the Steering Committee for their dedication, hard work and the successful contributions they have made. In particular I want to highlight the exceptional commitment and the tremendous contributions made by the HLPE Coordinator, Vincent Gitz and his colleagues at the HLPE secretariat.

I am grateful to the large number of experts who contributed to this report including the members of the first and the current HLPE Steering Committee in particular Sheryl Hendriks and Martin Kumar, who convened the Steering Committee's oversight, and to the Project Team leader Christophe Bene (France) and the Project Team members Gro-Ingunn Hemre (Norway), Moenieba Isaacs (South Africa), Vijay Gupta Modadugu (India), Ningsheng Yang (China) and Meryl Williams (Australia). The report also benefitted greatly from comments and suggestions by the external peer reviewers and a large number of experts and institutions who commented extensively both on the terms of reference and the first draft of the report. Last but not least, I want to thank the resource partners who support, in a totally independent way, the work of the HLPE.

This report is dedicated to the memory of Chandrika Sharma, who disappeared tragically on March 8, 2014 onboard the Malaysian airlines flight MH 370. Chandrika participated in the elaboration of this report as one of the peer reviewers, sending a very detailed and constructive review just a few days before the tragic event. Chandrika was a most pleasant and constructive team player and will be sorely missed. She will be remembered by the international community for her great passion and devotion to the support of fishworkers, especially women, and marginalized fishworkers' communities, for their rights for better justice and for progress to reduce inequalities and hunger.

Per Pinstrup-Andersen

Chair, Steering Committee of the HLPE, 21 May 2014

SUMMARY AND RECOMMENDATIONS

Fish,[1] either produced through fish farming/aquaculture[2] activity or caught from wild marine or freshwater stocks, is a primary source of protein and essential nutrients, and there is a growing recognition of its nutritional and health-promoting qualities. Fish is one of the most efficient converters of feed into high quality food. Fish and fish-related products provide income and livelihoods for numerous communities across the world.

The contribution of fisheries and aquaculture to food security and nutrition now and in the future is driven by many interactions between several environmental, development, policy and governance issues.

The need to feed a growing global population, and to address a growing demand for fish, puts pressure on natural resources and challenges the sustainability of marine and inland fisheries and of aquaculture development. It also raises several issues relating to the management of fish value chains to realise the right to food of fishing communities and to make fish available for all. It also questions the roles and contributions of the various actors (fishing communities, smallholders and international fishing companies, etc.) in a very diverse and heterogeneous sector, prone to significant inequalities.

In this context, in October 2012, the UN Committee on World Food Security (CFS) requested the High Level Panel of Experts on Food Security and Nutrition (HLPE) to conduct a policy oriented, practical and operational study on the role of sustainable fisheries and aquaculture for food security and nutrition, considering the environmental, social and economic aspects of fisheries including artisanal fisheries, as well as a review of aquaculture development.

Recognizing the importance of fish for food security and nutrition, what should be done to maintain or even enhance this contribution now and in the long term, given the challenges that both the fisheries and aquaculture sectors are facing in terms of sustainability and governance, and given the economic constraints and demographic conditions that they have to respond to? This report seeks to address this question.

Main findings

Fish as a critical food source

1. Today capture fisheries and aquaculture provide 3.0 billion people with almost 20 percent of their average per capita intake of animal protein, and a further 1.3 billion people with about 15 percent of their per capita intake. This share can exceed 50 percent in some countries. In West African coastal countries, where fisheries have historically been a central element in local economies, the proportion of total dietary protein from fish is remarkably high: e.g. more than 60 percent in the Gambia, Sierra Leone and Ghana. Likewise, in Asia, where fisheries are extremely important and fish farming has developed rapidly over the last 30 years: total dietary protein from fish is between 50 and 60 percent in Cambodia, Bangladesh, Indonesia and Sri Lanka. Fish provides a similarly significant proportion of protein in the human diets in most small island states (e.g. almost 60 percent in Maldives).
2. Overall, 158 million tonnes of fish were produced in 2012 (91.3 million tonnes from inland and marine capture fisheries and 66.6 million tonnes from inland and marine aquaculture), of which 136 million tonnes were used for human consumption. The continual growth in fish production – mostly from aquaculture since the 1990s – and improved production efficiency and distribution channels enabled the supply of fish for food per-capita to more than triple at world level since 1950, from 6 kg/cap/yr in 1950 to 19.2 kg/cap/yr in 2012. However, this global figure masks some important regional distinctions. Asia accounts for almost two-thirds of global fish consumption and 21.4 kg per capita[3] in 2011 – a level similar to Europe (22.0 kg/cap/yr) and North America (21.7 kg/cap/yr). Africa, Latin America and Near-East have lowest per-capita consumption (10.4, 9.9 and 9.3 kg/cap/yr in 2011, respectively). Oceania has highest levels per capita at 25.1 kg/cap/yr.

[1] "Fish" in this report includes finfish, crustaceans, molluscs, miscellaneous aquatic animals, but excludes aquatic plants and algae.

[2] In this report fish farming and aquaculture will be used interchangeably.

[3] These figures designate "apparent" fish consumption, in live weight equivalent, including non-edible parts, and without accounting for post-harvest losses.

3. World population growth, but more importantly the combination of urbanization, increased levels of development, living standards and income are key drivers of the increase of fish and seafood demand and of fisheries development. Demand has been rising in both the developed and developing world at more than 2.5 percent per year since 1950 and, as wealth increases in highly populated countries such as China and India, demand is likely to continue its rise.

Fish has received little attention in food security and nutrition strategies

4. Limited attention has been given so far to fish as a key element in food security and nutrition strategies at national level and in wider development discussions and interventions. Specialist fisheries debates have concentrated predominantly on questions of biological sustainability and on the economic efficiency of fisheries, neglecting issues linked to their contribution to reducing hunger and malnutrition and to supporting livelihoods. Yet increased consumption of fish, and its addition to the diets of low income populations (including pregnant and breastfeeding mothers and young children), offers important means for improving food security and nutrition for several reasons. First, the bioavailability of fish protein is approximately 5–15 percent higher than that from plant sources. Fish also contains several amino acids essential for human health; especially lysine and methionine. Second, the lipid composition of fish is unique, having long-chain, poly-unsaturated fatty acids (LC-PUFAs) with many potential beneficial effects for adult health and child development. Many low-cost, small pelagic fish such as anchovy and sardine are some of the richest sources of LC-PUFAs. Third, fish is an important source of essential micronutrients – vitamins D, A and B, minerals (calcium, phosphorus, iodine, zinc, iron and selenium) – especially so for many small fish species that are consumed whole (with bones, heads, and viscera).

Risks and pressures affecting the world fisheries

5. Since the early 1990s, numerous media headlines, scientific papers and environmental campaigns have been framed around the idea that all world fisheries resources are in crisis as a result of overfishing. This crisis narrative has some substance. FAO categorizes fish stocks either as underexploited, moderately exploited, fully exploited, overexploited, depleted or recovering. Analyses of world marine stocks show an increase in the percentage of overexploited and depleted stocks over time, while the number of underexploited or moderately exploited stocks decreases. Overall, world capture fisheries production has plateaued since the mid-1990s around 90 million tonnes per year.

6. Fish caught can end-up being dumped overboard (discarded) – either due to accidental by-catch of non-targeted species or legally undersized fish, or due to low quality, partial damage or spoilage – making them not being commercially worth landing. The volume of fish discards varies greatly between fisheries and within fisheries, with discard rates ranging from negligible in some small-scale coastal fisheries or in Atlantic herring fisheries, to 70-90 percent for some demersal trawl fisheries. Global discard volumes are particularly challenging to estimate, and any global figure is prone to significant uncertainty. The latest report published by FAO in 2005 on the issue has given an estimate of an 8 percent global discard rate of the world total capture fisheries, with a lower rate of 3.7 percent for small-scale fisheries.

7. Recent data confirm that the period of high investment in large-size vessels, which peaked around the mid-1980s, is largely over. However, in Exclusive Economic Zones (EEZs, 200 nautical miles from the coast), where both large and smaller operators are present, the total number and power of smaller boats have increased substantially over the same period. As a consequence, global fishing capacity is still very high and, with some notable exceptions, the required adjustments in fishing capacities have not yet happened. Many fishery resources are severely depleted and subsidies (often in the form of subsidised fuel) continue. Detailed attributed amounts of these subsidies are not systematically made public everywhere.

8. When the environment, production ecosystems and/or the resources bases (fish stocks) are degraded or overexploited, the capacities of the sector to deliver its food security and nutrition functions are limited or reduced. The sustainability of fisheries in their environmental and natural resource dimensions is therefore recognized to be a *sine qua non* condition for food security and nutrition. In practice, however, the links between the two are complex and remain not sufficiently documented. In addition, food security and nutrition outcomes of fisheries would not depend only on stock recovery but also on access to, and distribution, of the harvest.

9. The impacts of activities such as oil drilling, energy installations, coastal development and construction of ports and other coastal infrastructures, dams and water flow management (especially for inland fisheries), etc. have tremendous impacts on aquatic productivity, on habitats

that sustain resources (e.g. erosion and pollution), or on the livelihoods of fishing communities (e.g. through denial of access to fishing grounds or displacement from coastal settlements). Conservation activities and the establishment of Marine Protected Areas can also impact on the livelihoods of local fishing communities.

10. Climate change impacts are already visible, with modifications of the geographic distribution of species and warmer water species moving towards the poles, ocean acidification and changes in coastal conditions that affect habitat. This has various impacts on production. Inland fisheries and aquaculture may face higher mortality due to heat waves, water scarcity and competition for water. Climate change impacts on fish-dependent populations will depend on the evolution of fishing opportunities (evolution of resources available, entitlements and capacities to fish, evolution of operational costs in production and marketing) and the evolution of prices. Impacts of extreme events are increasing, with more risks of damage or loss of infrastructure and housing. Sea level rise might lead to the relocation of communities.

Opportunities and challenges in aquaculture

11. In the last three decades, farmed fish production has increased 12 times at an average annual growth of over 8 percent, making it the fastest growing food production sector. It is now widely agreed that the foreseen future increase in demand for fish will have to be satisfied through aquaculture production.

12. Aquaculture fish convert more of their feed into body mass than terrestrial animals. For instance, the production of 1 kg of beef (resp. pork and fish) protein requires 61 kg (resp. 38 kg and 13 kg) of grain. Moreover, aquatic animal production systems also have a lower carbon footprint per kilogram of output compared with other terrestrial animal production systems. Nitrogen and phosphorous emissions from aquaculture production systems are much lower compared to beef and pork production systems though they are slightly higher than those of poultry.

13. Aquaculture is expected to continue growing – although at a slightly lower rate than until recently – and there is a strong interest amongst different actors (public, private) in many countries to engage in this activity.

14. Aquaculture development came also with a range of challenges and externalities - including some affecting food security, but aquaculture experts are now more confident that the era of severe environmental problems has passed and that aquaculture is on the road of being more environmentally sustainable.

15. Often, previously existing land and water uses have been disturbed by the development of aquaculture, affecting the livelihoods of many – including a large number of fisherfolks. As more space is progressively allocated to aquaculture operations on lakes, water-bodies or along the coast, smaller wild stocks and more congestion are likely to affect the fishing activities in the areas remaining open for wild harvest. Conflicts are common when aquaculture is introduced into a region where fishery activities are already established, particularly at subsistence level.

16. As for livestock production, fish diseases (e.g. the early mortality syndrome), are a constant threat to production and therefore to local livelihoods. The use of antibiotics and chemicals in intensive systems are also sources of concern and many countries have put in place regulations on the use of antibiotics, drugs and chemicals in aquaculture production.

17. The potential release of aquaculture stock in the environment can constitute a risk for wild populations (e.g. risk of invasive species, or of genetically modified fish becoming invasive or crossing with wild varieties) and ecosystems.

18. Fish is also used as fishmeal and fish oil to feed carnivorous and omnivorous farmed fish and crustacean species (such as salmon, trout, tuna, shrimp and tilapia), poultry and other livestock. This use of fish “to feed the fish”, called *reduction*, has been highly controversial although the proportion of global fish production used as fishmeal has decreased from an average of 23 percent (26 million tonnes/yr) in the 1990s to 10 percent in 2012 (16 million tonnes), thanks to development and use of fishmeal replacers, including plant proteins, waste products from fish and terrestrial animals and use of improved breeds of aquatic animals with better feed conversion. Yet from a food security and nutrition perspective, debate continues on whether it would not be preferable to use such fish directly for human consumption instead as for fishmeal, especially as ‘lower grade’ but nutritious fish could be consumed by food insecure people, instead of being used to feed fish consumed by wealthier consumers.

Small vs large scale fishing operations

19. It is estimated that more than 120 million people in the world depend directly on fisheries-related activities (fishing, processing, trading), a vast majority of them living in developing and emergent countries. Small-scale fisheries account for 90% of fisher folk. Small-scale fisheries, as compared to larger scale fisheries, generally make broader direct and indirect contributions to food security: they make affordable fish available and accessible to poor populations and are a key mean to sustain livelihoods of marginalized and vulnerable populations in developing countries. The importance of small-scale fisheries (including inland fisheries) in terms of overall production and contribution to food security and nutrition is often underestimated or ignored. Catches from subsistence fishing are rarely included in national catch statistics. There is, however, sufficient evidence to support a focus on small-scale fisheries for food security and nutrition interventions in developing countries.

20. Larger-scale industrial fisheries can also contribute to the food security and nutrition of the poor in developing countries, especially when they favour the wide commercialization of cheap, easily stored and transported (e.g. canned) nutritious pelagic fish such as sardine, pilchard, herring, anchovy or even tuna. As noted in relation to international fish trade, revenues generated by large-scale operations can also contribute indirectly to food security through employment creation where legislation to protect decent working conditions is in place.

21. However, small- and large-scale fleets (e.g. trawlers) can compete for resources, fishing zones and gear, leading to conflicts in zones where they jointly operate, which in most cases increases small-scale operators' vulnerability, threatens their well-being, incomes and food security. Such competition can also negatively impact on coastal habitats.

22. For aquaculture, whether scale of operation is neutral or not with respect to food security and nutrition outcomes is less clear. In Africa, small-scale, subsistence aquaculture has failed to deliver the anticipated reduction of poverty and food insecurity, and interest has now shifted towards slightly larger (i.e. medium-scale), more commercial-oriented enterprises, with the hope that this new model will be more successful at delivering food security outcomes. In Asia, however, the debate is still open. While some scholars claim that medium-scale enterprises are more effective at addressing poverty reduction and food security, the fact remains that 70–80 percent of aquaculture production has come so far from small-scale farming.

Unsettled debates on fish trade

23. Fish is one of the most internationally traded foods. In 2012, international trade represented 37% of the total fish production, with a total export value of 129 billion USD, of which 70 billion USD of developing countries' exports. Evidence suggests that international fish trade can have mixed impacts on the well-being and food security and nutrition of local fishing populations. On one hand, some analysts point to the contribution that export revenues from fisheries make to local economies and extra government revenues, with opportunities to redeploy those for pro-poor interventions, including support for food security and nutrition. Additionally the growth and employment effects of fisheries development can have positive indirect consequences on the food security and nutrition of the poor. Other studies, on the other hand, have shown that in many cases very remunerative international fish trade generating millions of dollar of revenues co-exist with miserable living conditions for the local communities who have been displaced by industrial scale operators, or excluded from the trade by stringent commercial regulations, losing access to employment and to a rich food source. Existing evidence also suggests that developing nation governments have not always negotiated good agreements with foreign fishing operators for the resources extracted from their fisheries.

24. As countries compete in the global economy, national and international policies and interventions have so far provided strong support to international fish trade, often giving little attention and support to regional and domestic fisheries trade, despite its potential to improve food security and nutrition, especially for vulnerable groups. The large number of small-scale, informal producers and traders (mainly women) – who are usually marginalized by the globalization of fish trade oriented to a small number of globally traded species – would be able to better engage with the market opportunities created by domestic or regional trade, where demand exists for a diverse set of local species and products that small-scale fisheries can produce, and that are easier to commercialize at these levels. Focusing more policy attention, carefully devised interventions (such as development and market infrastructure) and research, on regional/domestic trade in developing countries would therefore help make more fish available locally, contributing to reduce

a growing tension -which fish imports cannot alone alleviate- between the demand and supply of fish. In Africa, renewed focus on local trade of products could also provide a further stimulus for aquaculture, which has been contending with production challenges. Increased demand for fish by the growing urban (and rural) population could also boost investments in, for example, peri-urban aquaculture.

25. The main focus of fish certification schemes to date has been on ecolabelling to address environmental sustainability issues. These schemes are also progressively moving to include social responsibility and labour considerations, but have failed so far to include food security and nutrition considerations. With limited exceptions, certification concerns predominantly developed countries and large-scale fisheries. More work is needed on appropriate indicators of the food security and nutrition outcomes of fisheries operations so that improvements can be better targeted and monitored. As certification schemes currently operate, their effect on food security and nutrition is unclear.

Social protection and labour rights

26. Most of these fishers or farming/fish processing and/or trading people live in developing countries, earn low income, often depend on informal work. They are exposed to three levels of exclusion: the existence or not of regulations of work and social protection in a country; the fact that these apply or not to fisheries; the importance of informal work, without access to social protection schemes (unemployment or pension schemes, health insurance, etc.). Although the International Labour Organisation adopted the Work in Fishing Convention No 188 in 2007, progress towards ratification of the Covenant 188 concerning working conditions in the fishing sector has been slow especially in the developing world.

Gender equity

27. The first comprehensive attempt to estimate the number of fish workers found that 56 million, near half of the 120 million people who work in the capture fisheries sector and its supply chains, are women. This is essentially due to the very high number of female workers engaged in fish processing (including in processing factories) and in (informal) small-scale fish trading operations. However, small-scale fisheries and supply-chain jobs outside production are not well recorded, so the actual number of women may be higher. Comparable estimates are not yet available for the 38 million aquaculture sector workers.

28. Gender, along with intersectional factors (such as economic class, ethnic group, age or religion), is a key determinant of the many different ways by which fisheries and aquaculture affect food security and nutrition outcomes, availability, access, stability and diet adequacy, for the population groups directly involved in fish production and supply chains, but also beyond.

29. Men are dominant in direct production work in fisheries and aquaculture. Much of women's work, such as gleaning, diving, post-harvest processing and vending, is not recognized or not well recorded, despite its economic and other contributions. Gender disaggregated data are not routinely collected and, partly as a result of this, little policy attention is given to women and to the gender dimension of the sector.

Governance

30. Governance is particularly important to determine access to fisheries resources, integrity of fisheries resources and distribution of fish benefits. In most countries, too little attention has been given to the ways different individuals and groups (including poorer and marginalized people in the fisheries and aquaculture supply chains, but also poor consumers more generally) will gain, lose, or be excluded from access to fish resources, to other productive supply chain assets, or to fish as a food commodity. In this regard, evidence suggest that human rights instruments are important effective tools to help ensure that states fulfil their obligations, including those pertaining to the right to food.

31. In the face of increasing and competitive economic exploitation of the oceans and freshwater, fish and food security and nutrition interests are usually acknowledged at the international level, but only in general and rhetorical terms. Analysis of existing international partnerships and initiatives reveals that detailed strategies linking production growth and sustainability to food security and nutrition are lacking.

32. With the notable exception of the UN-driven initiatives for which a very inclusive consultative process has been followed, most of the other recent ocean-related governance initiatives are deficient by their lack of representation of the small-scale operators from developing countries.

33. At the national level, the limited number of recent meta-analyses that are available show that both in terms of direct effects through access to and improved status of the resource base, and indirect pathways through income derived from fishing-related activities, co-management of fisheries' resources has not yet delivered the expected improvements in food security and nutrition.

Recommendations

1. Fish deserves a central position in food security and nutrition strategies

States should

1a) Make fish an integral element in inter-sectoral national food security and nutrition policies and programmes with special regard to promoting small-scale production and local arrangements (such as procurement through local markets, e.g. for school meals) and other policy tools, including nutrition education.

1b) Include fish in their nutritional programmes and interventions aiming at tackling micronutrient deficiencies especially among children and women, in the respect of cultural specificities, promoting local procurement, and taking into account costs and benefits.

1c) Strengthen international assistance and cooperation to build the capacity of developing countries to negotiate better terms in fishing agreements to protect the food security and nutrition of their populations.

1d) Eliminate harmful subsidies that encourage over-fishing, to make progress toward halting the current decline in global fish stocks. Revenues available to states from foregone subsidies could be redirected towards public good investments that support food security and nutrition in relation to sustainable fisheries (such as infrastructure and capacity development), or to improve the livelihoods and economic possibilities of fishing community residents.

States, national and international research institutes and development agencies should

1e) Conduct regular intra-household studies to better understand the pathways between fish, gender and the nutritional status of individuals and households, including on the impact of over-fishing. These studies need to be conducted based on gender-disaggregated data.

1f) Review fisheries' discarding practices and options through a food security and nutrition lens as well as with regard to resources and ecosystem sustainability.

2. Threats and risks for world fisheries, including effects of climate change

States should

2a) Mainstream climate change adaptation strategies relevant to fish and food security and nutrition into all aquaculture and fisheries policies and actions at national and subnational levels, including by linking them to climate and weather research and prediction agencies, developing specific studies and introducing, where needed, flexibility in management and governance mechanisms.

2b) Engage in inclusive dialogue and analysis to build scenarios to understand the possible impact of climate change on the food security and nutrition of most vulnerable zones (for example coastal and small island states) that could be affected and develop and implement the necessary actions through inclusive processes.

FAO should

2c) Take the lead in a global effort to redevelop resource assessment tools and governance concepts suitable for use in improving the contribution of fish to food security and nutrition, including by developing new approaches for use in the multispecies, multigear fisheries and more adapted to the specific characteristics of small-scale fisheries.

3. Opportunities and challenges in aquaculture

National and international research organizations (such as the CGIAR Centers), funded by the governments and other agencies, should

3a) Lead research and development initiatives that aim at enhancing sustainability and productivity of aquaculture, both in small and large scale systems. Research should focus on health control and food safety, improved feed stocks that do not directly compete with human foods, domestication and genetic improvement of key traits contributing to the various dimensions of food security and nutrition, integration of aquaculture in agroecological models of production at the farm and landscape levels, and improved linkages with food chain, with due consideration to ecosystems' integrity.

States and other private and public stakeholders and international actors should

3b) Put in place appropriate actions to reduce further the use of fish meal and fish oil as feed in aquaculture and livestock production, and should encourage their elimination by the use of alternate sources as well as by the promotion of low trophic level fish (herbivores and omnivores).

3c) Put in place the conditions to develop and implement South-South collaborations to encourage sharing and learning experience in aquaculture.

4. Small-scale versus large scale fishing operations

Governments and other private and public stakeholders should

4a) Recognize the contribution of small-scale fisheries to food security and nutrition, and take into account their characteristics in the design and implementation of all national and international policies and programs related to fisheries, including through appropriate and inclusive representation.

4b) Support self-organized, local professional organizations and cooperatives, as these arrangements strongly contribute to foster the integration of small-scale operators into markets.

National and regional agencies responsible for fisheries should

4c) Give high priority to the support of small-scale fisheries through adequate planning, legislation and the recognition or allocation of rights and resources. Where small-scale fisheries are in competition with larger-scale operations, governments should promote the former's contribution to food security and nutrition and, in particular, develop national policy regulations that protect small-scale fisheries.

5. Trade and markets

States should

5a) Ensure that food security and nutrition are better taken into account in the objectives of policies and mechanisms related to international, regional and local fish trade, including by the inclusive development of guidelines, procedures and regulations to protect the food security and nutrition of local populations.

International agencies, regional economic and fisheries bodies and national ministries should

5b) Allocate more policy attention and resources to develop, promote and support domestic and regional fish trade. Investment should take account of the voluntary guidelines for land, fisheries and forests and respect the Principles for Responsible Investment in Agriculture. They should redirect resources to and support capacity building for the different actors involved in local, national or regional fish trade activities, especially through the value chains involving small-scale fisheries, aquaculture and marketing.

Governments, international organizations, private sector and civil society should

5c) Support the development and use of existing or new sustainability certification standards which include food security and nutrition criteria and facilitate the engagement of small-scale operators by adequate support and capacity building.

6. Social Protection and labour rights

States should

6a) Ratify the ILO No. 188 Work in Fishing Convention to ensure improved working conditions and social security of those working in the fishing sector.

States, in particular national government labour agencies, in collaboration with fisheries agencies, should

6b) Improve national level regulations for fishworkers, including women workers in processing factories and markets, migrant and local crew on fishing vessels. Owners should guarantee that their vessels are sea-worthy and that at-sea working conditions are safe.

6c) Take measures to put in place social protection systems in the form of minimum wages and social security schemes for both fishers and fishworkers, including self-employed workers, women and migrant workers.

7. Gender equity

States should

7a) Ensure that their aquaculture and fisheries policies and interventions do not create negative impacts on women and encourage gender equality.

7b) Enshrine gender equity in all fisheries rights systems, including licensing and access rights. The definitions of fishing must cover all forms of harvest including the forms typically practised by women and small-scale operators, such as inshore and inland harvesting of invertebrates by hand and the use of very small-scale gear.

The FAO Committee on Fisheries (COFI) should

7c) Develop policy guidance on gender equality and economic contributions, e.g. technical guidelines on gender in aquaculture and fisheries within the Code of Conduct on Responsible Fisheries.

The CFS should

7d) Urge international and national fish sector organizations to fully address the gender dimension of the fishery and aquaculture sectors in their policies and actions to overcome the unintended gender-blindness of present approaches.

Development assistance programmes should

7e) Be gender-aware and give priority to gendered projects.

8. Governance

States must

8a) Comply with their obligations under international human rights treaties, including the International Covenant on Civil and Political Rights and the International Covenant on Economic, Social and Cultural Rights.

States should

8b) Assess policies, interventions and investments with direct and indirect links to fisheries and fishing communities in terms of their impacts on the right to food of the affected communities.

8c) Use the Voluntary Guidelines on the Good Governance of Tenure of Land, Fisheries and Forests in the Context of National Food Security, recognising the particular relevance of article 8.3 on collective rights and common resources, to design and assess policies and programmes especially these which affect the access of fishing communities to natural resources.

8d) Ensure that fishing communities and fish workers actively and meaningfully participate in all decisions that impact their enjoyment of the right to food.

8e) Ensure that food security and nutrition, that are gender-sensitive, are an integral element of fish-value-chain governance mechanisms, including national government policies, certification standards and corporate social responsibility policies.

8f) Formally protect the rights and ongoing tenure over sites for food-insecure people, fishing communities and indigenous and tribal peoples,

8g) Support the development of small and medium enterprises, by e.g. helping them access best management practices and credit schemes to stay profitable.

FAO should

8h) Lead reform of international fisheries and ocean governance with the objective of improving the transparency and representativeness of all the major international programmes and initiatives to guarantee that the small-scale fishers are fully included in these programmes. These programmes should go beyond their early focus on economic growth with ecological sustainability and aim to prioritize food security and nutrition and poverty alleviation.

The CFS and COFI should

8i) Convene a special joint session involving international fisheries and aquaculture bodies and related actors to share views on how to coordinate their policies and programmes towards progress in the food security and nutrition outcomes of their activities.

INTRODUCTION

Fish[4] (either produced through fish farming/aquaculture[5] activity or caught from wild stocks – marine, coastal, off-shore and freshwater) is used in many developing countries as a primary source of protein. The latest estimate by FAO (2014a) suggests that, in 2010, fish accounted for 17 percent of the global population's intake of animal protein and 6.5 percent of all protein consumed. Feeding a growing global population puts pressure on natural resources. Ensuring future food security demands therefore careful management and governance that protects these resources from over-exploitation and other sectors' impacts, and at the same time meets growing demand for nutritious foods.

Fish is also a major source of livelihoods and income, particularly in developing countries. It is estimated that more than 158 million people in the world depend directly on fish-related activities (fishing, fish farming, processing, trading).[6] More than 90 percent of them are small-scale operators living in developing countries.

Fish is a particularly nutritious food, rich in numerous micronutrients that are often missing in diets, particularly those of the poor. The presence of essential nutrients (such as iodine, vitamin B12 and D), the long-chain fatty acids (LC-PUFA), eicosapentaenoic (EPA) and docosahexaenoic (DHA) omega-3 fatty acids, protein of high quality and fish's very rich content in calcium, iron, zinc and vitamin A, is well documented in the literature.

Fish, in a broad sense, including fisheries and aquaculture, plays a crucial role for food security[7] as a purveyor of food (availability), livelihoods and income, particularly for some vulnerable and marginalized populations (accessibility) and provides essential micronutrients (utilization).

Yet, with a few exceptions, the importance of fisheries and aquaculture for food security and nutrition has often been undervalued by both the food security community and by an important part of the specialized fish discussions, that have too often focused on management of the resource rather than its contribution to people's well-being. A recent systematic review of international development and research agencies working in nutrition and food security revealed that "fish is strikingly missing from strategies for reduction of micronutrient deficiency, precisely where it could potentially have the largest impact" (Allison, Delaporte and Hellebrandt de Silva, 2013).

At the same time, the sector is facing major changes and challenges. Fisheries are threatened by overfishing, pollution and competition for water and coastal areas. The significant development of aquaculture raises many questions about its environmental impacts on land, water and biodiversity, and has itself to face competition from other users of land and water. Both sectors are facing major economic changes driven by increasing global demand for fish and the subsequent growth in international fish trade. These in turn lead to the emergence of large-scale actors, often better integrated with food chains and international trade than are traditional small-scale units, with important economic and social consequences, from economic development to changes in work organization and job availability.

Issues related to fish trade, to the relative contributions to food security of small-scale[8] versus large-scale fisheries are challenging to assess, and remain controversial. Paramount in this context is the question of the economic organization of the sector, and of how small-scale or large-scale sectors participate differently into local or international markets, and how they contribute to food security. This further raises the question of the governance of fisheries and aquaculture and the place of the sectors within their wider social, economic and ecological environment.

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4 "Fish" in this report includes finfish, crustaceans, molluscs, miscellaneous aquatic animals, but excludes aquatic plants and algae.

5 In this report fish-farming and aquaculture will be used interchangeably.

6 Full-time and part-time employment only (does not include occasional/subsistence and short-term seasonal).

7 According to the 1996 World Food Summit (WFS), "Food security exists when all people at all times have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life". Four dimensions of food security are implicitly associated with this definition: availability, access, stability and utilization. These dimensions, and in particular the "utilization" dimension, embody the food and care-related aspects of good nutrition.

8 The term 'small-scale' is used throughout this report. Another term is also often used in the literature ('artisanal' fisheries) to describe small-scale operators and make the distinction with larger operators.

In this context, in October 2012, the UN Committee on World Food Security (CFS) requested the High Level Panel of Experts on Food Security and Nutrition (HLPE) to conduct a policy oriented, practical and operational study on the role of sustainable fisheries and aquaculture for food security and nutrition, considering the environmental, social and economic aspects of fisheries including artisanal fisheries, as well as a review of aquaculture development.[9]

The present report entitled *Sustainable fisheries and aquaculture for food security and nutrition* aims to analyse the role of fisheries and aquaculture for food security, assessing the current situation faced by the two sectors (fisheries and aquaculture) in relation to food security and nutrition, pointing out ongoing changes, as well as present and future challenges.

The key question that this report will address is the following: "Recognizing the importance of fish to food security and nutrition, what should be done to maintain or even enhance this contribution now and in the long term, given the challenges that both the fisheries and aquaculture sectors are facing in terms of sustainability and governance, and given the economic constraints and demographic conditions that they have to respond to"?

The present report covers fisheries and aquaculture activities as well as the associated food chains and their contribution to food security in its four dimensions.

A fishery[10] is defined in terms of the "people involved, species or type of fish, area of water or seabed, method of fishing, class of boats, purpose of the activities or a combination of the foregoing features". Fisheries comprise marine fisheries operating along the coast, lagoons and off-shore as well as inland (freshwater) activities, on lakes, rivers, reservoirs, floodplains, permanent or seasonal water bodies. One can distinguish commercial, subsistence or recreational fisheries. As an economic activity, a fishery is characterized by its operational scale, ranging from small-scale to large-scale activities. What differentiates a small-scale fishery from a larger one is not necessarily clear, and "scale" is often considered partly contextual; a small-scale fishery in one country may be considered a medium-scale fishery in another. It is, however, possible to identify some generic scale characteristics. Small-scale fisheries and aquaculture are characterized by "low capital input" activities, low capital investments and equipment, labour-intensive operations. They also usually operate as semi-subsistence, family-based enterprises, where a share of the production is kept for self-consumption (Garcia *et al*., 2008).

Fisheries – especially small-scale fisheries – and aquaculture are a globally significant source of employment and livelihoods. It is estimated that between 660 and 820 million people (workers and their families) depend totally or partly on fisheries, aquaculture and related industries as a source of income and support (Allison, Delaporte and Hellebrandt de Silva, 2013). According to the most recent estimate, 58.3 million people were engaged in the primary sector of capture fisheries and aquaculture in 2012 (FAO 2014a). The other stages of the value chain, fish processing and trading, are estimated to employ more than twice as many people (World Bank/FAO/WorldFish, 2012). Many of them are women. Small-scale fisheries are an important, but often undervalued, source of employment, food security and income, particularly in the developing world and in rural areas: nearly 90 percent of the full-time or part-time fishers[11] are within the small-scale sector (FAO/World Bank/WorldFish, 2009), and 70 and 80 percent of aquaculture ventures are considered small-scale (Subasinghe *et al*., 2012).

This social and economic importance of fisheries is seconded by a strong cultural importance. Many social scientists who work on fisheries note that fishing (large- as well as small-scale) is also a particular "way of living" (Pollnac, Pomeroy and Harkes, 2001; Pollnac and Poggie, 2008; Smith and Clay, 2010; Coulthard, Johnson and McGregor, 2011; Armitage *et al*., 2013). Fishing communities are characterized by a very distinct and very strong sense of cultural identity and social bonds (McGoodwin, 2001).

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[9] See Appendix 3 for a description of the HLPE project cycle.

[10] http://www.fao.org/fi/glossary

[11] In this report, the more gender-neutral term "fishers" will be systematically used, along with other terms such as "fisherfolk" or "fishing community".

There is growing attention to better integrate a time dimension in food security and nutrition concerns, particularly when considering the relationships between available resources for food production and projected increase of demand, driven by population and income growth. This leads naturally to the question of the sustainability of production, often mainly seen from an environmental perspective. Food security, in its four dimensions – availability, accessibility, utilization and stability – invites to a better questioning of the three dimensions of sustainability – environmental, economic and social – and to integrate a time dimension in doing so (HLPE, 2014). Food security requires, in particular, considering resource management in relation to fish availability now, and in the future, but also in relation to livelihoods and income generated, now and in the future. This means examining the various systems in all their dimensions and the way they interact with food security, with particular attention to social and gender issues.

To prepare a report on the role of sustainable fisheries and aquaculture for food security and nutrition is challenging for several reasons.

First, because of the breadth of the scope. If we were to risk a comparison, it would be similar to writing a report on the contribution of wildlife hunting, crop and livestock farming activities considered altogether (and their food chains) in relation to food security and nutrition, from the farm gate to the global market level.

Second, it requires considering at the same time technical issues, such as modalities of fisheries management (from semi-open access to individual private fishing rights), or for aquaculture extensive versus intensive production systems, along with the economic and consumption trends that are driving them. It also requires examining, from the start, the beneficial relationship of fish with food security and nutrition. Fish provides food, and essential micronutrients, to those who eat it. It provides income and livelihood to those who collect, produce, transform or sell it. This in turn leads to consideration of economic issues, such as the price of fish, the distribution of economic benefits between producers and consumers, countries and people (including gender considerations), and competition for resources (competition for fish, and also for water and land). When discussing this topic, human nutrition – but also the very special nutritional value of fish, fish nutrition and the efficiency of fish in transforming feed into food – needs to be considered. Ultimately, ensuring sustainable fisheries and aquaculture for future food security requires sound governance and institutions.

The interrelationships between these very diverse issues create major methodological challenges for such an undertaking.

The first challenge is the utmost necessity of a multidisciplinary “thinking” and understanding, from nutrition to economics and social issues, from fish biology to governance of markets and food chains.

The second challenge is the need to consider the links not only between disciplinary approaches but also between scales (spatial and temporal). What is the impact of global trade on each part of the world and ultimately on each household? Some effects manifest themselves later than others. Furthermore, these various approaches can be different between the two sectors, fisheries and aquaculture, which interrelate in some of their dimensions but are also very diverse, especially in their relation to environmental sustainability. Fisheries have to manage a resource for the long term. Aquaculture can rely on its recent expansion and on its efficiency, as compared with other animal production sectors. But both fisheries and aquaculture are confronted by various threats – competition for uses, pollution and climate change. The question is how to assess trade-offs and distribution of resources between here and there; between now and the future. Such questions require integrating simultaneously very diverse impacts and accounting for different time frames.

The third challenge comes from the gaps and uncertainties in data that percolate in almost every aspect, from global fish resources to local trade and household expenditures. Fish production is often underreported. There are many informal jobs in primary production as well as in the processing and trade sectors. Lack of data makes it difficult to rigorously examine the potential links between key issues, such as between management of fisheries and household incomes and nutrition. To overcome these difficulties we used the best available published (secondary) data and projections, indicating when possible their reliability. We complemented these with local case studies, including examples suggested during the two open consultations. In using case studies, however, it is important to keep in mind that given the extreme diversity that characterizes both fisheries and aquaculture, extrapolations have to be taken with caution.

This report is organized as follows. Chapter 1 analyses the contributions of fisheries and aquaculture to food security. It describes global and regional fish production and consumption trends as well as the importance of the sector as a source of income at household and country level. It also analyses the contribution of fish to good nutrition and considers food safety issues as well as the importance of losses and waste and particularly of by-catch discarded at sea. Chapter 2 analyses the relations between sustainability in fisheries and aquaculture and food security and nutrition. It considers the status of fisheries resources and drivers of fishing capacity before analysing the environmental impacts of aquaculture as well as potential impacts of climate change on fisheries and aquaculture. It reviews evidence on the effects of scale and trade on food security and nutrition as well as social and gendered aspects. Chapter 3 considers the relations between governance issues in fisheries and aquaculture and food security and nutrition, at various levels, from international to regional, national and subnational levels. Chapter 4 draws conclusions from the previous chapters in order to propose recommendations.

1 IMPORTANCE OF FISH FOR FOOD SECURITY AND NUTRITION

Fish plays an important role for food security and nutrition by providing food and income. However, fish, fisheries and aquaculture are often kept on the side of debates relating to food security and nutrition. To a certain extent, the fisheries community is mainly focused on the fish and related resources, and the food security community, despite the widening of the definition of food security to include dietary patterns and their influence on nutrition, is still geared mainly towards food access and availability with a focus on staple foods. There is a need to better connect the topics of fish and food security and nutrition, for many reasons, detailed in this chapter.

Three fundamental aspects stand out to ground the importance of fish for food security and nutrition: (i) the protein and nutrient content of fish as food; (ii) the role of fisheries and aquaculture activities as a source of income and livelihoods; and (iii) the relative efficiency of fish to produce/transform proteins.

The relationships between fish and food security and nutrition involve many different "pathways", direct and indirect, operating at different levels from households to macro, global level, each having its own dynamic. Some pathways combine their effects towards food security and nutrition as, for example, in poor communities where fish is at the same time a source of nutrition and a source of income. Other pathways, however, imply trade-offs.

In this chapter we analyse the different pathways from fish to food security and nutrition along the four dimensions of food security.

- First, food availability, in terms of the production and use of fish as human food but also for feed, especially in the context of a growing demand for fish.
- Second, access to food, through the fact that fish and all related economic activities in the "fish-chain" represent an important means to generate jobs, income and wealth, with positive effects from household level to broader economic scales. As part of this question of access we will discuss the issue of "fish for whom?", recognizing the potential great discrepancy that can exist between availability and actual need for fish.
- Third, and importantly, we detail the contribution of fish to good nutrition – the "utilization" dimension of food security.

The fourth dimension (stability) results from the combination of availability and access at macro-level – which is itself a function of the sustainability of the sector – and of access, availability and utilization at the micro/household level.

Finally, to consider the contribution of fisheries and aquaculture to food security and nutrition, one needs also to take into account losses and waste (HLPE, 2014), including by-catch discarded at sea, post-harvest loss, and consumer waste.

Figure 1 represents conceptually these different pathways and how they are linked together to "deliver" food security and nutrition.

1.1 Fish for food: growing significance of fish availability and demand

1.1.1 Trends in fish production

As a food, fish can be processed into a wide array of products. It is distributed as live, fresh, chilled, frozen, heat-treated, fermented, dried, smoked, salted, pickled, boiled, fried, freeze-dried, minced, powdered or canned, or as a combination of two or more of these forms (FAO, 2012a).

Globally, 158 million tonnes of fish were produced in 2012 (11.6 million tonnes from inland fisheries, 79.7 from marine capture fisheries, 41.9 from inland aquaculture and 24.7 from marine aquaculture), of which 136 million tonnes were used for human consumption (FAO, 2014a). All mass numbers are expressed in live weight equivalent, including non-edible parts, as shell of molluscs, head part of fish, etc., and without accounting for post-harvest losses.

Figure 1 Conceptual representation of the different pathways between fish and food security and nutrition

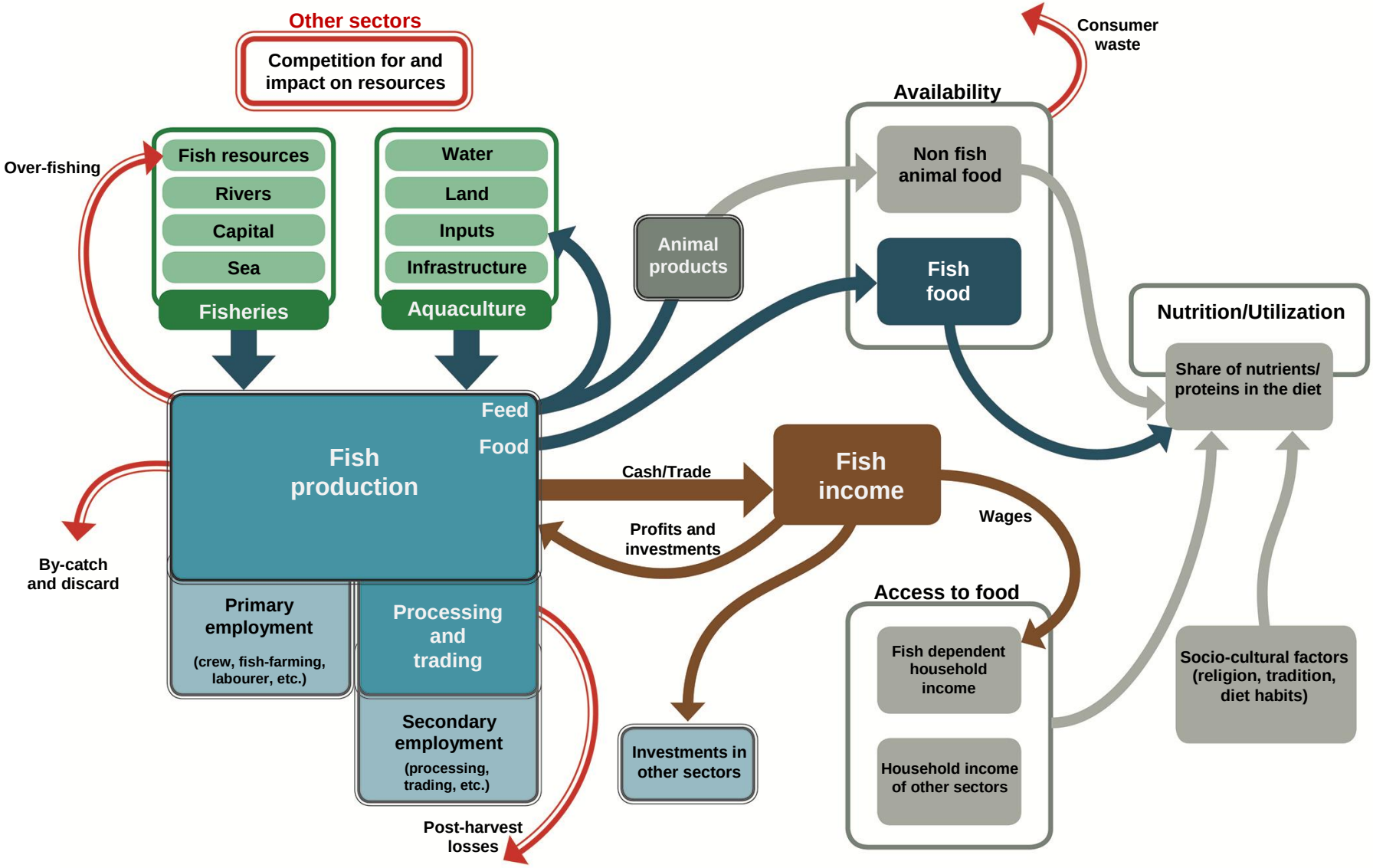
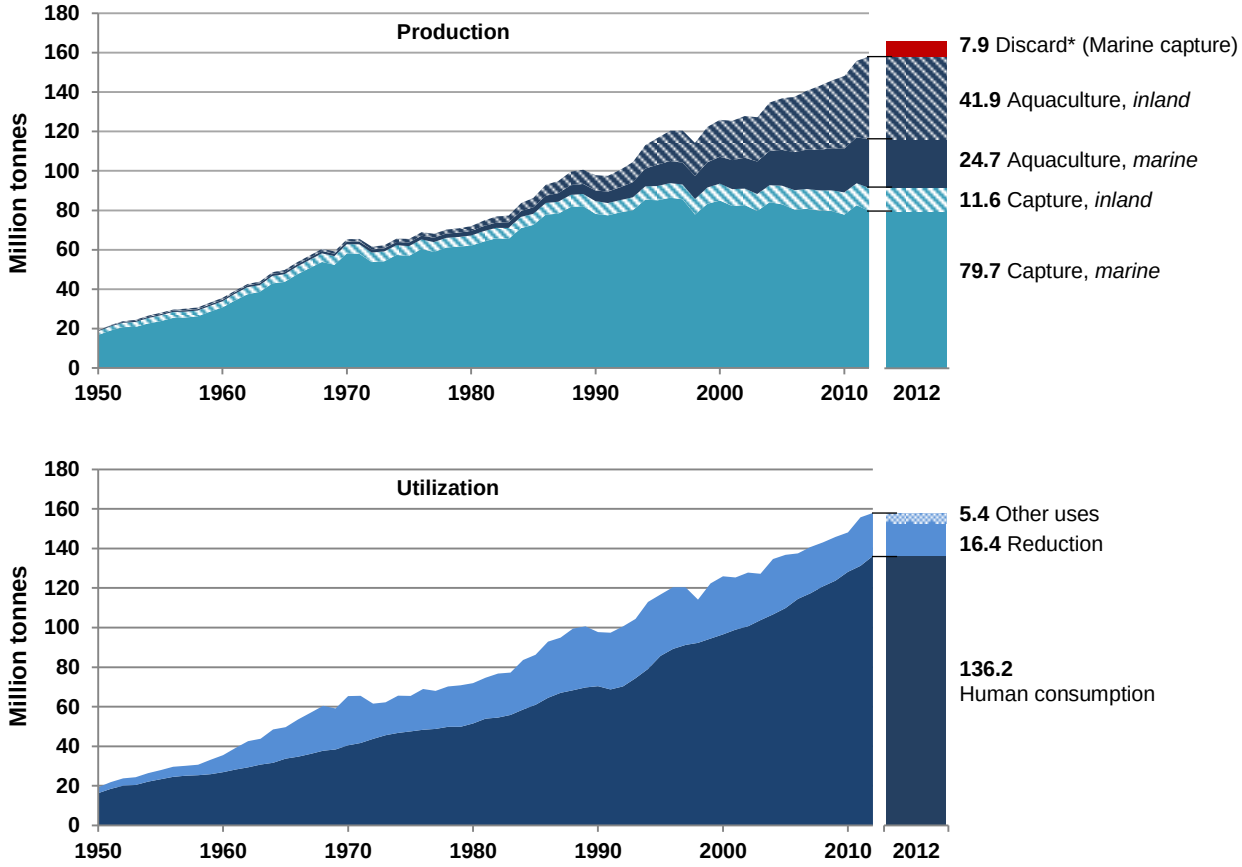


Figure 1 shows the different pathways by which fish contributes to food security and nutrition. Fish contributes to food security and nutrition directly through availability of nutrient-rich food both at the household and at local, provincial, and national market levels. Indirect pathways involve the trade of fish and generation of revenues, at household level or at higher (national) levels, including through income for crew-members and for those involved in fish-related activities such as fish processing factory workers. Income allows access to other food commodities (including other cheaper fish products).

Figure 2 World fish production and utilization in 1950-2012



Source: FAO Statistics and Information Branch of the Fisheries and Aquaculture Department. *Discard is a calculation based on the 8% estimate on capture as in Kelleher, 2005. All mass numbers are expressed in live weight equivalent, including non-edible parts, as shell of molluscs, head part of fish, etc., and without accounting for post-harvest losses.

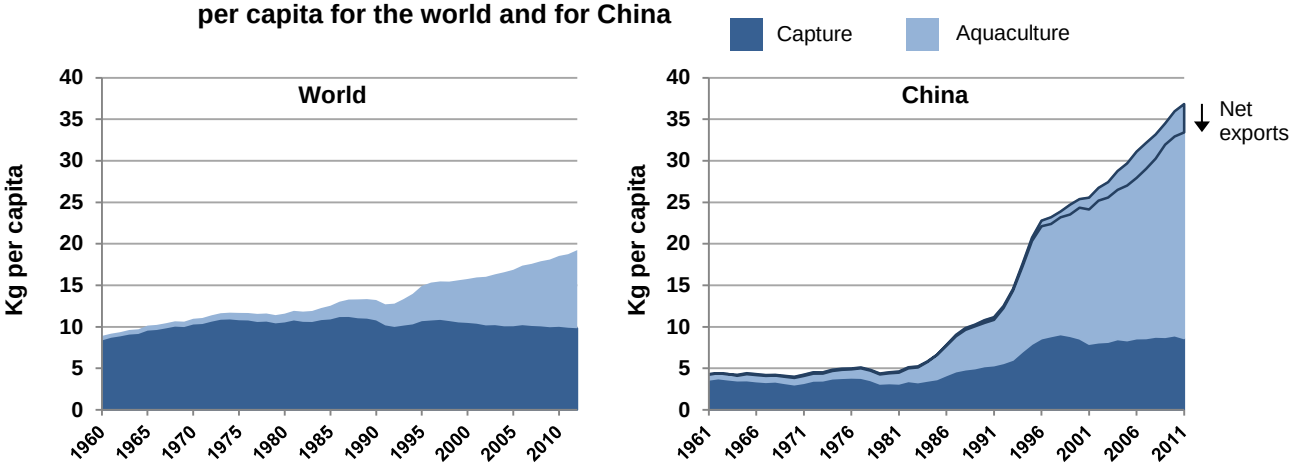
With continual growth in fish production (mostly from aquaculture since the 1990s as capture fisheries production has plateaued), increased production efficiency and improved distribution channels, the world's fish production has increased almost eight times since 1950 (Figure 2a), passing from 6 kg/capita/year in 1950 to 19.2 kg/capita/year in 2012 (Figure 3). In fact, with an average growth rate of 3.2 percent per year in the period 1961–2009, the world fish supply has effectively been growing faster than the world's population (FAO, 2014a). A large part of this growth is concentrated in Asia, with China being a major actor, spectacularly managing to meet domestic demand increase with an increase of domestic aquaculture production (Figure 3b).

Aquaculture has increased the availability of fish and contributed to the awareness and consumption of fish products worldwide. It enabled to satisfy the growth in fish demand, easing pressure on wild fish stocks.

In addition to being used directly as human food, fish also contributes indirectly to human nutrition when it is used as a source of feed (fishmeal) for aquaculture and poultry/livestock feeds (Tacon and Metian, 2009). In 2012, 21.7 million tonnes of fish – essentially small pelagic fish species such as anchovy, herring, mackerel and sardine – were destined feed use, of which 75 percent (16.3 million tonnes)[12] was reduced to fishmeal and fish oil to feed carnivorous and omnivorous farmed fish and crustacean species such as salmon, trout, tuna, shrimp and tilapia, as well as poultry and other livestock. In 2010, 73 percent of the total world fishmeal was used to feed farmed fish, followed by pigs (20 percent) and poultry (5 percent) (Shepherd and Jackson, 2013).

[12] The remaining 5.4 million tonnes were utilized as fish for ornamental purposes, for culture (fingerlings, fry, etc.), for bait, for pharmaceutical uses as well as raw material for direct feeding in aquaculture, for livestock and for fur animals (FAO, 2012a).

Figure 3 Relative contribution of aquaculture and capture fisheries to food fish production per capita for the world and for China



Source: FAO Statistics and Information Branch of the Fisheries and Aquaculture Department.

This dependence of farmed fish and some livestock on fishmeal raises important questions with regards to food security. In particular, is fishmeal the most efficient way to use fish (especially cheap small pelagic fish rich in LC-PUFA – the omega-3 fatty acids EPA and DHA – like those that are currently used for the production of fishmeal) or would these fish have a greater impact on food security if a larger share of the catch was eaten directly by local consumers in the countries where they are caught? These questions will be explored more thoroughly in Section 2.3.2.

1.1.2 Trends in fish consumption: Fish for whom?

Fish demand has been rising in both the developed and developing world at more than 2.5 percent per year (Peterson and Fronc, 2007) and, as wealth increases in highly populated countries such as China and India, demand levels are likely to rise more strongly (Garcia and Rosenberg, 2010).

Increased market demand has been key to the emergence of the aquaculture sector. Growth in catfish and tilapia aquaculture has satisfied consumer demand in the whitefish markets, in which the share of wild products has decreased considerably over time.

World population growth, but more importantly the combination of urbanization, increased levels of development, living standards and income are key drivers of the increase of animal food demand and in particular of fish and seafood (Speedy, 2003). Demand for fish is particularly high in the wealthier strata of society and increases with the economic level of development and living standards.

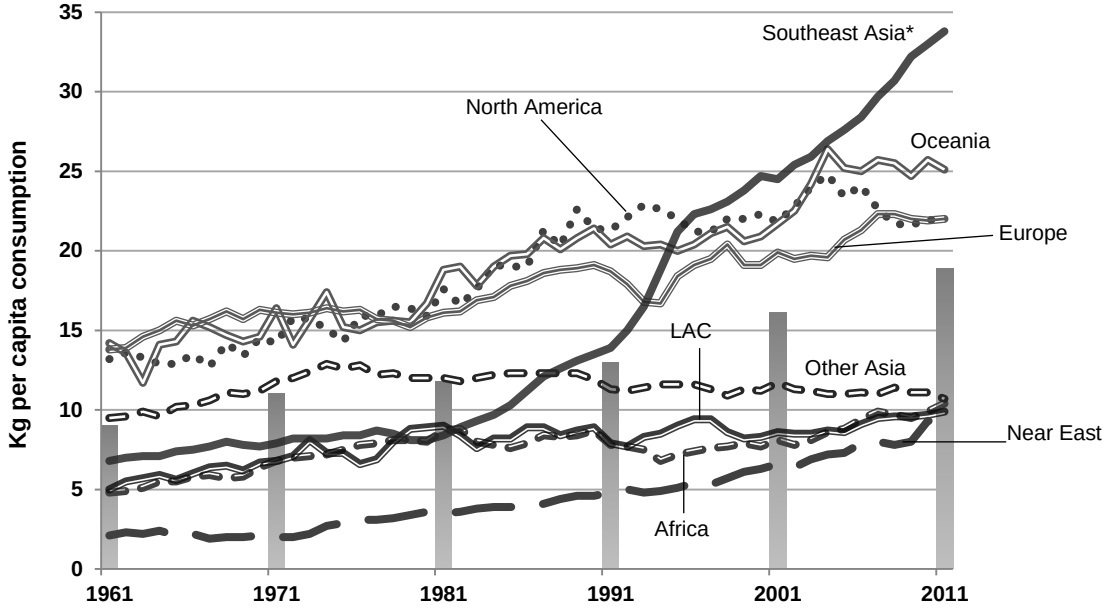
Delgado, Crosson and Courbois (1997) suggest that changes in food preference driven by urbanization alone have in the past accounted for an extra 5.7–9.3 kg per capita consumption of meat and fish per year. Overall, increases in per capita consumption of fish are fastest where wealth and urbanization are combined together, and when domestic supply is also increasing (Delgado, Crosson and Courbois, 1997). This explains, for instance, the rapid increase in demand for fish in the emerging economies of Asia.[13]

Given the above, the largest growing market over at least the next decade is likely to be found in emerging economies with growing wealth and urbanization. In China, for example, the demand for fish is projected to increase from 24.4 kg per person per year in 2000 to 41 kg per person per year by 2030 (World Bank, 2013).

The global figure of apparent fish consumption of 19.2 kg/capita/year in 2011 masks strong regional differences, which result from less efficient local market channels but also from differences in cultures, beliefs, diet habits and purchasing powers of the populations. All those factors strongly influence consumption levels.

[13] Betru and Kawashima (2009) present data from Ethiopia indicating that urbanization affects animal food consumption rates independently of income. Other results nuance these findings. Stage and McGranahan (2010) present data from India and China and cite studies from Viet Nam and the United Republic of Tanzania indicating that families with equivalent incomes in rural and urban settings do not differ in their consumption of animal-source foods.

Figure 4 Regional evolutions of fish consumption per capita



Source: FAO Statistics and Information Branch of the Fisheries and Aquaculture Department. Bars represent the world. *Southeast Asia includes: Brunei Darussalam, Cambodia, China, Indonesia, Lao People's Democratic Republic, Malaysia, Myanmar, the Philippines, Singapore, Thailand, Timor-Leste, Viet Nam. Other regions classified following the M49 UN classification http://unstats.un.org/unsd/methods/m49/m49.htm. LAC = Latin America and the Caribbean.

According to FAO (2014a), Asia accounts for almost two-thirds of global fish consumption and 21.4 kg per capita in 2011 – a level similar to Europe (22.0 kg/cap/yr) and North America (21.7 kg/cap/yr), and close to the levels of Oceania (25.1 kg/cap/yr). Africa, Latin America and Near-East have lowest per-capita consumption (10.4, 9.9 and 9.3 kg/cap/yr in 2011, respectively). At sub-regional level, within Asia, consumption levels are particularly high and increasing in Southeast Asia (Figure 4).

Although annual per capita apparent consumption of fish products has grown steadily in developing regions (from 5.2 kg in 1961 to 17.9 kg in 2011) and in LIFDCs (4.4 kg in 1961 to 8.6 kg in 2011), it is still considerably lower than in developed regions (from 17.1 kg in 1961 to 23.0 kg in 2011).

At the same time, however, fish is a major source of animal protein in many LIFDCs (Reynolds, 1993; Béné, Macfadyen and Allison, 2007; Allison, 2011; FAO, 2012a). According to Kawarazuka and Béné (2011), using FAO food balance sheets 2009, among the 30 countries in the world where fish represented more than one-third of the total available animal protein, 22 countries were classified as LIFDCs in 2010.[14] This shows that the majority of the countries where fish is an important part of animal protein are poor and in food deficit (see Appendix 1 for data).

1.1.3 Trends in prices of fish

Demand for fish depends on price (and price is influenced by demand). Changes in the prices of other meat products are also important to consider. The trend over the past 15-20 years has been for food fish price to rise – although not for several aquaculture products such as salmon. In contrast, red meat prices have fallen by approximately 50 percent over the same period.

There is in fact little doubt that the development of aquaculture has allowed the price of fish to be lower than it would have been otherwise. This is particularly evident for the period 2000–2010 (Figure 5).This deflationist effect occurs through two mechanisms: a supply effect and a competition effect. The supply effect stems from the fact that aquaculture clearly increased the availability of fish by supplying an increasing amount of fish on the world market, with an annual rate of growth in the last decade of 5.8 percent (FAO, 2012a).

[14] Out of these 22 countries, only 18 are still present in the 2014 LIFDC list (Appendix 1).

The competition effect stems from the fact that aquaculture created a more competitive fish market overall, generally selling its produce at lower price than wild caught fish. The result of such effects on the price of wild fish has already been documented for several species. For example, prices paid to wild salmon fishers and processors in the United States of America fell dramatically as world farmed salmon production expanded during the 1990s (Knapp, Roheim and Anderson, 2007). Similar trends were also observed for wild and aquaculture shrimp (Béné, Cadren and Lantz, 2000). Although these two examples concern high-value products consumed by high-income consumers, evidence suggests that these effects happen more broadly including for lower-value fish (De Silva, 2008). The impact has been shown to cause significant economic difficulties for fishers (e.g. Alaskan salmon fishers and processors, Knapp, Roheim and Anderson, 2007) while increasing fish availability for consumers.

1.1.4 Outlook in fish supply and demand

Some recent outlook exercises (Garcia and Rosenberg, 2010; Rice and Garcia, 2011; Hall *et al.*, 2011; OECD-FAO, 2013; World Bank, 2013) give a broad picture of the link between fish and food security and nutrition in the medium term (10–15 year horizon).

Fish product prices are projected to continue rising strongly over the coming decade as a result of strong demand, rising production costs and slower production growth (Figure 6a). Prices of livestock products, on the other hand, are projected to remain at relatively high levels for several years, reflecting higher feed costs (OECD and FAO, 2013). In fact, prices for both crop and livestock products are projected to remain high over the coming decade due to a combination of lower production trends and growing food and biofuel demand (HLPE 2013a). Rising prices are also projected for fishmeal and fish oil with continuing rapid growth in per capita consumption (Figure 6b).

According to the World Bank (2013), despite projected fish price increases, world per capita fish food consumption is projected to increase by +1.4 kg/cap, reaching 20.6 kg/cap/yr by 2022, up from 19.2 kg/cap/yr in 2012. These global numbers again mask regional differences, with per capita fish consumption projected to increase in all continents except Africa, with Oceania and Asia showing the highest growth rate. Capture fisheries production is anticipated to be stable at 2010 levels and aquaculture production is expected to exceed that of capture fisheries in 2015 and to reach 53 percent of total human consumption by 2022 and 62 percent by 2030 (World Bank, 2013).

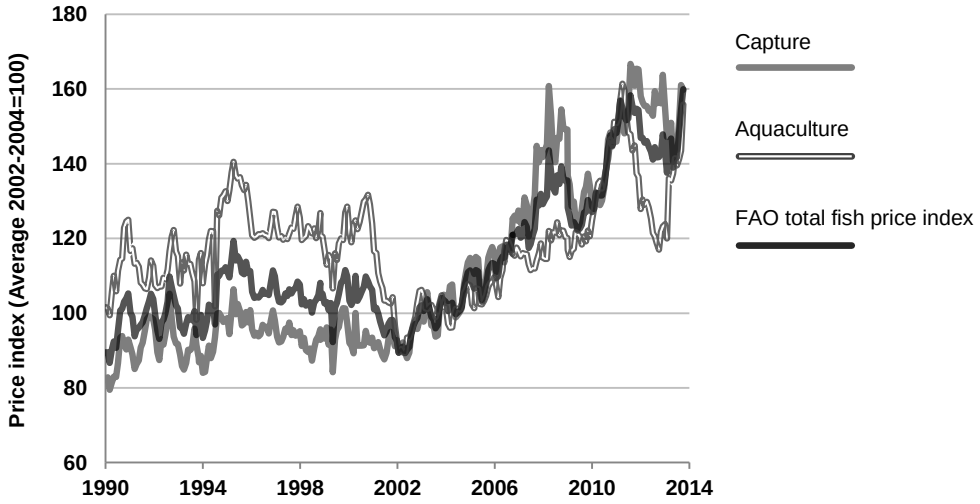
Thanks to aquaculture production that is expected to continue to expand on all continents, total fish production (capture and aquaculture) is expected to exceed that of beef, of pork or of poultry by 2015. Asia will continue to dominate world aquaculture production, with an expected share of 89 percent in 2021, with China alone representing 61 percent of total production. Notwithstanding a possible slower growth rate, aquaculture will remain one of the fastest growing animal food-producing sectors of the coming decades (World Bank, 2013).

Potentially increasing prices will provide an additional incentive for fisheries and aquaculture investments. However, if not properly managed, this could lead to river and marine stock collapse, leading to reducing supplies from capture fisheries.

Developing countries are likely to continue past trends of directing a large and growing part of their primary resources to export, in search of hard currency, and, without a major modification of the socio-economic perspectives in these countries and the development of alternative sources of livelihood, the risk is that their fishery resources will remain under very high pressure and the contribution of fish, particularly to local food security, may decrease (World Bank, 2013).

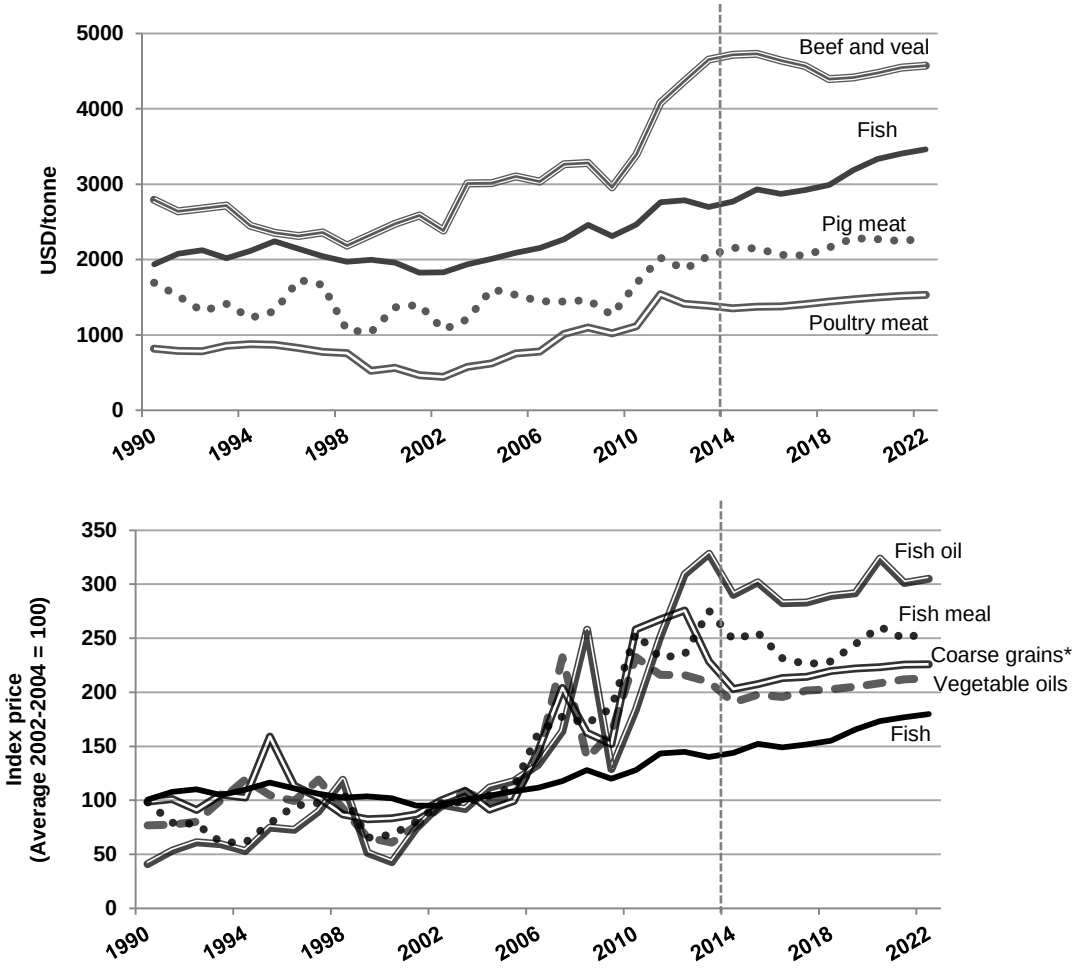
An important unknown is whether important volumes of lower-value fish will continue to be used in reduction for fishmeal and oils. As global fish demand increases, particularly for poorer communities and developing countries, these resources will be under tension between three main destinations: (i) the present use as animal feed – increasingly for aquaculture; (ii) food for humans; and (iii) food to rebuild predatory fish species stocks (e.g. tuna, cod) that is often overlooked.

Figure 5 Trends in the FAO fish prices index



Source: FAO 2014a.

Figure 6 Past and projected prices for crops, livestock products (including fish) and fishmeal and fish oil



Source: OECD-FAO Outlook (2013) http://www.oecd.org/site/oecd-faoagriculturaloutlook/database.htm.
*Coarse grains are all cereals excluding wheat and rice. 2013 prices are provisional; 2014-2022 are projected.

1.2 Fish for cash: fisheries and aquaculture activities as a source of income and livelihoods for food security

One fundamental contribution of fish to food security and nutrition derives from its "cash crop" function (Béné *et al.*, 2009a) for fish-dependent communities. Very few fishers and fish-farmers consume the totality of their production. Instead, fish has always been a traded commodity and most fishworkers work for the money from the sale of their share of the catch. Employment and income is generated all along the fish food chain from primary employment (fishing crew, pond labourers, etc.) to secondary employment (formal and informal fish traders, fish processing plant workers, etc.) – see Figure 1.

Employment and fish-dependent livelihoods

Estimates of global employment in fisheries and aquaculture related activities vary with different scopes, either focused on primary production, including or not occasional and part time fishers and fish farmers, and/or including transformation, distribution and trade, which in turn can be more or less specialized. It is made particularly difficult and uncertain because of the high level of informal employment in the sector and also because of the rapid growth of aquaculture, often as complementary to other agricultural activities.

It is estimated that between 660 and 820 million people (workers and their families) depend totally or partly on fisheries, aquaculture and related industries as a source of income and support (Allison, Delaporte and Hellebrandt de Silva, 2013).

According to the most recent estimate, 58.3 million people were engaged in the primary sector of capture fisheries and aquaculture in 2012, of which 18.9 million are fish farmers (FAO 2014a). The other stages of the value chain, fish processing and trading, can employ more than twice as many people as the production stage (World Bank/FAO/WorldFish, 2012). Many of them are women.

In aquaculture, employment at farm level includes full-time, part-time and occasional jobs in hatcheries, nurseries, grow-out production facilities, labourers. Employment at other stages along aquaculture value chains include jobs in input supply, middle trade and domestic fish distribution, processing, exporting and vending. Extrapolating from a ten-country case study representing just under 20 percent of the global aquaculture production, Phillips and Subasinghe (2014*, personal communication*) estimated that total employment in global aquaculture value chains could be close to 38 million full-time people.

Overall, small-scale fisheries are an important, but often undervalued, source of employment, food security and income, particularly in the developing world and in rural areas (Allison and Ellis, 2001; Neiland and Béné, 2004; Béné, 2006; Allison, Horemans and Béné, 2006; Menezes, Eide and Raakjęr, 2011). Nearly 90 percent of the world's estimated 34 million full-time or part-time fishers are estimated to derive their livelihood from the small-scale sector. They are estimated to contribute 80 percent of the total world catch – inland fisheries included – that is used for domestic human consumption (FAO/World Bank/WorldFish, 2009; Mills *et al*., 2011). These figures, however, are most likely to be underestimated as they derive from official statistics where small-scale operators are rarely well accounted for (Mills *et al*., 2011; Kolding, Béné and Bavinck, 2014).

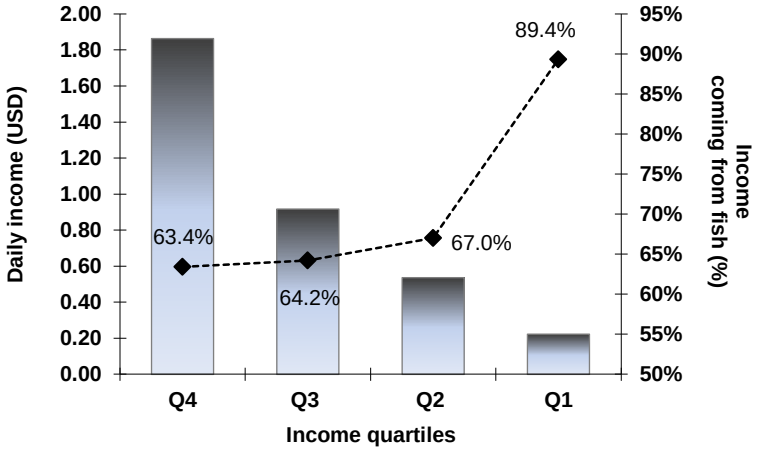
Between 70 and 80 percent of aquaculture ventures are considered small-scale, often family-based activities which are integrated at farm level with crop and livestock farming, and where part of the production may be retained for household consumption (De Silva and Davy, 2009; Subasinghe *et al*., 2012).

Household level

Many fishers or farming/fish processing and/or trading people live in developing countries, earn low income, often depend on informal work and do not benefit from social protection schemes (unemployment or pension schemes, health insurance, etc.).[15] Fisheries can give opportunities to the poorest, landless food-insecure people and households, providing them a critical (and sometimes unique) source of income and livelihood (Kawarazuka and Béné, 2010).

[15] Although the International Labour Organisation adopted the Work in Fishing Convention No 188 in 2007, progress towards ratification of the C.188 has been slow especially in the developing world where there is hardly any legislation to provide social protection. There is also a great need for an independent verification process to fully understand the contractual agreements, conditions of employment, health and safety regulations and pension benefits for fish workers (ICSF, 2013).

Figure 7 Relative contribution of fishing activities to household income for riverine farmer and fisher communities along the Luilaka and Salonga rivers in the Democratic Republic of Congo



Source: Béné *et al.* (2009a). Households ranked by quartile, from the poorest (Q1) to the richest (Q4).

For instance, a study based on data collected from fishing and farming communities in remote areas along 519 km of the Luilaka and Salonga rivers in the Democratic Republic of Congo shows that the poorer the people in these communities are, the more they depend on fishing activities for their income (Bene *et al.*, 2009a and Figure 7), and the more important fishing is for improving their accessibility to food – including better quality food – and therefore the more important fishing is for their food and nutrition security, as well as to better health and sanitation conditions.

Some fishers, living in isolated or remote areas, in harsh conditions, can also be relatively well-off income-wise, thanks to the cash they derive from their fishing activities (e.g. Panayotou, 1985; Neiland, Madakan and Béné, 2005; Béné *et al.*, 2009a).

Even when fishing is not the primary source of income, it can still play an important role for food security (see Box 1).

In aquaculture, several studies highlighted the effects of aquaculture development for various farm types with diversified activities (fish farming being often a complement to a main agricultural activity), with positive effects on income generation, and food security and nutritional status for aquaculture households, such as reduction in underweight children (Jahan, Ahmed and Belton, 2009; Dey *et al.*, 2006; Kumar and Dey, 2006; Aiga *et al.*, 2009).

The degree to which fish revenues are sufficient and/or effectively used to secure access to (non-fish) high-quality food remain however, unclear. The evidence documenting the ways fishing and fish-farming households use their income is scarce in the literature and does not generally provide any counterfactual evidence. The following theoretical pathway: "fish revenues allowing food purchase leading to food security and nutrition" at household level remain, therefore, largely unquantified: an issue which relates to the bigger issue of using income and investments to improve food security and nutrition of farming households (HLPE 2012a, HLPE 2013b).

Box 1 Fishing as a secondary – yet critical – source of income

A study in the Kompong Thom Province of Cambodia detailed the importance of small-scale fisheries as a secondary source of income (Hori *et al.,* 2006). During the dry season, some of the villagers move to the Tonle Sap Lake, located 30 km away from the study villages, and sell most of their catches for cash, while others only fish (mainly for subsistence) in rice fields, ponds and streams surrounding the villages. The income derived from fishing in the lake contributes to the annual household income, which was estimated at approximately double that of the group that stays in the villages (Hori *et al.,* 2006). As all villages suffer from shortages of rice stock, cash from fish is generally used for purchasing rice. In another study – also in Cambodia – poor rural households were found to engage in small-scale fishing in common-pool resources as a second major activity. This produced 31.2 percent of their total income – just below the wages of day labourers at 32.5 percent –and provided income opportunities, in particular during the lean season after rice harvesting, when work for labourers is not available (Chamnan *et al.,* 2009).

Table 1 Contribution of fish production to agricultural gross domestic product

Countries	Year	Total fish production value (1000 USD)	Production value as % of agricultural GDP
Namibia	2005	492 000	59.9%
Viet Nam	2007	6 960 385	49.9%
Thailand	2004	4 382 453	26.3%
Bangladesh	2006	2 952 104	24.3%
Senegal	2007	313 736	20.4%
Ghana	2006	877 328	19.4%
Mozambique	2007	245 439	11.1%

Source: Scholtens and Badjeck (2010).

Country level and fish trade

Fish trade is also recognized as contributing to food security at country-level, essentially through the generation of revenues from exports, taxation, license fees and from payment for access to resources by foreign fleets or foreign investment in aquaculture (Valdimarsson and James, 2001; Bostock, Greenhalgh and Kleih, 2004; World Bank, 2004; FAO, 2007a). The value of global fish trade exceeds the value of international trade of all other animal proteins combined (World Bank, 2011).

For developing countries, net exports of fish and fish products (i.e. the total value of fish exports less the total value of fish imports) are particularly high. They have grown significantly in recent decades, rising from USD 3.7 billion in 1980 to USD 18.3 billion in 2000, USD 27.7 billion in 2010, and reaching USD 35.1 billion in 2012. For LIFDCs, net export revenues amounted to USD 4.7 billion in 2010, compared with USD 2.0 billion in 1990. The share of exports from developing countries is close to 50 percent (value) and 60 percent (in volume of live weight equivalent) of global fish trade (FAO, 2012a). For some countries the contribution of fish to their agricultural GDP is substantial (Table 1).

These statistics show that fish can generate high revenue at national and global levels. For countries, as for households, whether these revenues are used to purchase (import) other non-fish (or affordable fish) food commodities and contribute to food security and nutrition is not clear. Questions about the impacts of fish trade on food security (if fish trade improves food security; if so, for whom and who are the winners/losers of international fish trade?) will be explored more thoroughly in Section 2.4.2.

1.3 Fish self-consumption for household nutrition security

In many developing country settings, fish from small-scale fisheries represents one, if not the principal, animal-source food for fishing populations, supplying both high-quality protein and essential micronutrients (Kawarazuka and Béné, 2011).

At household level, the contribution of small-scale fisheries (and in particular of inland fisheries) to rural household consumption is often underestimated, as catches from subsistence fishing are rarely included in national catch statistics and their importance is often ignored (Ahmed, Tana and Thouk, 1996; Dey *et al.*, 2005; Béné and Friend, 2011).

Yet existing studies show large differences in self-consumption of fish in rural communities. In the Lao People's Democratic Republic, for instance, it was estimated that in some rural communities about 75 percent of the fish were consumed at home (Garaway, 2005). In contrast, in Papua New Guinea, only 10–20 percent of the total finfish caught by households was estimated to be kept for home consumption (Friedman *et al.*, 2008). More generally, in areas where fish are abundant year-round, people seem to consume fish caught by household members and hardly buy them in the markets (Neiland *et al.*, 2000; Pinca *et al.*, 2008).

The species consumed by these households are often low market-value fish, and often also include other aquatic animals, e.g. frogs, freshwater molluscs and snails (Meusch *et al.*, 2003; Chamnan *et al.*, 2009). Even households whose main activity is farming but who live in the proximity of water bodies (ponds, river, floodplains, etc.) often engage in fishing activities during the peak fishing season in order to consume fish at home (Roos, 2001; Thompson, Khan and Sultana 2006; Karim, 2006).

Women in food-insecure households also engage in fishing if they live in the proximity of water bodies (Merten, 2004), and anecdotal data from fishing communities in the Democratic Republic of Congo suggest that a greater proportion of the fish caught by women – usually smaller fish and therefore more nutritious – is kept for home consumption. While no detailed nutritional analysis was performed in these cases, this combination of small fish and of a high proportion of self-consumption suggests that – although almost marginal in terms of quantity – fishing by women may play an important role in the nutritional security of the household's members (Béné *et al.*, 2009a).

In most of these studies, however, no counterfactual evidence is available that would enable us to compare fish consumption between fishing households and non-fishing households. The only exception found in the literature is a study in the coastal state of Lagos and the inland state of Niger in Nigeria, which indicates that the consumption of fish in fishing households is twice that of non-fishing households, whereas levels of meat consumption are similar (Gomna and Rana, 2007).

Fish-farming

As in the case of small-scale capture fisheries, more than 80 percent of global aquaculture production may be contributed by small- to medium-scale fish farmers, nearly 90 percent of whom live in Asia (Subasinghe *et al.*, 2012). Farmed fish are expected to contribute to improved nutritional status of households directly through self-consumption, and indirectly by selling farmed fish for cash to enhance household purchasing power (Ahmed and Lorica, 2002; Dey *et al.*, 2006; Jahan, Ahmed and Belton, 2009).[16] In India, Kumar and Dey (2006) observed that the energy intake of households that own fish ponds was 10.9 percent higher than that of households with wage-earners but without ponds, and that the prevalence of under-nourishment was 10 percent lower among the fish pond-owners than among the control population.[17] In the Dinajpur district of Bangladesh, another survey showed that small fish species are important food items for low-income households with fish ponds, especially in months when vegetables are not available or not affordable (Islam, 2007). In Malawi, it was observed that the frequency of fresh fish and dried fish consumption is higher in households with fish ponds (Dey *et al.*, 2006).

Yet, in other cases, households with fish ponds do not necessarily increase their fish consumption. No significant difference in fish consumption between producing and non-producing households was observed for instance in the Kishoreganji district of Bangladesh (Thompson *et al.*, 2002, p. 297). Another survey in Bangladesh suggests that fish produced through homestead aquaculture contributed only 1–11 percent of the total amount of fish consumed at household level and that fish from wild fisheries bought from local markets were the single most important source of fish consumed locally (57–69 percent, depending on season) for both households with and without fish ponds (Roos, 2001).

One reason for this is that fish produced by aquaculture usually differ from fish supplied by common-pool resources in their species or varieties, and in the objectives they serve (Prein and Ahmed, 2000). Much aquaculture production (even at small scale) is oriented towards producing medium- or large-size fish for higher-value markets. Aquaculture fish are, in fact, often considered as a "cash crop" rather than a "food crop" by their producers.

1.4 Fish's nutrition and human health benefits

A healthy diet has to include sufficient protein containing all essential amino acids, lipid with essential fatty acids (EPA/DHA), vitamins and minerals. Provided its rich nutrient content is preserved (essentially through good quality processing or when eaten fresh), fish constitutes a rich source of these nutrients. Fish in the human diet can therefore help reduce the risks of both malnutrition and of non-communicable diseases, which may co-occur when a too high intake of energy is combined with

[16] The evidence, however, is not conclusive. In particular many, but not all, of these studies report an increase in household fish consumption for those who invest in pond-based aquaculture or in integrated agriculture-aquaculture (IAA) systems (Prein and Ahmed, 2000).

[17] These authors do not indicate, however, whether those differences were statistically significant.

a lack of balanced nutrition (Allison, Delaporte and Hellebrandt de Silva, 2013; Larsen, Eilertsen and Elvevoll, 2011, Miles and Calder, 2012; Rangel-Huerta *et al.*, 2012).

Protein

Today capture fisheries and aquaculture provide 3.0 billion people with almost 20 percent of their average per capita intake of animal protein, and a further 1.3 billion people with about 15 percent of their per capita intake (FAO, 2012a). This share can exceed 50 percent in some countries. In West African coastal countries, where fish has been a central element in local economies for many centuries, the proportion of dietary protein that comes from fish is very high, e.g. 47 percent in Senegal, 62 percent in Gambia and 63 percent in Sierra Leone and Ghana. The same picture is seen for some Asian countries and some Small Island States, where the contribution from fish as a source of protein is also very important: 71 percent in the Maldives, 59 percent in Cambodia, 57 percent in Bangladesh, 54 percent in Indonesia and 53 percent in Sri Lanka (FAO, 2012a).

In addition to *animal* protein, fish contributes significantly to the *overall* protein intake of people, because the digestibility of protein from fish is approximately 5–15 percent higher than that from plant-sources (WHO, 1985). Animal-source foods, including fish, contain several of the essential amino acids, especially lysine and methionine, facilitating a balanced intake of essential amino acids from the diet (WHO, 1985, Tacon and Metian, 2013). Including fish in the diet improves total protein intake as fish can compensate for the shortage of these amino acids in other elements of the diet. Fish can therefore can play an important role in plant-based diets; this is the case in many LIFDCs.

Protein quality is, however, easily destroyed by, for example, bacteria and viruses, without proper hygiene or storage conditions. Therefore, to conserve the high nutritional value of fish protein, proper processing and conservation methods are critical (FAO/WHO, 2012).

Lipids

The lipid composition of fish is unique, having long-chain poly-unsaturated fatty acids (LC-PUFAs) in the form of arachidonic acid (ARA), eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA), with many potential beneficial effects for adult health and child development (Thilsted, Roos and Hassan 1997). Among fish species that are cheaper and often traded in developing countries, small pelagic fish such as anchovy and sardine are perhaps some of the richest sources of LC-PUFAs (USDA, 2011). In contrast, the amount of LC-PUFAs in “large” freshwater fish such as carp and tilapia is lower, while that of many smaller indigenous species is yet to be determined.

Fish intake has been shown to influence the LC-PUFA levels in the breast milk of lactating women. For instance, a study has shown that the level of DHA of breast-feeding women living in coastal regions in China is higher than in other regions (Chulei *et al*., 1995). Similarly, in the United Republic of Tanzania, women with high intakes of freshwater fish had levels of ARA and DHA in their breast-milk that were above the present recommendations for infant formulae (Luxwolda *et al*., 2014). These fatty acids are also efficiently transferred from the mother to the unborn child, and foetal DHA status of premature infants is positively related to head circumference, birth weight and birth length (Hornstra, Vonhouwelingen and Foremanvandrongelen, 1995). It has also been indicated that these LC-PUFAs affect positively learning ability, measured as reading and spelling improvements in 5–12 year olds (Richardson and Montgomery, 2005).

Micronutrients

As shown in Appendix 2, which summarizes available data on the nutritional content of fish, grouped into four categories: large freshwater fish, small freshwater fish, and lean and fatty fish, further comparing it with the nutrient content of other food items (Kawarazuka, 2010), fish compared to other foods is known to be an important source of essential micronutrients – vitamins D and B, and minerals such as calcium, phosphorus, iodine, zinc, iron and selenium (Roos, Islam, and Thilsted, 2003; Roos *et al.,* 2007a; Bonham *et al*., 2009). Lipid-rich fish also contain vitamin A. Recent research suggests that fish species that are consumed whole with bones, heads, and viscera (usually small fish) play a critical role in micronutrient intakes as these parts are where most micronutrients are concentrated. For instance, zinc is especially abundant in fish eaten whole. The potential contribution that fish (even in small quantity) can offer to address multiple micronutrient deficiencies, such as phosphorous deficiency in LIFDCs or B-vitamins deficiency, is now being increasingly recognized (e.g. Roos *et al*., 2007b; Kawarazuka and Béné, 2011; Thilsted, 2012).

Box 2 Fish's nutritional benefits: sardine as an example

The significance of fish for human nutrition can be illustrated by the benefits of a meal of fish, portion size 150 g, such as sardine (pilchard). It provides 37 g of high-quality protein and 17 g of lipid. 1.5g (or about the need for one week) of those lipids are omega-3 fatty acids essential for the normal development of the brain, for children's learning ability (Richardson and Montgomery, 2005), and for preventing non-communicable diseases such as cardiovascular diseases as stroke, high blood pressure and coronary heart disease (EFSA, 2010). Given the nutritional requirements for adults of 70 kg, it will further secure sufficient iodine intake for two days (iodine is essential against goitre and cretinism), and iron for a day. Iron and vitamin B12 are essential to prevent anaemia, while vitamin D is essential for calcium balance in all organs and especially in bone tissue and for bone mineralization. A portion of sardine provides 855 mg calcium, which, together with phosphorus, is "bone-strengthening" mineral.[18]

Box 3 Is there a difference between wild fish and farmed fish from the point of view of human nutrition?

Increasing fish consumption is expected worldwide, and most countries now look to the opportunity to establish aquaculture, and/or increase the sector's sustainable production, also in LIFDCs. A legitimate question is therefore: What will this switch from wild fish to farmed fish mean when it comes to nutritional sufficiency?

First, fish farming concerns a more restricted number of species than captured in the wild, with nutritional consequences (see Appendix 2).

Second, when it comes to the same species, current knowledge indicates similar fish protein quality and amino acid profile between farmed and wild fish. The amount of protein on a weight basis may vary, due to farmed fish often being more lipid-rich than its wild counterpart. The fattier the fish, the lower the absolute amount of protein per gram of fish will be.

All farmed fish studied so far have showed that complete or partial replacement of dietary fish oil with plant oil affects the fatty acid composition of the edible portion (Turchini, Torstensen and Ng, 2009). Thus, including plant oil in the farmed fish diet will result in increasing concentrations of the plant fatty acids of the omega-6 family, and decrease fillet concentrations of EPA and DHA. This will result in a lowering of the health-promoting EPA and DHA levels in farmed fish, but levels will still be much higher than in all other food commodities mentioned in Appendix 2. Vitamins A, D and E, and the minerals are also found to vary in farmed fish and being dependent on the fish diet (Lorenzen *et al.*, 1998; Graff *et al.*, 2002). However, the difference in minerals is minor compared with the other nutrients measured, due to the complex regulatory system of mineral absorption and retention at fish gut level.

Some caveats apply to this broad brush assessment of the importance of fish for good nutrition. The majority of the studies that aim at quantifying micronutrient content of fish eaten in developing countries have been conducted in Asia (essentially Bangladesh and Cambodia). Far less is known about species in other parts of the developing world, and especially in Africa. Different fish have different nutritional qualities (e.g. "white fish" and "oily fish", see Appendix 2) and these may also vary for aquaculture fish that are cultured differently, in particular those that received different types/levels of feeds. Therefore caution has to be exerted when extrapolating the nutritional value of fish from one species to another, or from one region to another.

Fish and food safety

The contribution of fish to good nutrition and health has been counterbalanced by concerns pointing to the risks of toxins/poisoning from harmful algae, bacteria, viruses and chemical pollutants in fish, which are problematic in several parts of the world.

A number of hazardous inorganic and organic compounds can be present in fish and other seafood. In terms of exposure from marine organisms, the compounds that represent the most significant health hazards are heavy metals such as methylmercury, cadmium and organic tin (STAP, 2012). Methylmercury is found in small amounts in many fish species. Considering that it accumulates in the food chain, the highest levels are reached in various predatory fish, with concentrations increasing with age and size (Storelli, Giacominelli Stuffler and Marcotrigiano, 2001). Because of this, a special concern has been raised about tuna consumption, as tuna, particularly the long-lived species, holds

[18] Data can be found in http://www.nutraqua.com and http://www.matvaretabellen.no/?language=en

quite high methylmercury levels. Methylmercury is a neurotoxic affecting the peripheral nervous system in adults and the central nervous system in children. The foetal brain is especially vulnerable, and increased concentrations of methylmercury may result in impaired cognitive and motor skills (Grandjean *et al.,* 2004). Cadmium may be found in large amounts in invertebrates, such as in squid, in brown meat of crab, and in heads of shrimp. Organic tin compounds are found primarily in bivalves as a result of pollution, especially in harbours since in the past tin compounds were used in antifouling agents for boats (FAO/WHO, 2011).

The most significant organic compounds that represent health hazards in fish are dioxins and PCBs, followed by campheclor (toxaphene) and polyaromatic hydrocarbons (PAHs). Fat from marine fish is often the most important source of intake of dioxins and PCBs (FAO/WHO, 2011). PAHs are primarily a problem in lower organisms such as bivalves, which are less able to convert and excrete PAH compounds. PAH concentrations in marine organisms result from local pollution (FAO/WHO, 2011). As long as maternal exposure to dioxins (from fish and other dietary sources) does not exceed the provisional tolerable monthly intake (PTMI) of 70 pg/kg body weight, neuro-developmental risk for the foetus is negligible. At levels of maternal exposure to dioxins (from fish and other dietary sources) that exceed the PTMI, neuro-developmental risks for the foetus may "no longer be negligible" (FAO/WHO 2011, p. 50).

Limited toxicological information exists on algal toxins. The main challenges in shellfish are associated with the paralysing toxins and the diarrhoea-producing toxins. Bacteria in fish products can come from the groups listeria, caphylobacter, yersinia, shigella and salmonella. Often these increase in number due to lack of hygiene during processing operations. Salmonella is the most significant cause of infection in humans, and is a challenge in all food types including fish. To lower bacterial exposure, hygiene and processing methods must be in focus. Hygiene and processing method will also affect the presence of viruses, especially hepatitis A and norovirus. Most probably, many cases of contamination are not recorded in any statistics (Cliver, 2001; Koopmans, 2002). Filtering molluscs are also known to accumulate bacteria or viruses found in water. Thus, when fish and other seafood are involved in virus-borne diseases,[19] most of the cases are caused by bivalves, especially oysters (Lees, 2000).

The growth of aquaculture in recent years has been accompanied by a rapid increase in therapeutic and prophylactic usage of antibiotics/antimicrobial agents including those important in human therapeutics, to overcome shortcomings in sanitary and unhealthy conditions in fish farming. Accumulated evidence suggests that unrestricted use of antibiotics is detrimental to fish, human health and environment, and efforts are needed to prevent development and spread of antibiotic/antimicrobial resistance in aquaculture to reduce the risk to human health (Serrano, 2005, 2005; Cabello, 2006; Heuer *et al.*, 2009; Cabello *et al.*, 2013).

Realizing the impact on human health of excessive use of antibiotics/drugs/chemical in aquaculture, many countries (importing and exporting) have put in place stringent regulations on the use of antibiotics/drugs/chemicals in aquaculture/animal food production (GAA, 2011).

Overall however when considered together, experts tend to agree that the positive effects of high fish consumption largely overcome the potential negative effects associated with contamination risks (see, for example, Mozaffarian and Rimm, 2006; FAO/WHO, 2011; Hoekstra *et al.*, 2013). In 2010, FAO and WHO organized, at the request of the Codex Alimentarius Commission, an expert consultation on health risks associated with mercury and dioxins in fish and the health benefits of fish consumption (FAO, 2012a). The experts emphasized that fish consumption reduces mortality due to coronary heart disease in the adult population and improves the neurodevelopment of foetuses and infants and is therefore important for women of childbearing age, pregnant women and nursing mothers, outweighing the health risks associated with mercury and dioxins.

1.5 Fish losses and implications on food security and nutrition

Losses and waste can be important all along fish food chains, particularly for fresh fish, because fish is a perishable product (HLPE, 2014). In addition, for capture fisheries, there is a specific category of losses which is by-catch and damaged fish discarded prior to landing. There can also be quality and nutritional losses even if the amount of fish is not loss in mass (HLPE, 2014).

[19] Food-borne viral infections are reported to be among the ten most common causes of disease in humans.

Fish discards

Prior to landing – and therefore not accounted in production statistics – harvested fish caught can be dumped overboard (discarded, in most cases dead, dying or badly damaged) – due either to accidental by-catch of non-targeted species or legally undersized fish, or due to low quality, partial damage or spoilage – making them not commercially worth landing. The volume of fish discards varies greatly between fisheries and within fisheries, with discard rates ranging from negligible in some small-scale coastal fisheries or, for instance in Atlantic herring fisheries, up to 70-90 percent for some demersal trawl fisheries. Global discard volumes are particularly challenging to estimate, and any global figure is prone to significant uncertainty. The latest report published by FAO in 2005 on the issue has given an estimate of an 8 percent global discard rate of the world total capture fisheries, with a lower rate of 3.7 percent for small-scale fisheries (Kelleher, 2005). Some quota policies or legislation prohibiting landing of small sizes tend to encourage discarding practices. However, with increasing fish scarcity and prices, the problem of discards is being resolved – at least partially – as new species previously deemed commercially inferior are progressively integrated into consumer eating habits and markets. Most shrimp fisheries (e.g. in Central America, India, Thailand) are now landing more by-catch for human consumption than in the past (Kelleher, 2005).

In 2011, (voluntary) International guidelines on by-catch management and reduction of discards were adopted by the FAO Committee on Fisheries (FAO, 2011a). They provide guidance for the management of by-catch and the reduction of discards in all fisheries and regions of the world, with measures ranging from appropriate regulatory frameworks to data collection programmes, to ensure the conservation of target and non-target species, as well as affected habitats.

In 2013, the European Union, under its Common Fisheries Policy, has taken a decision to ban discards in deep-sea fisheries, such as for mackerel and herring. The regulation comes into effect from January 2015, with a further ban in other fisheries starting from January 2016.[20]

Post-harvest losses

Fish is a very perishable food and hence susceptible to high post-harvest losses after landing, either in quantity or quality, due to post-harvest handling during transport, storage, processing, on the way to markets or in markets waiting to be sold. According to Gustavsson *et al.* (2011), 27 percent of landed fish globally ends up being lost or wasted from landing to consumption. If discards prior to landing are taken into account, fish losses and waste (in percentage of the landings) amount to 39 percent globally.

Fish post-harvest losses are important between landing and processing (post-catch) especially in developing countries. According to the Associated Chambers of Commerce and Industry of India,[21] poor handling infrastructure, lack of proper storage facilities and inadequate packaging in fisheries post-harvest operations leads to USD 2.5 billion economic losses annually, equivalent to 25 percent of the value of Indian marine fisheries landings.

Finally, according to Gustavsson *et al.* (2011), waste at consumer level is quite important in rich countries and negligible in other regions.

Quality and nutritional losses

Inadequate handling and processing methods can lead to quality and nutritional loss (Gram and Huss, 1996; Huss, Ababouch and Gram, 2004; Adams and Moss, 2008). This can lead to substantial economic losses as the value of fish decreases with quality loss. Specific requirements and preservation techniques are needed in order to preserve fish's nutritional quality, extend its shelf-life, minimize the activity of spoilage bacteria and avoid losses caused by poor handling (FAO, 2012a). The contribution of fish to micronutrient intakes is determined not only by the nutrient content of the fresh fish, but also by the local processing methods and eating patterns. As a consequence, several studies recalculated the actual nutrient content of the edible part by reflecting the local methods used to clean and prepare the fish for the meal (e.g. leaving or cutting off the head, removing a part of the viscera) and correcting the calculations to account for plate-waste after the meals (Chamnan *et al.*, 2009; Roos *et al.*, 2007a,b,c,d). These are accounted for in Appendix 2.

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[20] ens-newswire.com/2013/12/10/eu-bans-fish-discards-under-new-common-fisheries-policy/

[21] http://www.assocham.org/prels/shownews-archive.php?id=3874

We have seen in this chapter that fisheries and aquaculture play important roles, directly and indirectly for food security and good nutrition. Fish production is expected to continue growing, thanks to aquaculture, driven by an increasing demand. At the same time the sector is confronted with challenges to maintain and enhance its contribution to food security sustainably. These will be examined in the next chapter.

2 TOWARDS SUSTAINABLE FISHERIES AND AQUACULTURE FOR BETTER FOOD SECURITY AND NUTRITION

Chapter 1 has shown the important roles of fish for food security and nutrition. In this chapter we review the conditions for and ways to fully realize the potential for fisheries and aquaculture to contribute to food security and nutrition.

To determine how fisheries and aquaculture can best contribute to food security and nutrition in the long term, it is important to understand the organization of the sector and review the main challenges and opportunities it faces in terms of its environmental, economic and social sustainability and development. This chapter adopts a food and nutrition security lens to consider the synergies and trade-offs of different sustainability pathways for the sector.

Prior to review the key challenges and opportunities the sector faces in terms of environmental (Section 2.2 for fisheries and 2.3 for aquaculture), economic (2.4) and social (2.5) sustainability, and in order to better understand them, we briefly present some of the important related features of the sector (Section 2.1).

2.1 Some important features of the sector to understand how it relates to sustainability

The fisheries and aquaculture sector is very heterogeneous. A diversity of resource, economic and social conditions and constraints drive the organization of the sector and in return diverse structures perform differently in their environmental, economic and social dimensions.

There are a variety of scales of operations and wide diversity in terms of organizational levels ranging from informal activities and micro-enterprises, self-employed single operators to big formal sector businesses.

A common distinction is made between large-scale and small-scale fisheries. This issue of scale, which is mainly determined by the size of boats, is closely linked to the resources exploited and their proximity to the shore. There is no universally applicable definition for "small-scale fisheries", but some important characteristics can be identified (FAO, 2005a, and see also the introduction of this report), such as using relatively small fishing vessels (if any), without onboard cold storage or other conservation facilities, making short fishing trips, close to shore, mainly for local consumption. They are more labour-intensive and mobilize less capital and energy than large-scale fisheries, often using manual gears.

Fish resources are of very different kinds. Specific gears are generally needed to fish specific species.[22] This leads to a specialization of boats, and often also of harbours dealing with specific fisheries and related fleets, and their specific equipment. Coastal resources can be harvested either by local, small-scale fisheries living close to their fishing grounds, or by local or foreign large-scale operations.

Resources located far from the coast, in high seas, and their exploitation generally necessitate bigger, larger boats, specific bigger, heavier gear, powerful engines or means of propulsion and conservation capacities such as cold storage. Such fisheries are more capital intensive. Large-scale fisheries, because of the installed fishing capacity (number and size of boats), can remove high volumes of fish from the sea. When a certain gears is employed which has a high risk of by-catch, the objective of landing only a certain kind of produce could translate into high levels of discards.

[22] According to Chuenpagdee (2011), *"Three of the five most popular fishing gears employed in 2004 were bottom trawls, purse seines and mid water trawls – gear which almost only operate in large scale fisheries and contribute to nearly 3/4th of the world catches. The two other most common gears can be operated either by small scale or large scale fisheries (gillnets or gorges), accounting for 13% of catches. The 15% remaining of the global production comes from 29 different gears types, mostly gear used in small scale fisheries like lift nets, cast nets, raking, bagnets, diving and grasping by hand"*.

Small-, mid- and large-scale fisheries can in some places target very different fishing grounds, species and markets, with different related commercialization modes. For example, large-scale fisheries are often specialized, but small-scale fisheries are often more open to accommodate a wider diversity of catches. In other places small-, mid- and large-scale fisheries can coexist and share the same fishing grounds, use similar gear (that differ only in power and efficiency), target the same species and compete in the same markets, competing also in post-harvest activities.

Conservation and storage conditions are key for harvested fish. Harvested fish can either be sold to local markets and enter short value chains – with little or no transformation and processing, or with traditional forms of transformation such as drying, smoking or salting. Fish can also reach more distant markets, which require either cold chain or processing such as canning, and the related equipment and investments. The need for appropriate post-landing transformation or processing facilities or other post-harvest industries, which are also capital intensive and of larger scale than the boat themselves, is another factor of the economic concentration of the sector. It is often accompanied by requests for specialization and standardization of the product (homogeneity in size, quality, freshness). This has consequences on discards, as fish caught but not adapted to the specification of markets or processing will be dumped overboard.

Finally, in economic terms, fisheries drive a considerable number of ancillary activities, such as net-making, boat building, engine repair and maintenance. They all provide additional fisheries-related employment and income opportunities, often located close to ports and landing sites.

Fish is one of the most internationally traded foods. In 2012, international trade represented 37% of the total fish production in value, with a total export value of USD 129 billion, of which USD 70 billion of developing countries' exports (FAO, 2014a). This has an impact on the infrastructure needed to commercialize the product, especially given the fact that fish is a perishable commodity.

Governments and public authorities often allocate fishing rights (see Chapter 3). They also provide various kinds of subsidies to the sector: Sumaila *et al.* (2013) estimated marine capture fisheries subsidies at USD 35 billion globally, with a predominance of developed countries (68 percent of the world total) and large-scale operations.[23] Subsidies can include capital inputs and infrastructure (57 percent of the world total). At the global level, close to a quarter of subsidies take the form of subsidized fuel. Fishery development projects and rural fishing community development programmes receive smaller fractions of public money, about 3 and 1 percent of the world total, respectively (Sumaila *et al.*, 2010).

Recent data confirm that the period of high investment in large-size vessels, which peaked around the mid-1980s, is largely over. Since the beginning of the 1990s, the large vessel fleet has stabilized in size if not in fishing power (FAO, 2009a, 2014a). However, in Exclusive Economic Zones (EEZs, 200 nautical miles from the coast), where both large and smaller operators are present, the total number and power of smaller boats have increased substantially over the same period. As a consequence, global fishing capacity is still very high, probably at its highest point ever, and, with some notable exceptions, adjustments in fishing capacities have not yet been implemented (Garcia and Rosenberg, 2010). The number of newly built vessels per year has declined substantially since the 90s (FAO 2009a), driving a decrease of the fleet in the future (Garcia and Grainger, 2005).

Technology has improved fishing capacity and efficiency as well as safety on board, and in some cases improved fishing selectivity and product quality, but it has also contributed to overfishing worldwide (Garcia and Newton, 1997). Indeed, Squires and Vestegaard (2013) argue that technical change "has been perhaps the single greatest pressure on global fisheries". Its unbridled use will continue to direct fisheries on a trajectory of progressive automation and reduction of labour, with likely negative implications for coastal communities in terms of employment (Garcia and Rosenberg, 2010).

[23] Sumaila *et al.* (2010) classified and identified subsidies as: beneficial (fisheries management, research and development, MPAs); capacity enhancing (boat-construction and renovation, fisheries development projects, marketing and storage infrastructure, tax exemption, fishing access, fuel subsidies); ambiguous (fisher assistance, vessel buyback, rural fisher communities).

The fisheries sector is highly gender-sensitive. Men are typically engaged in fishing, one of the most dangerous occupations, as going at sea often comes with a combination of risks such as severe weather conditions, extreme fatigue due to long shifts, and dangerous equipment (Davis, 2011). Women engage in fish processing, marketing and near shore harvesting activities (FAO, 2004).

The development of aquaculture in a context of fisheries production plateauing appears as key to allow the sustainability of the two sectors altogether, and to enable the role of fish in future food security, as capture fisheries could not cope with the rise in fish demand. It is also a sector with high growth, which is an opportunity for diversification, job creation and new income generating activities in rural areas, also contributing to food security in this way. The development of aquaculture brings issues, which are similar to ones concerning the development of livestock in general, including risks and diseases (such as the recent early mortality syndrome affecting shrimp farming). There is a diversity of aquaculture systems with different scale of operation, different degree of intensity of capital and labor intensity. Some aquaculture systems can be quite intensive and very technologically advanced. Other systems offer strong linkages with agriculture, especially integrated systems and irrigated agriculture (such as rice-fish systems). As for livestock, some aquaculture systems are more directed towards export, other to local markets.

Given the above key characteristics of the sector, let us review the environmental, economic and social challenges and opportunities for sustainable fisheries and aquaculture to contribute to food security and nutrition.

2.2 Resource and environmental risks and pressures affecting the world fisheries and consequences for food security

As for other agricultural and food production activities, sustainable management of natural resources is key to ensure the contribution of fish to food security and nutrition.

From an environmental and resource perspective, overfishing is considered as the most important pressure on marine fisheries. The sector is also confronted to other threats, ranging from pollution and ecosystem degradation induced by the impact of other human activities, particularly in coastal areas, and to climate change.

For marine and inland fisheries, the main issue is to manage fish stocks and ecosystems, within a dynamic environment subject to climate fluctuations and change, in such a way as to maximize harvests without compromising future yields. Marine and inland fisheries are also confronted with the competition from other activities (economic and recreational) and with various environmental risks.

Capture fisheries harvest thousands of different species, most consisting of several distinct stocks in different marine ecosystems. One must therefore be cautious not to derive global statements about resource and environmental sustainability from a limited subset of findings and observations.

2.2.1 Overfishing and the “world fisheries crisis”

The extent to which capture fisheries have exceeded safe, sustainable levels of harvests and have reached a crisis has generated strong expert and public opinion debates. Starting in 1992, at about the time of the collapse of the Canadian cod stocks, many media headlines, scientific papers and environmental campaigns have been framed around the idea that all world fisheries resources are in crisis due to overfishing. FAO has expressed a less alarmist, more nuanced but nonetheless serious view on the state of world marine fishery resources (e.g. FAO 2011a).

The “world fisheries crisis” viewpoint has some substance. FAO categorizes fish stocks as underexploited, moderately exploited, fully exploited, overexploited, depleted or recovering. Analyses of world marine stocks show an increase in the percentage of overexploited and depleted stocks over time, while the number of underexploited or moderately exploited stocks decreases. FAO’s analyses of world marine stocks show that world capture fisheries production has plateaued since the mid-1990s around 90 million tonnes per year, with an increase in the percentage of overexploited stocks over time and a decline in the percentage of non-fully exploited stocks (b). According to FAO (2014a) “*the proportion of assessed marine fish stocks fished within biologically sustainable levels declined from 90 percent in 1974 to 71.2 percent in 2011, when 28.8 percent of fish stocks were estimated as fished at a biologically unsustainable level and, therefore, overfished. Of the stocks assessed in 2011, fully fished stocks accounted for 61.3 percent and underfished stocks 9.9 percent*”.

In its review of the state of world marine fishery resources, FAO (2011b) estimated that the Millennium Development Goal, set by the World Summit for Sustainable Development, of restoring by 2015 overfished stocks to the level that can produce maximum sustainable yields, was very unlikely to be achieved, notwithstanding the good progress made in some countries and regions (Worm, 2009).

The controversy about the "fisheries" crisis stems from scientific debates, views and counterviews, on methodologies used by different studies, which have been challenged for containing simplifications, methodological errors, notable data gaps – especially but not only for developing country fisheries – and inappropriate use and interpretation of data (see Table 2). There is also disagreement on where and to what extent the resources are being unsustainably used. Finally, there are nuanced views on how well fisheries are recovering under good management (Table 2).

Key to the debate is the fact that fishing capacities have reached an all-time high (see Section 2.1) and the existence of capacity-enhancing subsidies, which according to Sumaila *et al*. (2010) have reached a point of "disinvestment in natural capital assets" and led to resource overexploitation making impossible to achieve maximum sustainable long-term benefits. However, despite such controversies, there is general scientific consensus that there is today an excess of fishing capacity, considerable overfishing and therefore a need for action, as recognized by the FAO Committee on Fisheries, which has developed an international plan of action for the management of fishing capacity (FAO, 1999).

Despite lack of complete agreement, fisheries stock assessment experts have achieved considerable convergence in their views that global fisheries would be more productive if the current levels of overfishing were reduced. If the numerous overexploited stocks were allowed to recover and then harvested sustainably, fisheries would be able to achieve substantially more harvest than current levels.

Table 2 Views and counterviews in the fisheries crisis scientific debate

Fisheries crisis views	Counterviews
• 90% reduction in the biomass of large predatory fish (Myers and Worm, 2003).	• Inappropriate data and analytical methods have been used. • Tuna stocks (except for Bluefin tunas) not depleted to this extent (Polacheck, 2006; Sibert *et al*., 2006).
• Commercial fishing will end by 2048 at present rate of stock collapses (Worm *et al.*, 2006).	• Yes, fisheries do collapse, but they tend to rebuild at about the same rate (Branch, 2008). • Many fish stocks do not have data suitable for use in these analyses, especially for small-scale fisheries. • Outlook for marine fisheries is mixed, with positive and negative prognoses, depending on the stocks (Worm *et al*., 2009).
• Data-poor and unassessed fisheries tend to be in worse condition than assessed fisheries. Many of the assessed fisheries are recovering under management (Costello *et al.*, 2012).	• For regions with fewer assessments, Thorson, Branch and Jensen (2012) found little evidence for a greater proportion of collapsed unassessed stocks, although data were extremely scarce in some regions. However, the proportion of unassessed stocks that are collapsed (currently estimated from landings data at around 5%) is increasing. • In many developing countries, many catches are not reported by species (Figure S3 of Costello *et al*. (2012) Supplementary materials) and thus the state of these stocks cannot be assessed.
• At global aggregate, the trophic level of landed fish is declining ("fishing down the food web") (Pauly *et al*., 1998).	• "Fishing down" is not ubiquitous at regional scale, e.g. in large marine ecosystems. However, fishing is taking more and more of the aquatic resources through several fishing patterns – fishing through/down/up food webs (Essington, Beaudreau and Wiedenmann, 2006; Branch *et al*., 2010).

What is the impact of the fisheries' crisis and over-fishing on food security and nutrition?

Although the public discussion of the world fisheries crisis often refers rather superficially to its impacts on food security, and occasionally nutrition, the discourse is predominantly ecological and economic in nature, and relies almost exclusively on biological fish assessment methods (see Box 4). This discourse is framed primarily around objectives of ensuring, or restoring, the maximum biological yield and economic value of the fisheries stocks.

When the environment, production ecosystems and/or the resources bases (fish stocks) are degraded or overexploited, the capacities of the sector to deliver its food security and nutrition functions are limited or reduced (Agardy and Alder, 2007; FAO/NACA, 2012). Overfished stocks have lower abundance levels, and therefore produce less. They require strict management plans to rebuild their biologically sustainable productivity. A majority of the stocks of the most important species (accounting for about 24 percent of world marine capture fisheries production in 2011) are fully fished and some are overfished (FAO, 2014a). According to FAO (2014a), rebuilding overfished stocks could increase production by 16.5 million tonnes, an equivalent of USD 32 billion.

Srinivasan *et al.* (2010) proposed estimating the number of (additional) people in food-deficit countries who could have benefited from fish if the fisheries sector had been managed more sustainably. The authors estimated the catch losses induced by overfishing and converted them into potential food energy. Assuming an energy content of 120 kcal per 100 g of marine landings, they found that 20 million people could avoid under-nourishment annually if fisheries were not overexploited. Although the calculations are subject to debate, and do not take into account the nutrition dimension of fish, nor address the allocation and access issues, the study captures the point that overexploited or degraded resources create an absolute loss of potential product that could be used for food security and nutrition by producers and consumers.

The world fisheries crisis narrative and the ecological sustainability debate have also shaped many environmental campaigns, including through the promotion of ecolabels (see infra). More recently, these campaigns advocated for a local use of fish within reduced harvesting strategies. For instance in the case of the Peruvian anchoveta fishery (*Engraulis ringens*), Pikitch *et al.* (2012) advocated for a larger use as food of small pelagic fish species, traditionally considered as "feed fish" for larger fish, birds and mammals in the ecosystem.

The sustainability of fisheries in their environmental and natural resource dimensions is therefore recognized to be a *sine qua non* condition for long term, sustainable food security and nutrition. But, as we have seen in Chapter 1, long term food security and nutrition outcomes of fisheries would not depend only on stock recovery but also on access to, and distribution, of the harvest. Considering food security and nutrition leads to "hone" the sustainability pathways that the sector could follow.

Box 4 The historical purpose of fish stock assessments

For over a century, fish stock assessment science has been the lead field of fisheries science and its practitioners have interfaced with the human dimension of fisheries through fisheries management agencies and the fishing industry (Smith, 1994). Management has tended to focus on maximizing the quantity and value of catches, economic growth of the sector and stock sustainability under these conditions rather than maximizing livelihoods, food and nutrition security. These constructs, however, have been based mainly on practices in the developed countries. Saetersdal (1992) cautioned, however, that "other national objectives – such as equitable distribution of resources, value added processing, labour, foreign exchange earnings – may be deemed more important for national economies". Regardless, stock assessment models and appropriate secondary analyses typically are not used to advise managers on distribution objectives such as food security and the management of many of the fish species that are important to food security and nutrition. Stock assessment, secondary analyses and related management methods, however, could provide many tools with which to undertake such work and this could provide a very rich field of endeavour for the analysts. To be effective as a food security and nutrition advisory tool, stock assessment would need to be embedded in the appropriate governance and management frameworks for recommending how to achieve food security and nutrition outcomes.

2.2.2 Environmental pressures on marine and inland fisheries ecosystems

Even if overfishing is generally considered as the most important pressure on marine fisheries, they are also confronted to wider threats to their resources, from pollution and ecosystem degradation induced by the impact of other human activities, particularly in coastal areas (MEA, 2005, Rosenberg and Macleod, 2005, Cochrane *et al.*, 2009). In other words, part of the problem, and therefore part of the solution – as we will see in Chapter 3 – to the sustainability of fisheries lies outside the sector.

The impacts of activities such as oil drilling, energy installations, coastal development and construction of ports and other coastal infrastructures, dams and water flow management (especially for inland fisheries), etc. have tremendous impacts on aquatic productivity, on habitats that sustain resources (e.g. through erosion and pollution), or on the livelihoods of fishing communities (e.g. through denial of access to fishing grounds or displacement from coastal settlements). Inland fisheries are confronted with the same type of impacts (MEA, 2005, Allan *et al.*, 2005) as well as with competition in the use of water and with perturbations caused by the establishment of dams and modification of river beds. Locally, capture fisheries, coastal and inland can also face the impact of the development of aquaculture (see infra).

Dams interrupt stream flow, and generate hydrological changes along the integrated continuum of river ecosystems (Vannote *et al.*, 1980; Junk, Bayley and Sparks, 1989; FAO, 2001) that ultimately impact on their associated fisheries. The most obvious effect is that movements of migratory fishes along river courses will be blocked by dams (Box 5). The impact of dams on fisheries activities is not new and has been largely documented and discussed in the literature for years (Marmulla, 2001). But rarely has this debate been framed in terms of food security and nutrition. The trade-offs are complex and difficult to quantify. They eventually involve distributional issues between the local population who used to depend on these local fisheries for their direct and indirect food security and nutrition versus the more general economic development of the country. These trade-offs and tensions are not easily totally resolved through appropriate compensation programmes, nor are such programmes often implemented and local populations generally end up as the losers of these “development” operations.

In regard to food security, management will need to assess current and future resources, taking into account local and regional pressures and needs, including expected population increase, and other economic activities. For instance small island states are particularly dependent on fisheries for their economic development and their food security and nutrition. This will require careful management and valorization of resources, including innovative approaches such as landing of by-catch and development of aquaculture (see Box 6).

Box 5 Impact of dams on river fisheries – the case of the Mekong

In the Mekong, 135 species are long distance migrants and make up 40–70 percent of the fish catch (Baran, 2006). These migrations allow fish to access suitable spawning habitats that do not exist in the feeding areas downstream. Plans for hydropower development in the Mekong have led to growing concern over the potential environmental, economic and social costs, and there is acute concern over the impact on the basin's fisheries. It was reported that 11 dams are scheduled to be installed on the mainstream of the river within the next decade. Seven of these are located in the Lao People’s Democratic Republic, two in Cambodia and two will be shared between the Lao People’s Democratic Republic and Thailand. These 11 dams would convert 55 percent of the mainstream into a reservoir, altering water flows and so degrading the feeding and breeding habitats of fish along the river. In fact the impact of dams in blocking fish migration is believed to be the single most critical threat for fisheries (Dugan, 2008; Baran and Myschowoda, 2008). In view of this, recent reviews of the impact of dams on the Mekong have called for action by governments to site dams as high as possible upstream and on tributaries so that they minimize impact on fisheries (Dugan *et al*., 2010).

Box 6 Overcoming challenges to local fish availability to satisfy recommended fish-based diets in Pacific Islands

Coastal communities in the 22 Pacific Island Countries and Territories (PICTs) highly depend on fish for their protein supply, with limited options for producing or importing other sources of protein. In particular, the scarcity of land in many PICTs prevents the production of cereal crops and animal grazing. Purchasing power is also limited, restricting food imports or channelling expenditure to imported foods of poor quality.

Non-communicable diseases (diabetes, obesity and heart disease) are on the increase across the region (Cheng, 2010). In 2008, the Public Health Division of the Secretariat of the Pacific Community (SPC) has recommended a diet of 35 kg of fish per person per year, and to maintain traditionally higher levels of fish consumption where possible (SPC, 2008; Bell *et al.*, 2009).

However, the extent of available area of coral reef (which supports most coastal fisheries production in these regions) in many PICT countries is a strong constraint to the increase of the quantity of fish that can be harvested sustainably to feed rapidly growing local populations. Coral reefs area and their sustainable fish productivity (Newton *et al.*, 2007) is a limiting factor in eight PICTs today (and will be in nine in 2035 – Papua New Guinea, Vanuatu, Solomon Islands, Guam, Samoa, the Commonwealth of the North Mariana Islands, American Samoa, Kiribati and Nauru) for ensuring local supply to the recommended 35 kg of fish per person per year (Bell et al, 2009; Bell, Johnson and Hobday, 2011).

Tuna and freshwater tilapia aquaculture have therefore been identified as options to increase local fish supply. Tilapia farming has been identified as suitable given temperature conditions and given water availability due to rainfall conditions (Pickering *et al.*, 2011, SPC, 2013).

Increase supply of tuna would result from local harvest and the establishment of networks of “fish aggregating devices” (FADs) which attract tuna congregation, anchored relatively close to the coast, easily accessible by canoes and small motorized boats. Another mean to increase tuna supply is when purse-seine vessels transfer their catch to fish cargo vessels in Pacific ports (McCoy, 2012). During these transhipping operations, by-catch and small-sized tuna are separated from the tuna to be delivered to canneries. The by-catch and small tuna can be landed to provide low-cost fish for local populations.

Capture-based aquaculture involves the capture of wild individuals, either as broodstock, or as early life stages for subsequent on-growing under controlled conditions. It is practised on a diverse range of freshwater and marine fish species and invertebrates and can be a highly significant economic and social activity in its own right, often creating many jobs for poor people, although of a transient nature as the aquaculture system develops. However, this practice may result in negative impacts on fisheries: for aquatic species with low reproductive capacity, the mass capture of wild seed, juveniles or broodstock may have a negative impact on white fish recruitment (Hair, Bell and Doherty, 2002). By-catch of other species along with target species can lead to biodiversity loss, potentially affecting wild fisheries. Finally destructive fishing practices for collection of wild seed or broodstock can damage fisheries habitat (see Box 7).

Box 7 Capture of wild seed – the case of shrimp in Asia and in Latin America

Despite improvements in hatchery production of seed, shrimp farming in some countries still relies on seed collected from the wild, especially for species such as *Penaeus monodon* for which the life cycles are still difficult to close full in hatcheries. The collection of seed from the wild has impacted the wild populations of both targeted species and the species that are caught incidentally and discarded (by-catch). For instance, in Nicaragua, collection of seed from the wild is claimed to be a major factor responsible for the reduction in wild shrimp and other fisheries production.

Source: Briggs *et al.* (2004); Soto *et al.* (2012).

2.2.3 Climate change

Changes in global and regional climate will interact with many other factors which govern the distribution and ecology of the resources and influence the capacity and performance of the marine fisheries sector to meet future consumption rates (Merino *et al.*, 2012).

Unlike most terrestrial animals, aquatic animal species are poikilothermic (cold-blooded) and changes in habitat temperatures will more rapidly and significantly influence metabolism, growth, reproduction and distribution, with stronger impact on fishing and aquaculture distribution and productivity. The interconnectedness of aquatic systems allows fish species to migrate with shifts in ecosystems conditions.

Expected changes in climate patterns and extreme events, sea level rise, glaciers melting, ocean acidification and changes in river flows are expected to result in significant changes across a wide range of aquatic ecosystems with consequences for fisheries and aquaculture in many places (FAO 2009b; IPCC, 2014).

Climate impacts are already visible (Cochrane *et al.*, 2009; IPCC, 2014). Studies have found changes in the species composition of marine capture fisheries, correlated to changes in ocean temperatures; with changes in the geographic distribution of fish species: an increase of warmer water species at higher latitudes and a decrease of subtropical species in the tropics (IPCC, 2014). Predicted changes indicate increased productivity at high latitudes and decreased productivity at low/mid latitudes, with considerable regional variations (Barange *et al.*, 2014; IPCC, 2014). Effects of climate change will combine with other pressures, pollution, ecosystem degradation and overfishing, particularly on coastal areas and coral reefs (IPCC, 2014; Barange *et al.*, 2014). Coral reefs, which play an important role in many coastal fisheries, are particularly susceptible to extremes in temperatures; temperatures in excess of 1 or 2 degrees of normal maximum are sufficient to disrupt the symbiotic relation between the dino-flagellates and their coral hosts, leading to coral bleaching. 60% of coral reefs are considered to be under immediate threat from local anthropic pressures, rising to 75% with climate change (IPCC, 2014). Aquaculture production of calcifying organisms such as molluscs will experience loss of habitats because of ocean acidification (IPCC, 2014).

There is considerable less information on climate change impacts on inland fisheries and aquaculture. Some studies have detected changes in species composition. Other attribute decreases of production in some East Africa lakes to climate change, but this assumption has been counter balanced by other estimating that it is rather due to a change of fishing practices (IPCC, 2014). In areas that experience water stress and competition for water resources, aquaculture and inland fisheries will be at risk (IPCC, 2014). Xenopoulos *et al.* (2005) have predicted that river discharge could decrease by as much as 80% in 133 rivers worldwide for which data on fish species was available, leading to a 75% fish biodiversity loss by 2070, mainly in tropical and subtropical areas.

Climate change impacts will likely be as varied as the changes themselves and will be felt through changes in fishing opportunities (resources available and entitlements), operational costs (in production and marketing) and sales prices, with increased risks of damage or loss of infrastructure and housing (FAO, 2008). Fishery-dependent communities may also face increased vulnerability in terms of less stable livelihoods, loss of already insecure entitlements (Allison *et al.*, 2009), increased safety risks while fishing and loss of days at sea because of bad weather. They will also experience erosion of coastal and riverine living space; sea level rise and extreme events will have a particular impact on those located in low lying areas.

Barange *et al.* (2014), combining dependence of economies and food systems on fisheries with projected impacts of climate change suggest that these impacts will be of greatest concern in South and Southeast Asia, South west Africa, Peru and some tropical small island developing countries. They also highlight the importance of other factors such as management strategies.

These impacts of climate change will in turn affect the four dimensions of food security and nutrition: availability, stability, access and utilization of food supplies (Cochrane *et al.*, 2009, HLPE 2012b, Garcia and Rosenberg, 2010, IPCC 2014). Uncertainty and vulnerability may increase for fishers and fish farmers at the local level, and current access rights might not be adapted to the shifting resources. Changing conditions may lead to a period of quantitative and qualitative instability in supplies. It is unclear whether industrial fisheries or artisanal fisheries are better equipped against such instability. Some changes may also be positive, opening new opportunities as new species become accessible. A study by Fulton (2011) on Australian fisheries has predicted that large-scale fisheries, more flexible, could increase the value of their operations by as much as 90% by 2060;

while small-scale fisheries would experience variations depending on regions, from a decrease of 30% to 51% to an increase of 10%. Fish availability to consumers will depend on governance performance and eventual redirection of global trade flows. Access to fish can change as prices are likely to increase even more.

In a context where pressures on marine fisheries will increase, the capacity to meet future fish demand in a context of climate change will more than ever rely on the performance of aquaculture, in various dimensions.

2.3 Opportunities and challenges in aquaculture for food security

In the last three decades, farmed fish production has increased by 12 times, at an average annual growth of over 8 percent, making it the fastest-growing food production sector, answering to the growth in fish demand. In 2012, inland and marine aquaculture's production reached an all-time high of 67 million tonnes (FAO, 2014a). The growth was possible through a wide range of technological innovations but has entailed major changes in land and water use.

The World Bank (2013) estimates that demand for farmed fish will further increase to 93 million tonnes by 2030. The issue is therefore to increase production while minimizing external environmental impacts and continue lowering natural resource footprints of aquaculture, especially, from a food security and nutrition lens, compared to other forms of protein and nutrients production.

Conversions of land and water to introduce aquaculture have often disturbed existing uses and users, and some have been ecologically damaging (Barraclough and Finger-Stick, 1996; EC, 1999; EJF, 2002), leading to criticism and anti-aquaculture environmental campaigns – primarily in response to shrimp and salmon farming and intensive aquaculture – and in social justice campaigns when livelihood of small-scale fishers were affected (Béné, 2005; De Silva and Davy, 2009; Naylor *et al.*, 1998; Naylor *et al.*, 2000). There were also concerns about impact of invasive species escaped from farms and/or introduced alien species on the natural populations in terms of ecological interactions and genetic impacts of interbreeding and spread of diseases (FAO, 2005b; Thorstad *et al.*, 2008).

Eventually, environmentally sustainable aquaculture production will depend on the right combination of farming systems (including health management), resource use (e.g. land water, energy), farming species low on the food chain, use of appropriate inputs (feeds, seeds, labour, infrastructure) and management of production (e.g. escapes, diseases), given trade-offs with other uses of the resource bases (water, land) and considering options for innovation such as new culture species (Lebel *et al.*, 2010), and other technological innovations for better fish health management practices, closing of life cycle for more species, better product quality control and improved marketing/distribution systems.

What are the environmental sustainability challenges that aquaculture face and how do they (and the related solutions) relate to food security and nutrition? In this section we explore some of these issues.

2.3.1 Relative resource efficiency of aquaculture production systems

Fish in aquaculture systems are very efficient converters of feed into protein – more efficient than most terrestrial livestock systems (Table 3). For instance, poultry converts about 18 percent of the food consumed and pigs about 13 percent as compared with 30 percent in the case of fish (Hasan and Halwart, 2009). Production of 1 kg of beef protein requires 61.1 kg of grain while 1 kg of pork protein requires 38 kg as compared with 13.5 kg in the case of fish. Most of this difference comes from the fact that fish are poikilotherms (their body temperatures vary along with that of the water in which they live) and therefore do not expend energy maintaining a constant body temperature. Moreover, because aquatic animals, especially finfish, are physically supported by the aquatic medium, fewer resources are used on bony skeletal tissues, and a larger part of the food they eat is effectively allocated to body growth.

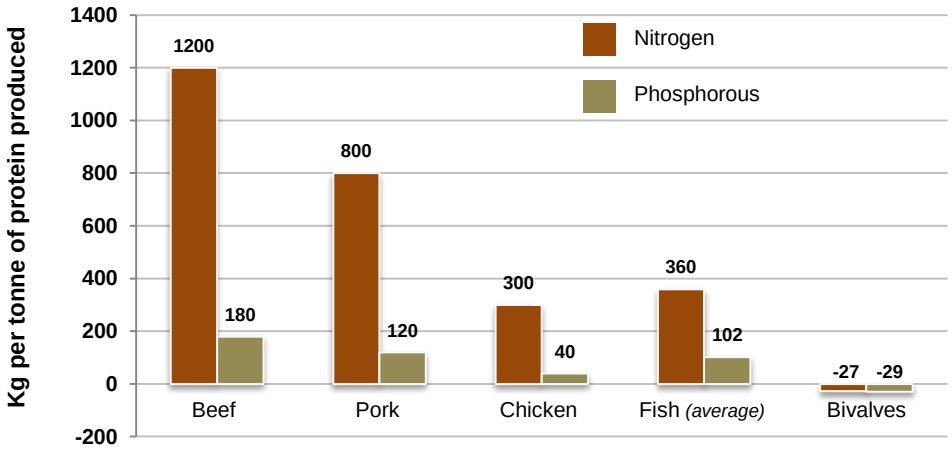
Aquatic animal production systems also have a lower carbon footprint per kilogram of output compared with terrestrial animal production systems (Hall *et al.,* 2011). Nitrogen and phosphorous emissions (kg of nitrogen and phosphorus produced per tonne of protein produced) from aquaculture production systems are much lower when compared with beef and pork production systems and slightly higher than that of poultry. In fact, some of the aquaculture production systems such as farming of bivalves absorb nitrogen and phosphorous emissions from other systems (Figure 8).

Table 3 Feed and protein conversion efficiency of the major animal foods

Commodity	Dairy	Carp	Eggs	Chicken	Pork	Beef
Feed conversion ratio (mass of feed/mass of edible product) – FCR	0.7	2.3	4.2	4.2	10.7	31.7
Feed conversion efficiency (mass of edible product/mass of feed) – FCE	143%	43%	24%	24%	9%	3%
Protein content (% of edible mass)	3.5%	18%	13%	20%	14%	15%
Protein conversion efficiency (protein in edible product/protein in feed)	40%	30%	30%	18%	13%	5%

Source: Hall *et al. (2011).* Protein conversion figure from Smil (2001). Calculation based on average United States of America feed requirements in 1999.

Figure 8 Nitrogen and phosphorous emissions for animal production systems



Source: Data for fish are derived from Hall *et al*. (2011). Data for beef, pork and chicken are derived from Flachowsky (2002) and Poštrk (2003).

2.3.2 Aquaculture feed and the use of fishmeal and fish oil

Though molluscs and filter-feeding finfish (eg. silver carp, bighead carp) do not require feeding, aquaculture production is for a great part dependent on some supplementary or external feed, including fishmeal (FAO, 2012b). According to Tacon, Hasan and Metian (2011), fed aquaculture represents 81 percent of global fish and crustacean aquaculture production, and 60 percent of global aquatic animal production of aquaculture. Low-trophic level species mostly farmed in developing countries use fewer supplementary feeds and fishmeal, while higher trophic level species such as salmon, trout, shrimp are still dependent on fish from the wild for fishmeal and oil in formulated feeds. Large differences exist, however, between countries as to the sources and efficiency of use of the wild fish resources in feeds (Tacon, Hasan and Metian, 2011).

The use of fish from the wild in fishmeal and fish oil to produce fish has been the cause of major public controversy (Wijkstrom, 2012). In 2012, of the world's total catch of fish, 16 million tonnes, about 10 percent, was reduced to fishmeal and fish oil (Tacon, Hasan and Metian, 2011; FAO, 2014a). Small pelagic species, in particular anchoveta, are the main contributors for reduction, and the volume of fishmeal and fish oil produced worldwide often varies annually according to the fluctuations in the catches of these species. In addition to fishmeal and fish oil, "low-value" fish (also called "trash fish"[24]) are also used directly as feed for aquaculture, especially in Asia.

[24] The term "trash fish" is unfortunate because many species involved are in fact species that would be suitable for human consumption if allowed to grow and some could be used as food fish directly.

Since the early 1990s, the proportion of fish production used as fishmeal has decreased[25] from an average of 23 percent (26 million tonnes/yr) in the 1990s to 10 percent in 2012 (16 million tonnes). Overall, the use of fishmeal in aquaculture feeds is expected to decrease with time, thanks to increasingly effective development and use of fishmeal replacers, including plant proteins, waste products from fish and terrestrial animals and use of better/improved breeds of aquatic animals with better feed conversion (Tacon, Hasan and Metian, 2011). Formulated feeds are a significant factor of production costs, and therefore there is an incentive on technology development towards more affordable and sustainable feeds.

From a food security and nutrition perspective, and despite the number of jobs created by feed and fish oil industries,[26] a key question is whether some of these fish currently used for non-direct human consumption would not be more "efficient" if they were used for direct human consumption. Indeed, despite a relatively high efficiency of fish to convert feed into protein, as compared with other farmed animals (see Section 2.3.1), the rate of conversion of fishmeal to fish is still a source of concern. On average, for every kg of farmed fish produced, 1.9 kg of wild fish are needed. For omnivorous farmed fish, the rate of conversion is down to an acceptable figure of 0.2 to 1.41 kg of wild fish for 1.0 kg farmed fish. For carnivorous farmed fish, however, the rate is far higher: 1.35 to 5.16 kg of wild fish necessary to produce 1.0 kg of farmed fish (Naylor *et al.*, 2000; Boyd *et al.*, 2007).

Several of the higher-trophic level species (such as salmon, trout and shrimp) are species with high market values, and are almost exclusively sold to wealthier consumers from developed countries who are not necessarily nutrient-deficient. The small pelagic fish species (which are particularly rich in nutrients and PC-PUFAs) that are used to feed these higher-trophic-level fish and crustaceans as well as livestock could have a greater impact in terms of food security and nutrition if they were sold on the local markets of LIFDCs.

Local commercialization seems possible. Research to find alternate sources of protein for replacing fishmeal in aquaculture and livestock feeds would also certainly contribute to increase the availability of these fish for human consumption.

2.3.3 Challenges and opportunities of genetic improvements in aquaculture

Domestication[27] that allows genetic improvement of stocks in aquaculture is and will be a major driver of efficiency of production and thus an opportunity for lowering the ecological footprint of the sector (Dunham *et al.*, 2001). Although estimates of the extent of domestication and use of genetically improved stocks are difficult to make (Benzie *et al.*, 2012), one study estimates that about 20 percent of cultured species are domesticated and that the proportion of domesticated species increases with the total production (Bilio, 2008). However, in the absence of effective genetic improvement and breeding programmes, cultured stocks may even be inferior to wild populations due to inbreeding (Eknath and Doyle, 1990; Acosta and Gupta, 2010).

Future aquaculture development will likely concentrate on fewer species than at present. From an environmental viewpoint, genetic improvement offers great opportunities (Bilio, 2008; Browdy *et al.* 2012) but also some risks. It requires natural biodiversity to be conserved, at the ecosystem, species and genetic level.

Food security and nutrition considerations have not always been a key factor in germplasm conservation and genetic improvement programmes. Trade and commercial interests are major drivers of breed improvement programmes. The successful example of the genetically improved farmed tilapia (GIFT) programme, which began as a food security initiative to help small-scale fish farmers in developing countries improve productivity and profitability, shows that a food and nutrition security approach to breeding programmes can trigger substantial growth in aquaculture development and markets (Eknath, 1995; Gupta and Acosta, 2004).

[25] This decrease is primarily due to the reducing volumes of raw materials used for fishmeal, and the increased use of more cost-effective dietary fishmeal replacers (Davis and Sookying, 2009; Hardy, 2009; Nates *et al.*, 2009).

[26] An estimated 97 400 jobs have been created in feed fisheries, fishmeal/fish oil industries, fish/shrimp feed industries plus many more in the aquaculture enterprises using the feeds (Wijkstrom, 2012).

[27] Domestication in aquaculture refers to: (i) the selection of natural species of interest; (ii) the mastering of the biological cycle of fish (reproduction, production of juveniles, fattening); and (iii) the adaptation, by genetic selection/improvement, of these species to cultured conditions.

2.3.4 Technological opportunities and challenges in aquaculture

To maximize its contribution to food security and nutrition, aquaculture will need to overcome the following technological challenges (NACA/FAO 2000):

- the domestication of a large number of aquaculture species reducing the dependency on wild caught seed, this is key to reduce the impact of capture based aquaculture (see Section 2.2.2);
- the development of sophisticated, efficient farming systems and husbandry practices besides traditional integrated crop–fish–livestock production systems with reduced negative impacts on environment;
- improved feed management through development of cost-effective and nutritionally complete feeds with reduced fishmeal use, along with efficient feed management systems;
- the production of improved breeds through application of genetics and selective breeding programmes for a number of species;
- the application of biotechnology; and
- better fish health management practices through development of vaccines, diagnostic tools, etc.

Looking ahead at these challenges and at the potential to overcome them, aquaculture experts are now more confident that the era of severe environmental problems is behind; that aquaculture is on the road of sustainability (Costa-Pierce *et al.*, 2012), and progressively becoming a more accepted form of fish production, delivering on its original promise, long championed by development institutions (Muir, 1999), to alleviate poverty, enhance food security and promote economic development.

2.4 Economics of fisheries and aquaculture for food security and nutrition: scale and trade aspects

From an economic perspective two interrelated aspects are of particular interest here: the dichotomy between small-scale and large-scale units and the importance of international trade, both in fisheries and aquaculture, and what do they mean for food security and nutrition of different groups (such as coastal populations versus inland urban centres).

Both fisheries and aquaculture sectors are facing major economic changes driven by increasing global demand for fish and the subsequent growth in international fish trade. These in turn lead to the emergence of large-scale actors, often better integrated with food chains and international trade than are traditional small-scale units, with important economic and social consequences, from economic development to changes in work organization and job availability. Issues related to fish trade, to the relative contributions to food security of small-scale versus large-scale fisheries are challenging to assess, and remain controversial. Paramount in this context is the question of the economic organization of the sector, and of how small-scale or large-scale sectors contribute differently to local or international markets, and how they contribute to food security and nutrition of specific groups, depending on the context.

2.4.1 Scale of operations and food security

The introduction of this chapter has highlighted the great economic heterogeneity of the sector. What consequence does this have for food security and nutrition? How do small-scale and large-scale respectively perform in food security and nutrition terms? In the agricultural context the issue has already been discussed in the HLPE report *Investing in smallholder agriculture for food security* (2013b), which showed the important role of small holders in ensuring food security across the world.

Similarly to what was highlighted in the HLPE (2013b) report, the following narrative is also often found in the fisheries' literature: it presents small-scale fishers as the "poorest of the poor", asserts that they will never be competitive; they are too poor, vulnerable and marginalized. Eventually, as part of a "natural" modernization process, they will be replaced by larger-scale activities, which are able to engage in the global market. Only a few of the small fishermen will be entrepreneurial enough to evolve and the majority will disappear.

According to the concurrent narrative based on a series of key socio-economic indicators as in Table 4 and developed since 1980 by several authors (Thomson 1980; Lindquist, 1988; Berkes *et al.*, 2001; Pauly, 2006; FAO, 2012a; Kolding, Béné and Bavinck, 2014), small-scale fisheries generally make broader direct and indirect contributions to food security than large-scale fisheries: they make affordable fish available and accessible to poor populations and are key to sustain livelihoods of marginalized and vulnerable populations in developing countries. Yet small-scale fisheries attract less attention, support and resources both overall and per fisher than large-scale fisheries, which attract significant capital investment, and government assistance in terms of infrastructure and policy priority.

As exemplified with the above controversy, on which governments and development agencies have often predetermined views, the relations between scale and food and nutrition security have important policy implications.

We elaborate below on how this "*small-scale versus large-scale*" debate relates to food security and nutrition, in its four dimensions, availability, access, utilization and stability. Of particular relevance are how the sectors perform differently in terms of availability of fish, in terms of resource efficiency (including the issue of discards), in terms of access to fish resources and in terms of employment (especially among unskilled labour, and buffering functions), economic development and access to food.

Availability of fish

Although large-scale fisheries land more fish overall (approximately 50 million tonnes, compared with 40 million tonnes for small-scale fisheries), almost every fish caught by small-scale fisheries is destined for human consumption, compared to 80 percent in the case of industrial fleets' landings. Overall, it is estimated that, in absolute terms, small- and larger-scale fisheries contribute broadly the same amount to direct human fish consumption (about 40 million tonnes annually).

Table 4 Comparisons between small-scale and large-scale fisheries in previous studies

Benefits	Small-scale					Large-scale				
	1	2	3*	4	5	1	2	3*	4	5
Annual catch for human consumption (million tonnes)	~20	24	20-30	~30	~40	24	29	15-40	~30	~40
Annual catch reduced to meal/oils (million tonnes)	..	..	n.a.	..	..	~19	~22	n.a.	20-30	~15
Fish and other sea life discarded at sea (million tonnes)	n.a.	0	n.a.	..	~2	n.a.	6-16	n.a.	8-20	~8
Number of fishers employed (million)	> 8	> 12	50	> 12	> 30	~0.45	0.5	0.5	~0.5	~2
Fishermen employed for each 1 million USD invested in fishing vessels	1 000 - 10 000	500 - 4 000	..	500 - 4 000	200 - 10 000	10 - 100	5 - 30	..	5 - 30	3 - 30
Annual fuel consumption (million tonnes)	1-2	1-2.5	1-2.5	~5	3-15	10-14	14-19	14-19	~37	30-40
Catch (tonnes) per tonne of fuel consumed	10-20	10-20	10-20	4-8	3-15	2-5	2-5	2-5	1-2	1-2

Source: (1) Thomson, 1980; (2) Lindquist, 1988; (3) Berkes *et al.*, 2001; (4) Pauly, 2006; (5) Kolding, Béné and Bavinck, 2014. *Berkes *et al.*, incorporates both marine and inland fisheries.

Box 8 Contributions of large-scale small oil-rich pelagic fisheries to food and nutrition security: the examples of sardine and horse mackerel

Sardine – also known as pilchard – is one of the most important food items in the diets of South Africans, especially the poor.[28] The most common form is canned pilchard, which mainly comes in three recipes – in tomato sauce, in chili sauce or in brine. It is the ease with which it can be stored and transported, as well as its flavour, that explains the universal commercialization of the product. Another advantage is that canned sardines come in small tins of 155 g, 215 g, 400 g size, all priced below one USD equivalent in South Africa. It can be used it with bread, rice, potatoes, pap (maize meal) or even eaten it on its own. Canned pilchards can be found in all corners of South Africa right into rural areas. In a similar way, pilchards from Namibia are one of the largest fish import commodities in the Democratic Republic of Congo (Franz, Hempel and Attwood, 2004).

The horse mackerel industry is one of the most important fisheries in Namibia, largest in volume and second largest in value, and it has now also increased its employment. Namibia is also the dominant producer of horse mackerel (*Trachurus capensis*) in southern Africa. The industrial fleet involved in the exploitation of horse mackerel is partly local and partly leased Russian freezer trawlers. The bulk of the catch (approximately 80 percent) is transhipped and moved directly to markets in West Africa, only 20 percent being landed for re-export or to be processed ashore (FAO, 2007b). The species is very popular among locals as it is easily available and cheap and, with canning, could be conserved up to two years and easily transported. More than half of Namibia's population (56 percent) still live in poverty (below 2 USD per day), and 30 percent of the children are malnourished and live in densely populated areas in the central northern and north-eastern areas (FAO, 2007b). To help fish make a better contribution to overcoming malnutrition, the Namibian Fish Consumption Promotion Trust has been relatively successful in getting Namibians to eat more fish and, together with the nutritional benefits in canned horse mackerel, this makes it an essential product in addressing malnutrition in children.

The important result is therefore that the large number of small-scale fishers largely compensates the high production capacity of large-scale fisheries, making small-scale fisheries as important as the larger fleets in terms of availability of fish. In addition, a substantial proportion of these small-scale fisheries' landings is directed at developing countries' consumers in local or regional markets. This is especially true for inland fisheries, for which 94 percent of the small-scale inland production is consumed within the country of origin (Mills *et al.*, 2011).

In certain circumstances, larger-scale operations can also make significant contribution to food security and nutrition and provide food to rural and urban poor in developing or emergent countries, often in the form of canned fish. The large-scale sardine fishery in South Africa is a good example (Paterson *et al.*, 2010).[29] Consumption of small oil-rich pelagic fish (mackerel, herring, pilchard, sardine, anchovy) that are locally caught or imported is therefore particularly important in developing regions such as sub-Saharan Africa (see Box 8). Sardine, mackerel and other small-pelagic fish are not, however, the only species that can be exploited industrially and benefit the food security and nutrition of a large proportion of the population in LIFDCs.

Resource efficiency

Small-scale and large-scale fisheries also differ in the way they are more or less resource efficient for the same amount of output or fish made available.

Fish-catching operations are heavily dependent on fossil fuel and large-scale fisheries operations use about ten times more fuel per tonne of catch than small-scale fisheries (See Table 4).

Fish caught can end-up being dumped overboard (discarded) – either due to accidental by-catch of non-targeted species or legally undersized fish, or due to low quality, partial damage or spoilage – making them not being commercially worth landing. Here also small-scale fisheries and large-scale fisheries perform differently (see Section 1.5). In fact, some artisanal fishers (for example in

[28] In fact, even before they became a safe and easily transported food for soldiers and miners during the nineteenth and twentieth centuries, small pelagics such as these sardines have been commonly consumed in all areas of the world, especially in Latin America, Africa, Asia and Europe, and contributed significantly to the human diet, particular the poor (Alder *et al.*, 2008).

[29] South African sardines (*Sardinops sagax*) are caught on the west and south coast of South Africa and locally canned in six canneries. Established in the 1940s, the South African small pelagic industry, of which sardine is one of the main species, is the largest by landed volume and second to hake in terms of value (Hara and Raakjaer, 2009; Hara, 2013).

Mozambique) even collect and commercialize discards from large-scale vessels (Béné, Macfadyen and Allison, 2007).

Access to resource: large-scale fisheries' impact on local small-scale fisheries and food security and nutrition

The Governments of Indonesia, Malaysia, Sri Lanka and India introduced a trawling ban on their inshore fisheries with the objective of protecting the access to the resource of the smaller coastal fishers (Box 9). The actual outcomes of these decisions have been mixed. In Malaysia, although the trawling ban was just within the five-mile limit and rezoning of fishing grounds was based on gear types in an attempt to achieve more equitable redistribution of rights to small-scale fishers, in practice non-compliance and encroachment by the large-scale vessels and even foreign operators into the prohibited fishing areas are reducing the potential positive effects of the ban (Viswanthan *et al.*, 2001). In Sri Lanka, enforcement of the trawling ban policy has been shown to be problematic (Bavinck, 2003) and calls were made by several experts for better economic instruments to incentivize trawlers not to encroach in small-scale fisheries zones (e.g. Kuperan and Sutinen, 1998).

Box 9 Impact of large-scale trawling on small-scale fishing communities – some livelihood and food security implications

Large-scale trawls are massive funnel shaped fishing nets, fitted with a variety of heavy steel and wooden fixtures and ropes that are needed to keep the funnel mouth open. These trawls are towed behind powerful mechanized fishing crafts called trawlers. Large-scale trawls also require considerable mechanical power to be hauled on board. Trawls can be technically characterized as active, non-selective, intensive and efficient. Trawl nets are used to harvest fish species that inhabit the surface, mid-water or bottom layers of the sea/lake and are variously referred to as pelagic trawls, mid-water trawls or demersal trawls, respectively. Large-scale trawling entails huge capital investments, high running costs and when operated in quota management systems there are pressures to build up and maintain a track record to justify future quotas (Nedelec and Prado, 1990; Watling and Norse, 1998).

Large-scale pelagic trawls straddle temperate and tropical waters to harvest large shoals of small pelagic species within the Economic Exclusive Zones of many countries. Such operations are undertaken on a perennial basis. Along with their target pelagic species, they also harvest a significant share of larger-sized fishes and marine mammals, since the former is prey for the latter. Small-scale fishers would have caught these larger fishes using more selective and passive gears at the appropriate seasons. This again results in competition with local small-scale fishers, who are also often totally marginalized. In many quota-managed fisheries, these larger species are considered overexploited and hence denied to small-scale fishers; but the "incidental" catch by trawlers is often overlooked or condoned. Large-scale trawling for pelagic species, with notable exceptions, is most often linked to supplying fish-feed for industrial aquaculture (Naylor and Burke, 2005).

Large-scale trawl fishing, over time and presently, continues to be the major source of intense competition and conflict over both the resources and fishing space of the small-scale fishers. Large-scale trawlers also often physically destroy the small, selective fishing gear of the small-scale fishers causing considerable economic losses. Collisions with crafts of small-scale fishers are frequent, leading to loss of lives (Mathew, 1990). The four-fold violence – loss of access to resources and fishing space; destruction of their gear and loss of life – have an overbearing impact on the income, capital stock and lives of small-scale fishers and not just on their food security. In many countries this has also resulted in a dispossession of small-scale fishing communities from their customary relationships with the marine ecosystem. This has in turn deprived them of the way in which their cultural identity, sense of place and spiritual meaning are referenced.

In many countries around the world, large-scale trawling has been banned or severely restricted by the state at various junctures for one or more of the reasons enumerated above. The list includes, *inter alia*, Indonesia, Trinidad, Malaysia, Costa Rica, Brazil, Venezuela, Ecuador, Hong Kong SAR, India and Senegal. In these countries, the adverse ecological and socio-economic impacts inflicted on coastal small-scale fishing communities by large-scale trawling have led to considerable physical violence and consequently to disruption of their normal livelihood patterns resulting in income and food insecurities.

Large-scale trawling innately leads to greater concentration of the fish landings into large ports, often disrupting the erstwhile, decentralized settlements of small-scale fishing communities. While this at one level facilitates economies of scale, at another it results in barriers to entry to these ports for women fish sellers and processors from small-scale fishing communities who have lower financial endowments and limited access to large infrastructure and transportation facilities. The resulting loss of employment and income for women has a significant adverse impact on the food security of many small-scale fishing families.

Source: John Kurien and International Collective Support of Fishworkers, *personal communication.*

Overall, interactions between small- and large-scale fleets are often fuelled with conflicts over resources, fishing zones and gear. Large-scale fleets often encroach into fishing zones demarcated for small-scale fishers, destroy their gear and impact the seabed and habitats. In fact, the adverse ecological and socio-economic impacts inflicted on coastal small-scale fishing communities by large-scale trawling have led to considerable physical violence and consequently to disruption of small-scale fishers' normal livelihood patterns resulting in income and food insecurities (Box 9).

Impacts on employment, economic development and access to food

How the structure of the sector impinges on the accessibility dimension of food security depends on two key variables: for fish dependent populations, on the number of jobs and the level of income; for the consumers, on the price of fish.

Based on the latest update of Thomson's initial analysis, an estimated 32 million[30] people are directly engaged in some form of fishing activities in the world (Kolding, Béné and Bavinck, 2014). Over 90 percent of these are employed in small-scale operations. As such, employment in small-scale fisheries is several times higher per tonne of fish landed than in large-scale fisheries. As Figure 1 showed, the development of employment opportunities and the related income generation are critical for food security. In these dimensions, small-scale fisheries perform far better than large-scale fisheries. As shown in Table 4, for one million dollars invested, large scale fisheries generate between 3 and 30 jobs, and small-scale fisheries between 200 and 10 000.

There is also an important "labour buffer" function of the small-scale fishery sector in developing countries, given the common-pool nature of the resource-base. Quite a significant number of small-scale fishers or (female) fish traders are landless, and for them fisheries provide an important alternative to agriculture to support their livelihoods in the absence of better opportunities elsewhere.

Forms of aquaculture considered "small-scale" have received particular attention both in Asia (Friend and Funge Smith, 2002; De Silva and Davy, 2009) and in Africa (Harrison, 1994; Jamu and Brummett, 2004). However, in Africa the sector has broadly failed to build on the five decades of donor-driven pilot projects, this has led to question the conventional wisdom that direct participation in aquaculture by low-income producers should provide greater potential to alleviate poverty and contribute to food security (Brummett, Lazard and Moehl, 2008; Beveridge *et al.*, 2010). As a consequence, a growing number of studies and discussion papers on aquaculture in sub-Saharan Africa now advocate for investing in medium-size entrepreneurs and more commercial-oriented enterprises where fewer people are employed, yet with greater production development and national food security outcomes. Interestingly, the work of Dey *et al.* (2010) and Belton, Haque and Little (2012) in Asia came to a similar conclusion, namely that more commercial-oriented medium-size fish farmers may actually be better equipped to achieve the development of the sector together with enhancing its contribution to national level food security. While some scholars claim that medium-scale enterprises are more effective at addressing poverty reduction and food security the evidence on which they base their analysis (a few case studies in Bangladesh) might still be too narrow to allow for a complete generalization.

Investing in small-scale fisheries and aquaculture for food security and nutrition

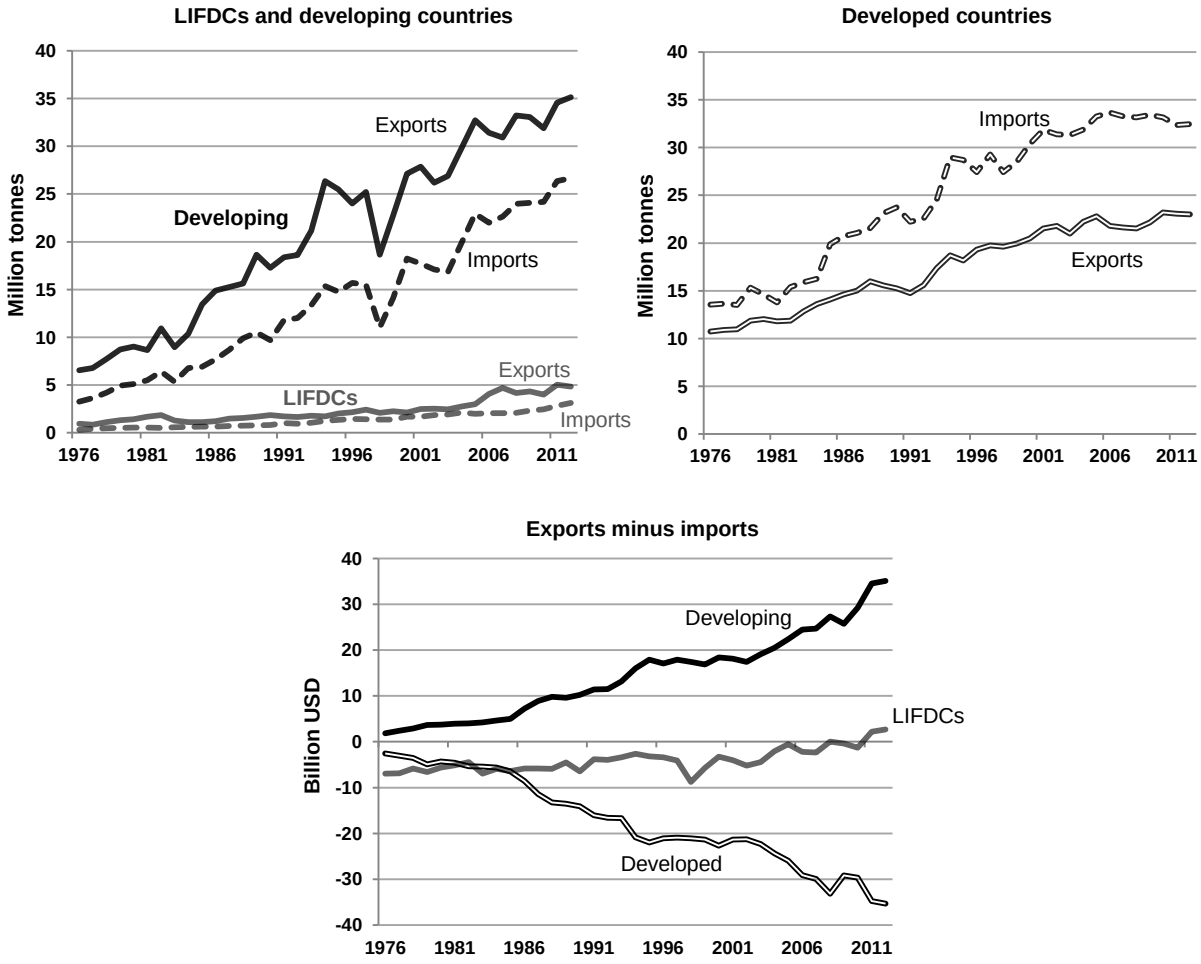
What to retain from these reflections on scale issues and food security and nutrition? First perhaps that some parallel can be drawn between agriculture and aquaculture, with the importance of small-scale structure in terms of global production. In Asia for instance 70–80 percent of aquaculture production comes from small-scale farming, including traditional forms of aquaculture. However, medium-scale aquaculture can show impressive productivity and contributions and might be a focus for future directions (e.g. Belton *et al.,* 2011b). Second, that small-scale fisheries, as compared to larger-scale fisheries, generally make broader direct and indirect contributions to food security: they make affordable fish available and accessible to poor populations and are a key mean to sustain livelihoods of marginalized and vulnerable populations in developing countries. There is therefore sufficient evidence to support a focus on small-scale fisheries for food security and nutrition interventions in developing countries. Third, large-scale fisheries can also in certain circumstances play a significant role to support food security and nutrition in developing countries, when their activity is oriented towards the production and commercialization of cheap, easily stored and transported (e.g. canned) fish for local or regional markets, as the example of the South African pilchard illustrates.

[30] This figure does not account for the people engaged in post-harvest activities (processing and trading).

2.4.2 Fish trade and food security

Fish is one of the most internationally traded foods (see Figure 9). In 2012, international trade represented 37% of the total fish production value, with a total export value of USD 129 billion, of which USD 70 billion of developing countries' exports (FAO, 2014a). Developing countries are well integrated in the global seafood trade, and the flow of seafood exports from developing countries to developed countries has been increasing (World Bank, 2013). In value, two-thirds of fishery exports by developing countries are now directed to developed countries (FAO, 2012a).

Figure 9 Fish trade in LIFDCs, developing and developed countries



Source: FAO Statistics and Information Branch of the Fisheries and Aquaculture Department.

An unsettled debate

The question of the impact of international fish trade on food security is not new – see for example Kent (1997). Currently, the scientific community remains divided between two polarized views, which one can found also in the literature concerning food commodities' trade.

One view, following the general theory on trade, is that international fish trade is good for poverty alleviation and food security. Fish exports, it is argued, can act as an engine of growth for developing countries endowed with large fish resources and provide them with important sources of hard cash flow, and overall positive economic returns, less international debt, extra government revenues, with opportunities to redeploy those for pro-poor interventions, including support for food security and nutrition. Exported fish income can also consolidate the import-export food balance at national level in counterbalancing spending on imported food to supply the domestic market, with better national food security accounts (FAO, 2007a; Valdimarsson, 2003; Bostock, Greenhalgh and Kleih, 2004; World

Bank, 2004; Valdimarsson and James, 2001).[31] Additionally the growth and employment effects of fisheries development (both in fisheries and in processing) can have positive indirect consequences on the food security and nutrition of the poor (Kurien, 2004).

The other view contends that international fish trade impacts negatively food security and livelihood options for the poor by taking away fish from the local economy and the local populations (Kent, 1997; Jansen, 1997; Abila and Jansen, 1997; Ruddle 2008). Global trade fishery policies are also said to lead to losses of local jobs and adversely affect the development of the domestic fishing industry (Jansen, 1997; Porter, 2001; Kaczynski and Fluharty, 2002; Abila, 2003). In parallel, it is also argued that fishing agreements signed between high-income countries (importers) and developing nations (exporters) usually take advantage of the developing states without providing fair returns (Kaczynski and Fluharty, 2002; UNEP, 2002). These different authors cite as evidence the apparently minimal economic benefits that developing states have managed to derive so far from these agreements (Porter, 1999; Petersen, 2003), pointing out the low rates of revenue reinvested in the sector and the low use of local processing facilities and infrastructure by foreign operations. Finally, some theoretical analysis suggests that revenues generated from fish exports in countries where the high-value market chain is dominated by a small number of firms, or by foreign investors, may "leak" out of the national economy in the form of capital flight and expenditure on luxury imports, leaving little to be reinvested in development (Wilson and Boncoeur, 2008).

So, does international trade of fish reduce or accentuate food insecurity of those in developing countries who are the most in need of the nutrients that these fish contain? In 2003, the Norwegian Agency for Development Cooperation (NORAD) commissioned a global study entitled *Fish trade for the people: toward understanding the relationship between international fish trade and food security* (Kurien, 2004) while FAO was organizing at the same time an expert consultation on international fish trade and food security (FAO, 2003). Ten years after Kurien's initial study, NORAD commissioned a follow-up study: *A value-chain analysis of international fish trade and food security with an impact assessment of the small-scale sector* (NORAD-FAO, 2013).

The last three most recent comprehensive reviews conducted independently converged towards the same findings (NORAD-FAO, 2013; Allison, Delaporte and Hellebrandt de Silva, 2013; Arthur *et al.*, 2013). Their conclusion is: at best, the evidence is unclear and contradictory – with some positive but also negative stories –, and at worse no strong/rigorous evidence exists to substantiate either of the two narratives. We are quoting here the conclusion of the Arthur's review:

> *"The findings that emerge from this heterogeneous body of literature are relatively inconsistent, reflecting essentially the lack of tangible evidence and the subsequent unsettled debate that characterises current discussions." (Arthur et al., 2013, p.17)*

The NORAD-FAO (2013) review based on 14 country case studies is slightly more assertive:

> *"relative to other players in the value-chain, small-scale fishers and fish farmers are receiving the least economic benefits in terms of amount of money earned for their products. Processors and retail markets were found to be receiving more of the distributional benefits of the value-chain due to their stronger bargaining power." (NORAD-FAO, 2013, p.19)*

Table 5, extracted from Allison, Delaporte and Hellebrandt de Silva (2013) – and derived from the initial Kurien (2004) global analysis – illustrates the situation. From the case studies included in the analysis, it appears that international fish trade has a positive effect on trade revenues (first column "impact on trade revenues") and possibly on job creation ("Impacts on fishers"; "Impacts on fishworkers'). Yet, these revenues do not seem to translate into positive outcomes in terms of local fish consumption.

[31] Note, however, that if these imported food commodities are nutrient-poor, there is a risk that they could contribute to, or even worsen, the nutrient deficiency that may already be affecting the population.

Table 5 Direct and indirect impacts of fish trade on food security

	Impacts on				
	Trade revenues	Fishers	Fishworkers	Local fish consumption	Fish resources
Nicaragua	+++	+++	++	+	---
Brazil	+	+++	++	+	---
Chile	+++	+	++	-	-
Senegal	+++	++	+ and -	--	---
Ghana	---	--	+ and -	--	--
Namibia	+++	+++	+++	+	+
Kenya	-	+	+ and -	---	---
Sri Lanka	++	++	++	+++	--
Thailand	+++	++	+++	+	---
Philippines	++	-	+ and -	-	---
Fiji	+++	+	+	+	-

+ small positive impact ++ significant positive impact +++ large positive impact

- small negative impact -- significant negative impact --- large negative

Source: Allison, Delaporte and Hellebrandt de Silva (2013), adapted from Kurien (2004).

The case of the Nile perch fishery in Lake Victoria shared between Kenya, Uganda and the United Republic of Tanzania in East Africa is particularly illustrative in this regard. The fishery generates high revenues due to the export of Nile perch to the European market, estimated to vary between USD 250 and 400 million a year (Thorpe and Bennett, 2004). However, export revenues do not necessarily translate into local food security outcomes, as those will depend on how these revenues are distributed, as well as on local situations. Fish income is not necessarily sufficient to counterbalance existing inequalities between households or regions. For example, Geheb *et al.* (2008) found that the Ugandan and Tanzanian districts located on the shores of the lake were, despite being closer to the fish resource, systematically displaying higher rates of stunted and wasted children than those in the rest of their countries.[32]

Despite creating a high number of jobs, the Nile perch fishery did not change the "highly unequal relationships between fishermen and the factories", with "income being very unevenly distributed" (Geheb *et al.*, 2008). This disparity of earnings and its role in impeaching positive local food security and nutrition outcomes of the activity is corroborated by the most recent NORAD-FAO report (2013), which shows average earnings for Kenyan exporters of Nile perch to be 250% more than the fishers' earnings.

Finally, the last column on the right ("Impacts on fish resources") is of concern to food security and nutrition. If sustainability of the resource is a *sine qua non* condition for food security (as was highlighted in Section 2.2), international fish trade seems to work against food security. International demand puts an additional pressure that, unless a country's fisheries are sustainably managed, may lead to overexploitation of the resources Some fish demands are related to the local dearth of fish in other countries, such as those in the OECD, that are restricting their own fish harvests in order to rebuild their stocks.

[32] It is not claimed here that fish trade is the reason for this situation, as many other factors could explain the fact that districts located on the shores of the lake are systematically displaying higher rates of stunted and wasted children than other districts. One reason could be precisely that it attracts landless people, and this case suggests that fish trade revenues, despite their magnitudes, have not leaked to the local population – or that these effects have not managed to overcome the other factors that led to these high levels of stunting and wasting in the first place.

Regional and local fish trades: pro-poor food security alternative

Demand for fish continues apace and enterprises in the sector are scaling up in ways similar to other food sectors. Fishing and aquaculture companies are engaged in mergers and acquisitions and vertical integration in the supply chain. Fish processing factories (often owned by companies in importing countries or multinational corporations) increasingly operate their own fishing vessels, hire their own crew or own fish-farming labourers, control other enterprises relating to fish supply acquisition, transport, distribution and export marketing (Jansen, 1997; Goss, Burch and Rickson, 2000; Crosoer, van Sittert and Ponte, 2006; Felzensztein and Gimmon, 2007). It is increasingly difficult for small-scale producers to keep up with the level of investments and technical conditions requested, e.g. compliance to HACCP procedures, or even to ecolabelling (Belton *et al.*, 2011a) reducing further their competitiveness and their chance to integrate the global markets (Gibbon, 1997; Henson *et al.*, 2000; Henson and Mitullah, 2004; Kambewa, Ingenbleek and van Tilburg, 2008).

As in other agri-food industries (Dolan and Humphrey, 2000; Gibbon and Ponte, 2005), this process leads to the exclusion from access to big markets of an increasing number of small-scale producers (fishers and fish-farmers) and small-scale fish-processors who were already operating on the margin of the export sector.[33] Contract farming arrangements, as in the shrimp industry for instance, can enable small-scale producers to access big markets (Goss, Burch and Rickson, 2000), however a fair implementation of contract farming requires appropriate conditions and rules to deal with the a priori unequal powers of the parties (HLPE, 2013b). Cluster farming arrangements (Umesh *et al.*, 2009) also offer similar options, with similar challenges for the smallest of the parties involved.

As private operators (often supported by governments) try to compete in the global economy, national and international policies and interventions have so far provided strong support to international fish trade. Although it is correct to point out that trade of high-value fish exported to international markets may not necessarily *directly* remove fish from the poor countries consumers' plates (since they sometimes involve different species and/or different products), it remains true that often little attention and support has been given to regional and domestic fisheries trade, despite its potential to improve food security and nutrition, especially for vulnerable groups (Béné, Hersoug and Allison, 2010; Allison, 2011). This situation could be compared to cash crops (coffee, cocoa, cotton) in agriculture.

An orientation towards more regional or domestic fish trade in developing countries, with more policy attention, carefully devised interventions, such as development, market infrastructure, and research, could however have positive food security and nutrition effects for both urban and rural poor consumers and small-scale producers for several different but related reasons explained below (Box 10).

Box 10 Benefits of local fish trade – the case of inland fisheries

Fish from common-pool resources are widely traded in local markets all over the world, contributing in large part to the local population's nutritional security. For example, food consumption surveys in Cambodia (Chamnan *et al.*, 2009) showed that 54 percent of the households consume fish every day, making fish the second ranked food after rice, in terms of frequency in the diet. The majority of these fish were purchased in the local markets and were originally supplied by small-scale fisheries (Chamnan *et al.*, 2009). It was also estimated that fish and other aquatic animals contributed on average 37, 51, 39 and 33 percent of the total protein, calcium, zinc, and iron intake, respectively, of the women in the area surveyed, confirming once again the importance of fish in the diet as a major source of protein and micronutrients but also the central role of local fish trade in ensuring access to this commodity (Chamnan *et al.*, 2009). In sub-Saharan Africa, the very limited information available also underlines the importance of local trade. In the Democratic Republic of Congo, for instance, data collected from the region of Lubumbashi revealed that households consume fish on average 5.17 times per week (31 percent consumed fish every day). In these areas, the species most frequently eaten are small dried fish from Lake Tanganyika or from smaller lakes in Zambia. These are traded and sold locally (Mujinga *et al.*, 2009).

[33] Gereffi, Humphrey and Sturgeon (2005), in their typology of governance in global value chain, observe that sectoral re-organization that leads to greater vertical integration is generally associated with increasing power asymmetry among the different actors of the chains, usually at the expense of the lower levels (producers).

First, it would create new market and development opportunities for the large number of small-scale, informal producers and traders, mainly women (see, for example, Nayak, 2007) who are usually marginalized by the globalization of fish trade oriented towards a small number of globally traded species. Indeed at domestic or regional levels, demand more easily exists for a diverse set of local species and products that small-scale fisheries can produce, and it is easier to commercialize those fish at these levels.

Second, it would help make more fish available locally, contributing to reduce a growing tension – which fish imports cannot alone alleviate – between the demand and supply of fish. It could thus contribute to help reduce the growing deficit between the demand for fish in developing countries and the supply, which so far is not satisfactorily filled by low-value fish imports. A major unknown is the extent to which actions to promote trade at these levels would impact – positively or negatively – on the supply and sustainability of local resources. In Africa, renewed focus on local trade of products might be a further stimulus for aquaculture, which has been contending mainly with production challenges. The increased demand for fish by the growing urban (and rural) population could boost investments of, for example, peri-urban aquaculture (Brummett *et al.*, 2011). In other cases where the local demand is currently low, new markets for the small-scale sector and related products could be searched for and promoted (NORAD-FAO, 2013, p. 23).

Third, it would allow small-scale operators, especially the ones operating at the fringe between formal and informal markets, to re-engage with the trade opportunities which were often barred by specific constraints such as stringent market conditions, inconsistent food safety regulations, unequal price negotiation power – in a sector where buyers are the ones who control the prices (e.g. as revealed in Viet Nam oyster farming by Pierce and O'Connor, 2014).

Fourth, it would allow counterbalancing the focus by many actors on the sole big export markets such as shrimp, tuna and white fish, and to alleviate the eviction effect it creates, as public and private support on export market can come at the expense of local market production infrastructure, local fish traders and local consumers (including national and international policy-makers' attention, research and development efforts, management support and donors' money), see Box 11. The re-orientation of fish towards regional and domestic markets would mean redirecting private and public resources as well as policy-makers' attention towards smaller-scale operators, with food security and nutrition impacts.

Box 11 Why an Africa-to-Africa trade?

Africa is a very important potential fish market for its own production. In Africa, more than 200 million people regularly eat fish (Heck, Béné and Reyes-Gaskin, 2007), and this figure is rising as the African population is growing fast and its urbanized segment is expanding even faster. It has been estimated that in order to maintain its current consumption level, Africa will need about 27 percent more fish per year in 2020 (WorldFish Center, 2005). To try to improve the African per capita supply in order to match the world current figure (14.2 kg per capita – excluding China) by 2020, another 10 million tonnes of fish would have to be supplied per year in Africa at current levels of production and export.

Although demand for fresh fish is increasing in Africa (in particular in urban areas), smoked, dried and low-value processed fish still represents by far the largest majority of the fish consumed by the rural populations as well as by the low-income classes in urban areas. These low-value fish are caught and processed by small-scale operators, working in labour-intensive, mostly self-employed enterprises. In fact, more than 95 percent of the women and men fishers and fish processors in sub-Saharan Africa are artisanal operators who trade fish locally (Overa, 2003; Gordon, 2005; Abbott *et al.*, 2007). In addition to the coastal full-time professional fishers and wholesale merchants, the seasonal inland fishers, fisher-farmers, part-time or full-time small-scale fish processors and traders have also to be included. This amounts to between 6 and 9 million households are engaged to various degrees in fish-related activities in sub-Saharan Africa (Heck, Béné and Reyes-Gaskin, 2007). Presently, however, the bulk of these small-scale, unorganized, and unskilled African producers and traders, face huge challenges to access the high-value fish trade activities, because of their difficulty to comply with the food quality standards requirements imposed by importing countries and which international trade institutions (e.g. WTO) accept as constraints to trade (Henson *et al.*, 2000; Gibbon and Ponte, 2005; Kambewa, Ingenbleek and van Tilburg, 2008). In addition, their local products may not be those sought on international markets, except in the case of small expatriate markets. The question is how to increase the bargaining power of the small-scale operators in both domestic and international markets.

Box 12 Challenges and opportunities to local food security benefits of large-scale, global trade oriented fisheries: canned tuna as an example

Tuna canning can contribute to food security in diverse ways depending on the way it is organized, and it provides a good example of diversified valorization of parts of the fish.

Canned tuna is extremely popular with the EU, United States and Japanese retailers as an easy-to-use source of protein and is of growing interest in the emerging markets of Latin America, the Middle East, the Russian Federation and South Africa (Hamilton *et al.*, 2011).

The canning industry generates a considerable amount of by-products and the practice of utilization of these by-products varies in different geographical regions.

Canned tuna grew significantly in the 1980s due to outsourcing operations towards low-cost countries with different policies for industrial management and located closer to the fishing grounds, such as Thailand, Philippines, Indonesia, Papua New Guinea and Ecuador (Miyake *et al.*, 2010). In 2011, the canned tuna production exceeded 1.7 million tonnes and Thailand produced 25 percent of the world's canned tuna with little local demand (Hamilton *et al.*, 2011). Most of the production is therefore exported.

Papua New Guinea is different as there is a significant demand for canned tuna in the local market – amounting to between 20 and 30 percent of the local production. All the fish is sourced locally from Papua New Guinea vessels and, with duty-free access to EU market, around 70 percent of the canned tuna is exported to the EU (Hamilton *et al.*, 2011). Foreign investors are keen to invest in more canning operations, but face challenges in terms of labour productivity, capital cost, scarce infrastructure (power and fresh water) and costs of transport.

Commercializing by-products of the tuna canning industry can also contribute to food security locally and in neighbouring countries. In Thailand, those are mainly utilized as tuna meal, tuna oil and tuna soluble concentrate. In the Philippines, most of the canning industry by-products are converted to tuna meal, but black meat is also canned and exported to neighbouring countries. Edible tuna by-products from the fresh/chilled tuna sector, like heads and fins, are used for making soup locally and visceral organs are utilized to make a local delicacy or for fish sauce production. Scrape meat and trimmings are also used for human consumption (Globefish Research Programme, Vol. 112 July 2013).

However, one should also note that some studies (NORAD-FAO, 2013) have pointed to the need of appropriate accompanying measures, organizational models and specific programmes, in order for the small-scale sector to benefit from the opportunities that a re-orientation to local and regional trade could offer. Indeed, a number of structural problems would also need to be addressed, which include: weaknesses in domestic markets, infrastructure limitations, contractual insecurity, poor governance, the illegal/unreported nature of part of the trade, and the inability of governments to benefit from it. Huge financial and capacity building investments are therefore needed to improve the poor quality and food safety conditions of all segments along the local, national and regional market chains: landing, transport, cold storage, distribution. Innovations on low-cost processing and preservation technologies adapted to the institutional bottlenecks and poor conditions that affect the vast majority of the post-harvest activities operated in Africa (e.g. lack of electricity, remoteness and lack of access to input supply) would have to be addressed as well. Much of this needs private sector investment.

Some examples like tuna canning in some countries (see Box 12) show how large-scale fisheries, generally turned to global trade, could also be linked to local food security outcomes – however with some important challenges linked to capital and infrastructure investment.

Contribution of fish certification to sustainability in all its dimensions and to food security and nutrition

Voluntary certification standards for sustainability were mainly developed to valorize and promote sustainable management of resources. They constitute an additional constraint for access to markets for small-scale fisheries. They could also integrate food security concerns in their standards.

The main focus of fish certification schemes to date is on ecolabelling and environmentally sustainable production. Other dimensions of sustainability and food security have not been given much consideration. When the concept of certifying sustainably sourced fish was introduced (Sutton, 1998; FAO, 2012a) early concern was expressed about the likely impact it could have on small-scale fisheries. Development experts felt that certification would allow large-scale fish distributors to control the resource, rather than small-scale producers (IUCN, 1998). At the time small-scale producers have been the focus of development efforts in governance decentralization (see Chapter 3).

Fisheries certified under the certification system of the pioneering Marine Stewardship Council (MSC), are predominantly from developed countries. In developing countries, a few fisheries have become certified, mainly those from larger-scale operations for export, e.g. Maldives pole and line skipjack tuna fisheries, South African hake, Fiji albacore tuna longline. More rarely, small-scale fisheries manage to achieve certification, with examples such as Viet Nam Ben Tre clam hand gathered, Mexican red rock lobster fishery (MSC, 2013). Using the MSC standards and FAO certification requirements (FAO, 2009b; FAO, 2012a) as a guide, several NGOs are working with local communities to help them move their fisheries management and harvest arrangements towards certification standards.[34] MSC does not explicitly mention social responsibility in its mission.

All certified fisheries are producing products for the export market. However, not all fisheries are at industrial scale, showing that certification and its companion processes can also help improve the economic and social returns for small-scale fishers, such as greater attention, services, better roads from government agencies, and helping protect access to the resources (MSC, 2013, reporting on the experience of the Mexican red rock lobster fishery).

The Aquaculture Stewardship Council (ASC), similar to MSC, was founded in 2010. It has now established eight standards (abalone, bivalves, freshwater trout, pangasius, tilapia and salmon) covering 12 species. The ASC mission mentions not just environmental sustainability but also social responsibility. In ASC standards, and following the FAO (2009b) guidelines, social responsibility concerns employee standards and does not go into depth on food security and nutrition dimensions.

In addition to MSC and ASC, a number of other certification-like schemes exist, such as the WWF Sustainable Seafood Consumer Guides with their red–yellow–green ranking of seafood, Friends of the Sea Sustainable Seafood, and Greenpeace Sustainable Seafood Scorecards. Many of these schemes bring out country-specific consumer guides that are mainly targeted towards environmental sustainability. As the guides are also central to sustainable seafood advocacy campaigns, their methods and scores may be influenced by campaign needs. They are therefore also moving slowly towards criteria that concern social responsibility because their major clients, such as the giant supermarket chains, are concerned about their reputation for corporate social responsibility (CSR). Again, social responsibility, to date, is more interpreted as fairness to supply chain labour rather than a full accounting for food security and nutrition.[35]

In summary, to date, certification has mainly been targeted at environmental sustainability (which is an essential but not sufficient element of food security and nutrition). Emerging market interest in social responsibility provides more opportunity to broaden the certification agenda to be inclusive of food security and nutrition considerations. Food security and nutrition, however, go beyond social responsibility as defined presently by CSR statements.

Certification will not alone solve food security and nutrition issues since its coverage of global fish production is small and since certification schemes are difficult to access for small-scale actors (FAO, 2014c). The interest of consumers and retailers for voluntary sustainability standards (Meybeck and Gitz, 2014) and the importance of markets' orientations and especially of large international markets, provides new opportunities for the development of voluntary standards and the integration of food security concerns in these schemes.

2.5 Social and gendered aspects of fisheries and aquaculture for food security and nutrition

2.5.1 Social factors affecting food security at household level

We documented in Section 1.2 how important fishing, fish farming and fish trading activities can be for generating income at household level. At the same time, the presence of large amounts of fish-generated cash does not necessarily mean that fishing or fish-farming households are food secure. Poverty profiles conducted in Côte d'Ivoire for instance suggested that food insecurity can be endemic among artisanal fishers in terms of availability and quality of food, and diversification of diets (Pittaluga, 2002, p. 3). Evidence from fishing communities living on the shore of Lake Victoria also

[34] See e.g. World Wide Fund for Nature (WWF) and others who use the Fishery Improvement Project process based on MSC – see WWF current FIPS list of nine fisheries https://sites.google.com/site/fisheryimprovementprojects/

[35] For example, the Sustainable Agriculture Initiative (undated) found that CSR statements of agro-industrial companies did not mention food security (or gender) among 19 issues in 14 independent standards and codes.

suggests that prevalence of under-nutrition can indeed be observed among small-scale fishers in some cases despite fish-related activities providing opportunities for income generation. This high level of under-nutrition among some fishing communities may be due to their location in marginalized remote rural areas where provision of – or access to – health systems is limited (Allison, Béné and Andrew, 2011; Mills *et al.*, 2011; Béné and Friend, 2011), and/or because of their particularly high exposure to diseases including malaria, water-borne diseases (e.g. schistosomiasis), STDs and HIV/AIDS (Allison and Seeley, 2004; Béné and Merten, 2008; Parker *et al.*, 2012), which undermine the health benefits from consumption of fish (e.g. Seeley and Allison, 2005; McPherson, 2008).[36]

When households lack food, fish produced from aquaculture or captured from the wild are sold in order to purchase essential, cheaper food items (Karim, 2006; Islam, 2007). For instance, in the Lake Chad area, the poorest fishing households were shown to consume a lower proportion of their catch than the better-off households and instead sell most of their fish in order to be able to purchase cheaper foodstuffs – in this case, essentially millet (Béné *et al.*, 2003). The direct contribution of fish to food security for the poorest households may therefore be lower than generally thought, preventing these households from accessing the whole nutritional benefits that fish offers.[37] This suggests that in certain cases lack of access to food may lead poor households to try to secure their energy intake at the detriment of their own nutritional status.

In other circumstances, where markets are inefficient (e.g. due to poor infrastructure, lack of access to inputs and credit) or where fish resources are in decline, the incomes from fishing may even be insufficient to purchase more than the basic starch-based staples, leaving fishing communities no better off nutritionally than non-fishing communities. Iron deficiency, for instance, may be observed in some fishing communities, even if fish is recognized to be high in iron. In India, for example, two large studies have documented malnutrition of women in coastal communities. One study found that more than 70 percent of the fisherwomen in the coastal communities of Andhra Pradesh, Karnataka, Kerala and Tamil Nadu are anaemic, even though they spent about 60 percent of their earnings on food (Bentley and Griffiths, 2003). A second large study (Vijaykhader *et al.*, 2006) specifically focused on the nutritional status of fisherwomen and found, similarly, that 72 percent were anaemic, moderately malnourished; and 2.9 percent severely malnourished. In the first study, there was no link to eating habits, but the poorer the family, the higher was the occurrence of anaemia.

Finally, primary causes of under-nutrition are more complicated than just dietary intake, with other factors such as child-care practice or diseases being potentially important (UNICEF, 1990). For instance, prevalence of underweight children under age five in South Asia is perceived to be due to low social status of women (von Grebmer *et al.*, 2009). There is no reason to believe that fishing or fish-farming communities are less exposed to these risks than the rest of the population. In fact, the very high exposure and vulnerability of fishing communities to diseases mentioned above suggests that fishing communities are in fact probably facing a higher risk of under-nutrition than the rest of the population.[38]

Linkages between social aspects of fisheries and aquaculture on the one hand, and food security and nutrition on the other hand remain a key area for further research, studies, and data collection, in order to overcome the scarcity and point-based character of currently available evidence, and especially to cover the gender and nutrition dimensions of the fish-food security linkages.

2.5.2 Gender, food security and nutrition

Food insecurity and malnutrition arise from inequalities, including those related to gender. In the fisheries literature, “gender” and “gender and development” papers focus mainly on women, ignoring

[36] These mixed results are in agreement with the wider literature (outside fisheries); while it is recognized that increases in income are usually associated with increases in energy intake from staple foods, especially for the poorer households and with non-staple food consumption, especially meats (Alderman 1986), the literature has also established that increase in household income, while improving access to food, does not always directly contribute to improved nutritional well-being (von Braun *et al.*, 1992). Indeed, the additional income may be spent on foods of low nutritional value or even on non-food items (alcohol, cigarettes, etc.), especially if the additional income comes through men in the household (Quisumbing *et al.*, 1995). Intrahousehold differences to access to fish and other food are important in food security and nutrition.

[37] This is especially likely to be the case where access to traded food is possible. In other places where cash and access to market is more limited, the trend seems to be reverted and poorer households consume a larger share of their own catch.

[38] Prevalence of these diseases is often higher in fishing communities than in the rest of the population (Kissling *et al.*, 2005).

that men's conditions and behaviour are also critical in social and gender relations; and that men can also suffer from food and nutrition insecurity because of gendered fish sector work.

The mention of gender in a fisheries context evokes typically themes of the divisions of fisheries labour, women's roles in productive and reproductive spheres, women's agency in the sector and women in fisheries and aquaculture institutions (Harper *et al.*, 2013; Williams *et al.*, 2012a). Deeper analyses are emerging, however, revealing the dynamics of gender issues of significance to food security and nutrition, such as the importance of the intersections between gender and social factors such as culture, economic class, religion and social status ("intersectionalities") and the gendered impacts of the massive sectoral change such as modernization, mechanization, market concentration and labour cost squeezes, as well as the impacts of acute disasters. We distinguish here between the relevance of gender to fish and food security and nutrition for: (a) people in the general population (consumers); and (b) those within fish supply chains (producers, processors, traders) – who are more directly affected.

General population: gender, fish, food security and nutrition

In the general population, gender is important in at least two ways: nutrition and access to fish.

Gendered aspects of the role of fish in food security and nutrition include when balancing the benefits of eating fish by gestating women on foetal development and for children on childhood brain development and the risks of damage from dioxin and methylmercury contamination (see Chapter 1 in this report). In 2010, FAO and WHO (FAO/WHO, 2011) reviewed these risks and benefits and concluded that, overall, fish provide people with energy, protein and a range of other important nutrients, including the long-chain n-3 polyunsaturated fatty acids (PUFAs). With regard to maternal and childhood fish consumption, the report recognized that, in most studies, the benefits of PUFAs outweigh the risks of methylmercury to women of childbearing age and that maternal fish consumption lowers the risk of suboptimal neurodevelopment in offspring compared with the offspring of women not eating fish (FAO/WHO, 2011).

Awareness of the role of fish in food security and nutrition is rarely adequately emphasized in food security and nutrition discussions. Without awareness about the beneficial nature of fish as a source of good protein and micronutrients, it may not be consumed. In developing countries, an important condition to ensure this awareness is female literacy, as well as available relevant informative material.

Although not studied in the general population, intra-household difference in access to fish as food is likely to differ by gender because fish is often higher priced than other food, more volatile in price and seasonally scarce. In times of scarcity, the whole household may lose access to fish, but women are likely to be the more severely affected due to their relatively subordinate positions in most societies, their lower incomes and control of household funds (Maxwell and Smith, 1992; Quisumbing *et al.*, 1995).

During times of crisis and disaster, and depending on the nature and location of the crisis, women and men experience different risks and opportunities during and after, including access to food and relief services (World Bank/FAO/IFAD, 2009; see also gendered change below). Specific information on the role of fish in these circumstances is not available. Due to its price and the perishable nature of many fish products, fish typically are not part of the food supplies used in disaster or famine relief. WFP (2013) recommends including animal protein in famine relief diets, but milk-based ingredients rather than fish or meat are given in sample formulated foods. The WFP guidelines emphasize the importance of nutritional deficiencies experienced by lactating women (e.g. iron, vitamin A, fatty acids) but do not address the role that fish could play.

Fish linked communities: gender, fish, and food security and nutrition

Within the population groups directly linked to the fish production and supply chains, gender has a central role in the different mechanisms and processes that determine food security and nutrition – availability, access, stability and utilization and nutrition adequacy. Gender, along with intersectional factors such as economic class, ethnic group, age or religion, influence food security and nutrition in myriad ways. Five priority ways are explored here: the gendered patterns of fish sector work, gender blindness in fish sector policy, gender within the household, gendered change within the sector and intersectional issues.

Gender and work in the fish sector

The work that people do and how it is rewarded has a major impact on their own food security and nutrition and that of those around them. Thus, to better understand the gender patterns of work, gender disaggregated data should be systematically considered.

Most work in fisheries and aquaculture is highly differentiated by gender. Women work in nearly every type of fish sector activity but their typical roles are much less visible than those of men, often leading to the perception that fisheries and aquaculture are men's domains both in developed and developing countries (Davis and Nadel-Klein, 1992; Bennett, 2005; Williams, Nandeesha and Choo, 2004). Men are dominant in the fisheries and aquaculture direct production work. Much of women's work, such as gleaning, diving, post-harvest processing and vending, is not recognized or is poorly recorded, despite its economic and other contributions (Weeratunge, Snyder and Choo, 2010). For example in Indonesia, the Bureau of Statistics collects and produces fisheries related data for each province on the number of fishers employed either on a full-time, part-time "major" or part time "minor" basis, but this generally refers to male fishers only (see Fitriana and Stacey, 2012, p. 160). Likewise, in Chile, the fish sector activities of many women are not registered as formal activities and so women cannot access sectoral support (Araneda *et al.*, 2005). In many other countries also, women cannot register as fishers and so are outside the systems of sector support and capacity development. However, the recent shift to taking a whole-of-supply-chain approach means that the gender dimension in fisheries is now more visible as more women workers are likely to be counted (FAO, 2013).

Women and disadvantaged groups are also getting organized for their rights, but often have to build their own capacity to take advantage of new laws that allow them access, as professional fishers, to benefits (e.g., in Brazil, see Miranda and Maneschy, 2010; Pierri and de Azevedo, 2010).

The first comprehensive attempt to estimate the number of fishworkers found that near half of the 120 million people who work in the capture fisheries sector and its supply chains (56 million or 47 percent) are women (Mills *et al.*, 2011). The vast majority of these work in association with small-scale fisheries in developing countries. Post-harvest workers (84 million), many of whom are women, outnumber the harvest workers (35 million).[39] In small-scale inland fisheries and large-scale marine fisheries, women outnumber men, in the latter case due to the number of women working in processing (Table 6). However, small-scale fisheries and supply-chain jobs outside production are the most poorly recorded, so the actual percentage of women may be even higher.[40]

Women's participation varies greatly from country to country, e.g. over 70 percent in Nigeria and India, and 5 percent or less in Bangladesh and Mozambique (Table 7, Mills *et al.*, 2011).

Comparable estimates are not yet available for the 30 million aquaculture sector workers. However, the FAO National Aquaculture Sector Overview Fact Sheets show that women's participation varies by country and type and scale of enterprise, e.g. typically being more active in small-scale operations, hatcheries and post-harvest processing (Williams *et al.*, 2012b). Overall, less information is available on gender in aquaculture compared with that on gender in fisheries.

Table 6 Global capture fisheries employment by gender

	Small-scale fisheries			Large-scale fisheries			Total
	Marine	Inland	Total	Marine	Inland	Total	
Number of fishers (millions)	13	18	31	2	1	3	**34**
Number of post-harvest jobs (millions)	37	38	75	7	0.5	7.5	**82.5**
Total	50	56	106	9	1.5	10.5	**116.5**
Percent of women	*36%*	*54%*	*46%*	*66%*	*28%*	*62%*	***47%***

Source: Mills *et al.* (2011).

[39] A more recent work estimates the total number of direct and indirect jobs (including ancillary – i.e. manufacturing, marketing and equipment repair –, processing, and trading) created by marine fisheries to be around 260 millions (Teh and Sumaila 2013).

[40] Statistics on participation in fish supply chains not only undercount women, but also indigenous people, and men in certain jobs.

Table 7 Women in fisheries workforce in developing countries

Country/Case study	Total workforce ('000s)	Percentage
Nigeria	6 500	73%
India	10 316	72%
Cambodia	1 624	57%
Ghana	372	40%
Senegal	129	32%
Brazil	493	30%
China	12 078	19%
Bangladesh	3 253	5%
Mozambique	265	4%

Source: World Bank/FAO/WorldFish (2012).

As in most economies subject to increasing globalization, women's income in fisheries and aquaculture is usually lower than that of men, at least partly because women are locked into less influential and remunerative work (Neis *et al.*, 2005). Even where women are the majority, such as in processing factories, few rise to the supervisor and management levels. In a study of ten factories in Sri Lanka, De Silva and Yamao (2006) found that those who did rise were either better educated than their male peers or were wives of top managers.

Gender-blindness in fish sector policy and practice

Gender disaggregated data are not routinely collected and, partly as a result of this, little policy attention is given to the gender dimension in the fish sector. All major recent normative instruments, starting with the Code of Conduct for Responsible Fisheries, have been gender-blind (Williams *et al.*, 2012c), thus effectively precluding substantive attention to gender in development policies and programs at global and national levels.

Small-scale fisheries, women's livelihoods and food and nutritional security tend to be strongly linked, yet women's sectoral needs tend to have been ignored. Sectoral development assistance was channelled to men in efforts to mechanize and modernize fishing and aquaculture; while general gender/women's programmes focused on women's basic needs – see for example Ram-Bidesi (2008) in the case of Pacific island fisheries.

Although gender-blind, policies can have large gendered impacts. The thrust on mechanization and motorization, for example, has negatively affected women. Landings have moved away from beaches to centralized landing centres, reducing women's access to fish for domestic consumption and sale. Lacking credit and infrastructure, women get access to only low-value fish, with lower profit margins, or to low-paid jobs sorting/drying fish. The storage of fish on a small scale is done mostly by women but most cold storage facilities are managed by men. Policy-makers often ignore or are unaware of the gendered consequences of such sectoral trends.

Some conditions of work in the value chain present problems because they are not changing, e.g. outdated market infrastructure, as well as threats from impending change, e.g. construction of new markets. Presently, the conditions at many fish markets and harbours/landing centres have poor access to basic facilities, for instance, hygiene facilities (the lack of toilets leads to women often suffering from urinary infections). As argued in the Section 2.4.2, few efforts are devoted to promoting women's access to local, national and regional markets, removing basic impediments and improving working conditions. In Mumbai, for example, market infrastructure is confronted with pollution problems and competing demands for real estate; different groups of women marketers cannot agree on common needs; and men's unemployment strains gender relationships (Peke, 2013).

In the last 30 years, periodic efforts have been made to initiate global fish sector policy and practice on women/gender but most were not sustained beyond the time frames of the projects under which they were initiated. These efforts often focused directly on gender and food security and nutrition, e.g. the Sustainable Fisheries Livelihood Programme (FAO, 2007c), and the Regional Fisheries Livelihood Programme (Lentisco and Alonso, 2012). In 2011, FAO conducted a workshop to help develop the

way forward and is currently engaged in internal follow-up (FAO, 2012a). For the first time, gender was highlighted as a special theme in the 2012 FAO State of World Fisheries and Aquaculture (FAO, 2012a).

Another consequence of gender-blindness in the fish sector is that little has been invested in research for development to help understand the problems of gender inequality and how to address them. What is invested in gender research mainly focuses on women, with very few studies examining the relevance of masculine behaviour (Allison, 2013), gender relations and their impacts on food security and nutrition.

Development projects incorporating gender have tended to focus on narrow economic approaches for women's empowerment. The support is directed at giving women income-earning opportunities, often only at the welfare level and ignoring deeper social and cultural factors. Choo and Williams (2014, forthcoming) reviewed 20 studies and five gender and fisheries symposia dating from 1998 and found that many projects ignored critical systemic power factors. Some development interventions merely overburdened women with additional work. To move up the empowerment ladder, women needed legitimate access and secure rights to space and resources, plus training, professional recognition and visibility. Culture tended to either support or limit women's empowerment, but few interventions sought to change it. Most importantly, empowerment takes time and fisheries development agencies often have to undergo deep organizational change in order to address gender adequately (Debashish *et al.*, 2001, Nowaza, 2001).

Gendered arrangements within the household

Cultures and local practices create an infinite set of variations of the theme of households (Porter, 2012). Households rarely operate as single units and often do not keep common financial accounts. From the results of several studies, women are more likely to be the ones in the households who feed, clothe and educate children and dependent family members (Quisumbing *et al.*, 1995; Porter, 2012). When resources and assets are scarce, the negotiated use of income and assets can be critical to survival. Porter (2012) examined these issues in a coastal fishing community in the United Republic of Tanzania in which women used and negotiated their scarce resources to support their own separate households and, at times, those of a shared husband/partner.

These intra-household complexities have important consequences when the fish sector development strategies are often aimed at directing assistance to male-dominated activities such as new fishing and fish-farming technologies. Such assistance may have little positive impact on household food security, as it is not also directed to help the women who are more likely to give greater priority to food security.

Finally, female-headed households tend to be significantly poorer and hence more likely to suffer food insecurity than male-headed households. For example, in a Cambodian study of over 5 000 fishing-livelihood-dependent households, Ahmed *et al.* (1998) found that literacy levels were higher for male (85 percent) compared to female heads (57 percent) and female-headed households lagged behind male-headed households on economic activity, numbers of children in school and housing standards.

The sectors' rapid changes and gender considerations

The fish sector has undergone rapid structural, economic and resource change and continues to evolve. Most drivers of change, whether internal or external, are gender neutral, but result in highly gendered outcomes (Neis *et al.*, 2005). Disasters in fish-linked communities are another form of very rapid change that may also have gendered impacts on food security and nutrition, despite or because of how post-disaster relief is delivered.

Claims that many new fish sector jobs have been created for women have often proven, on balance, weakly founded because the transformation often also removes some jobs. For example, local women lost much of their traditional fish processing work in Gujarat (India) when industrial fishing and processing took over. Poorly paid migrant women – rather than local women – were recruited from Kerala and Kanyakumari for the factories, (Nayak, 2007), and the status of women workers remained low (Gopal, Geethalakshmi and Unnithan, 2009).

Much fish sector work has become feminized and casualized, making estimates of gains and losses in jobs difficult to validate. Women may lose the access to fish for trading that they previously enjoyed, but unpaid and uncounted female labour is likely to increase (e.g. MacDonald, 2005). As enterprises gain in scale, e.g. industrial fish farming, total employment may decrease and activities shift their locus due to the takeover of family fish farms. In fisheries, many vessel operators reduce their operating costs by using predominately lowly paid migrant workers. This can add to risks for the

workers' safety because they may not be trained sufficiently in sea safety, e.g. on trawlers and purse seiners in Thailand (Chokesaguan, Ananpongsuk and Wanchana, 2009). Indeed, working conditions for the mainly male workers on fishing vessels have received the attention of the International Labour Organization (ILO), which with FAO and the International Maritime Organization (IMO) approved the ILO Convention No. 188 on Work in the Fishing Sector (2007). However, seven years after its agreement, only four countries have so far ratified the Convention.

In addition to globalization as a powerful form of change, declining fishery resources can also cause several kinds of gendered change. The most vulnerable households are usually those in which women and men both participate in a fishery in decline, e.g. in the Pantar islands, Indonesia (Fitriana and Stacey, 2012). As fishery production decreases, women's work such as fish processing and selling becomes less visible, but their social support in the household more critical. Within stressed households, domestic violence, usually undocumented, becomes more prevalent but, due to the social stigma, is kept private. The repercussions of this for household food security are not documented. Men displaced by fishery crises often move into work and social spaces that overlap with those of the women, as Turgo (2012) described in the fish market space in a Philippine town.

Gender and post-disaster relief

Different disasters have different impacts on women and men and usually greatly impact small-scale fishing and aquaculture communities. In Guimaras, Philippines, the large oil spill in 2006 from the sinking of the tanker *Solar I* affected the coastal livelihoods of nearly 20 000 people. Food security of women was more seriously impacted than that of men. The disaster temporarily eliminated women's inshore fishing and onshore activities (Defiesta, 2013). Emergency responses gave relief and rehabilitation work preferentially to men, relegating the women and girls to greater reliance on household and outside work, and exposed them to greater domestic violence at home and sexual harassment in the emergency shelters (Badayos-Jover, 2013). Overall, this coastal disaster exacerbated women's local economic marginalization.

In mid-June 2008, Typhoon Frank (or Fengshen by its international name) cut through the Philippines, hitting hardest in and flooding four provinces of the Western Visayas. Fishing and farming were the main activities of those affected (Suyo *et al.*, 2013). Unlike the *Solar I* oil spill, typhoon Frank affected household members equally and women and men worked in complementary ways to secure and protect the family assets, but gender differences did emerge in preferred coping and future avoidance mechanisms. Women gave priority to family physical and financial safety while men undertook more outward directed facilitation and managerial actions to protect the family.

Coastal, riverine and lacustrine communities are often highly vulnerable to natural disasters because of their waterfront locations. Relief and reconstruction efforts can both help and hinder recovery. Targeting the rehabilitation efforts at the right scale and meeting local needs are critical to food security and nutrition. In major coastal disasters such as the 2004 Indian Ocean tsunami, the massive rehabilitation efforts of international and other agencies became competitive rather than collaborative (Stirrat, 2006; Tewfik *et al.* 2008); long-term development needs at the micro-enterprise scale and immediate reconstruction targeted at large infrastructure, including boat building, could be in conflict (Regnier *et al.*, 2008); and relocation of fishing communities sometimes resulted in them losing their original coastal sites in Sri Lanka (Ingram *et al.*, 2006). Where local needs were properly diagnosed and supported by national as well as international efforts, greater success is reported. For example, in Aceh in Indonesia, the local *tambak* ponds, used for extensive shrimp farming, were rehabilitated successfully by using technology developed in earlier ACIAR-Indonesian projects and delivered to farmers through national technical partners with international support (Martin, 2008).

Intersectional issues

In the fish supply chain, gender is one of the key human dimensions that can affect food security. It intersects with class, age, religion, migrant status and other factors, creating combinations of factors that can influence the chances of some groups becoming food insecure and the reverse. In that context, food security and nutrition risks are not limited to women in small-scale operations. It can also occur (for women and men) on larger, industrial vessels, and in onshore processing factories. These employ many poor people, often immigrant workers earning meagre incomes and working under difficult conditions. Most immigrant labour is low-paid and hence implies a food security risk. This can be compounded by hazardous working conditions.

A preliminary study of transnational organized crime in the fishing industry postulated that the decline of coastal fish stocks and the consequent food insecurity of dependent communities was a factor in providing men and youths as forced labour on fishing vessels (de Coning, 2011). The study found that

the male victims of human trafficking became forced labour for “fishing vessels, rafts or fishing platforms, in port, or in fish processing plants”. Food security and nutrition may not be assured for these workers, and little is known about the food security of those left at home.

Women and children could be forced into prostitution at ports and in processing plants. Even if not trafficked, women are reported to be at risk of sexual exploitation in some processing plants (Nishchith, 2001) or even at landing sites (Béné and Merten, 2008). Women and men often work in processing plants under conditions hazardous to their health (e.g. Nag and Nag, 2007); women may be more affected than men (Jeebhay, Robins and Lopata, 2004).

In addition to human trafficking and forced labour, immigrant contract labour (women, men and children) is an increasing part of national fish industries, e.g. in Thailand, 75 percent of male labourers on Thai fishing vessels are Burmese and Cambodians, and the remainder are Thai nationals (Chokesaguan, Ananpongsuk and Wanchana, 2009).

Age is also an important intersectional factor. Even girls and boys (under age 18 years) labour in large numbers in fisheries to secure their own and their families’ food security (FAO/ILO, 2013). From limited data available (Allison, Béné and Andrew, 2011), the majority of child workers are boys. Often the work is hazardous but almost invariably it brings life-long detriment to the children as it limits their opportunities for access to regular education and later work opportunities and social advancement – all factors contributing indirectly to food insecurity.

We have seen in this chapter that the potential contribution of fish to food security and nutrition can be enhanced and optimized on the long term by ensuring the sector’s sustainable development in the three dimensions: economic, environmental and social.

The analysis of the relations between the three dimensions of sustainability and the four dimensions of food security and nutrition points to two crucial factors.

First of all, sustainable management of resources, fish stocks, but also water and land, especially coastal and riverine areas, is crucial to support and ensure food security and nutrition, particularly on the long term.

Second, access to resources and the way resources and incomes derived from them are distributed, between countries, along food chains and even inside households, taken into account gender considerations, are essential to ensure effective food security and nutrition.

These two points call for a stronger attention to governance of the sector and of the resources on which it depends.

3 GOVERNANCE OF FISHERIES AND AQUACULTURE FOR FOOD SECURITY AND NUTRITION

This report has raised two important questions. How well fish and fisheries can perform for improving food security and nutrition? How can the sector overcome the sustainability challenges in order to enhance and optimize the contribution of fish to food security and nutrition? We have seen in the previous chapter that answers to these questions lie in many domains, ranging from technology to social issues, including the management of resources, trade orientations and rules, organization of value chains, development policies, etc.

Generally there is no pre-defined, unique solution to the above questions, and the previous chapters have presented a range of different options, which could be applied and mobilized for different national and regional contexts.

The way these options are identified, chosen, designed and implemented is determined by the governance of the sector.

3.1 Overview of governance issues of fisheries and aquaculture

Governance could, in a simplified way, be summarized as being composed of three elements: the rules themselves (including formal and informal ones); the way/process by which they are established and who contributes to it; the way they are implemented (and monitored etc.) and who is involved.

The sector is characterised by a complex web of rules and access rights of diverse natures, international rules, national rules and local and customary rules and practices. It is also characterized, probably more than the rest of agriculture, by the great heterogeneity of actors often competing for the same resources. They are also, probably more than other agricultural activities, working in an environment and with related resources used by other economic activities. These three characteristics make the governance of fisheries and aquaculture, and the consideration of food security and nutrition objectives within it, particularly challenging.

Historically, the debate was centred on a main issue: how to reconcile the environmental sustainability of the resources with the economic outcomes of the related activities (Beddington, Agnew and Clark, 2007). However, as shown in Chapter 2, the distribution of the outcomes of fisheries and aquaculture (fish and income), and the social aspects of it, are key determinants to ensure food security and nutrition benefit for producers and for consumers. Adding food security and nutrition, as well as social objectives, complexifies the already difficult issue of reconciling economic and environmental dimensions.

These issues raise a number of governance questions such as: How do people decide, and who decides what needs to be done at different levels and how the sector can be organized? What are the main arrangements within the fisheries sector? What are the main arrangements outside the fisheries sector which influence it? What are the governance challenges for fisheries and aquaculture to deliver on food security and nutrition goals? How do existing governance arrangements and schemes integrate these concerns and what evidence do we have to assess their performance in relation to these challenges?

Fisheries are common pool resources and their sustainable management presents, in addition to the peculiar characteristic of the management of “commons”, additional complexities due to specific difficulties to monitor and control resources and control how they are exploited.

Aquaculture depends on access to land and water (fresh or sea water), and on security of tenure, which can create specific challenges, including for capture fisheries, given the growth rate of the sector.

Four aspects are key for the sustainable management of the fisheries and aquaculture sector:

1. for fisheries, the measurement of fish stocks and status of resources,
2. the attribution and recognition of rights over fish, water and land resources,
3. the management of the system (including modalities of monitoring and control, etc.)
4. the determination of a supportive environment (policies, programmes, support measures) for the various actors.

These points require adequate governance, and governance which accommodates the increased complexity of the expected outcomes: economic, environmental, economic and social sustainability, as well as food and nutrition security objectives.

Access to fish, land and water resources, the distribution of fish benefits and the degree to which these benefits are effectively shared (including who gets the fish income, as well as who gets to eat the fish, given the market forces) are important governance considerations. Institutional and market mechanisms influence the ways diverse individuals and groups (here primarily poorer and marginalized people in the fisheries and aquaculture supply chains, but also poor consumers) will gain, lose, or be excluded from access to fish resources and other productive supply chain assets, or to fish as a food commodity.

Because governance occurs at different levels (from international to local), we use these levels as a way to organize the discussion in this chapter. The analysis will be centred on the governance of the sector, taking into account as appropriate the other governance mechanisms outside the sector, which impact it or condition the food security outcomes.

Very broadly speaking the global landscape of principles and rules governing the sector could be described as organized in 4 levels, from the global to regional, national and sub-national levels (including provincial, district and local levels);

The global level (Section 3.1) is the one of international treaties, conventions, agreements and instruments of binding or non-binding nature, as well as various international declarations. The regional, national and subnational levels are those of implementation or where management is exerted (Section 3.2).

There are logical links between the international to local levels: to various extents, texts adopted at international level draw the general principles and guidelines (binding or voluntary) that translate

(i) into other multilateral (e.g. regional, bilateral etc.) agreements for the management of specific areas and/or stocks (Section 3.2.1), and

(ii) into national-level implementation (the case being through obligation of states) through national laws, policies and programmes. Texts of a higher level (bigger scale) often require national legislation, or even sub-national rules to be implemented (Section 3.2.2).

At each level, instruments “specific” to the fish sector are influenced by other rules, for example those regarding land and water tenure, environmental protection, human rights, social rights and economic regulations.

At each level, there are often complex interactions between the instruments that regulate the “fish” sector and the other sectors, as well as with many international initiatives (and the related programmes) of relevance to fisheries which have grown rapidly in the last 15 years, often linked to a prevailing discourse (see Section 2.2.1) of a “world fisheries in crisis”.

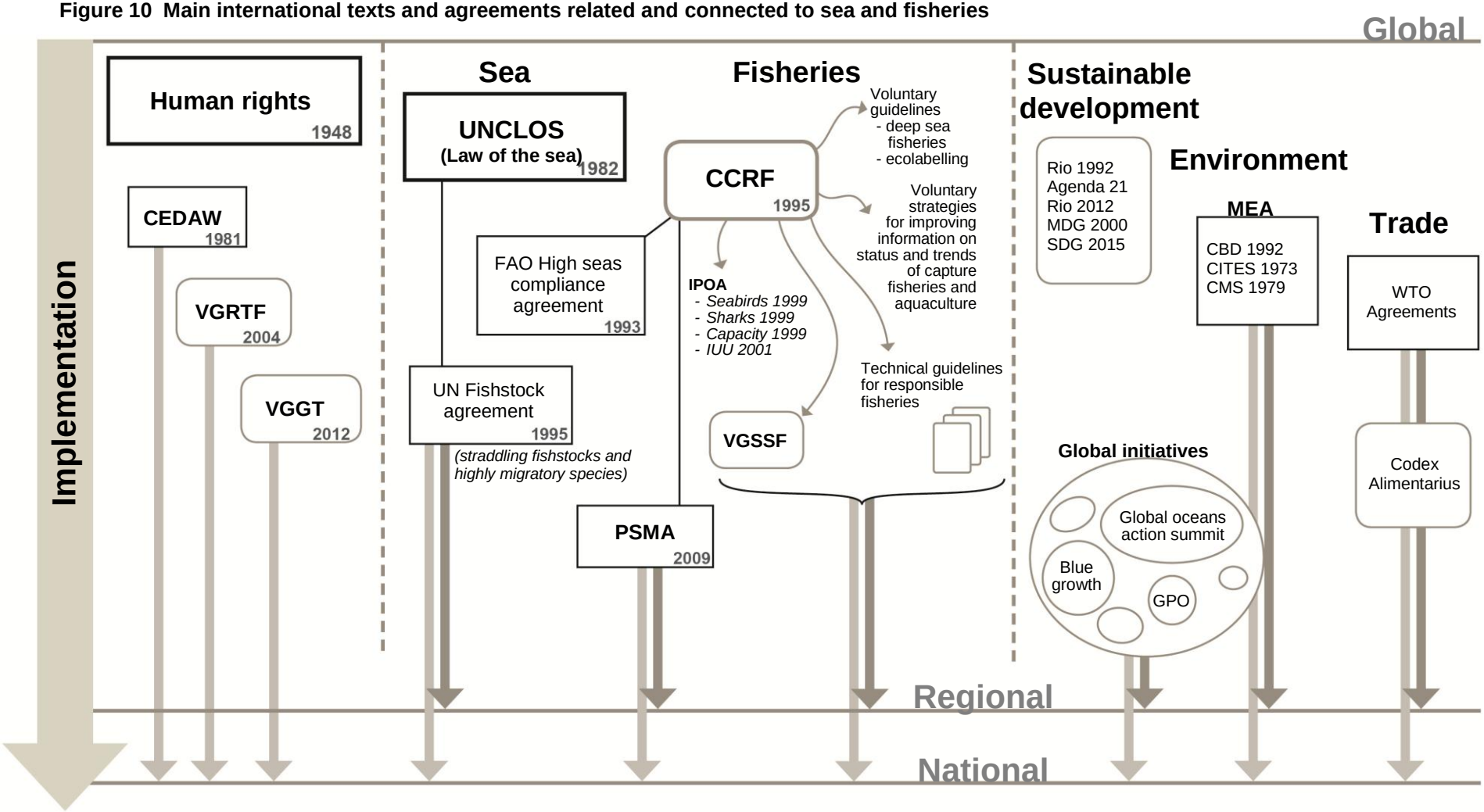
3.2 International level governance

In this section we consider, with a food security and nutrition lens, the existing rules and governance schemes and structures that act on fish, on the related natural resources that sustain the fish resource, as well as on the related economic and social factors.

Linked to these governance issues, both influencing them and linked to implementation arrangements, one can also find a plethora of international initiatives and partnerships, which we also consider briefly.

International level governance plays a considerable role, particularly for marine fisheries. Sixty-five percent of the world oceans are international “high seas”, for which international coordination and rules must be found to sustainably exploit the resource. Roughly 35 percent of the oceans fall under national jurisdiction in exclusive economic zones (EEZ). To ensure the sustainable exploitation of the resource, fisheries operating within EEZ also need a certain degree of international rules, regulations and coordination (Brundtland, 1987), as many species move during their life and reproductive cycles and/or are dependent on other species which are themselves mobile. It includes highly migratory pelagic species, and species that migrate between sea and fresh water.

Figure 10 Main international texts and agreements related and connected to sea and fisheries



Legally binding texts and agreements are in rectangles.

CEDAW = Convention on the Elimination of All Forms of Discrimination against Women; VGRTF = Voluntary Guidelines on the Progressive Realization of the Right to Adequate Food in the Context of National Food Security; VGGT = Voluntary Guidelines on the Progressive Realization of the Right to Adequate Food in the Context of National Food Security; UNCLOS = United Nations Convention on the Law of the Sea; CCRF = Code of Conduct for Responsible Fisheries; IPOA-IUU=Plan of Action to Prevent, Deter and Eliminate Illegal, Unreported and Unregulated Fishing; PSMA = Agreement on Port State Measures to Prevent, Deter and Eliminate Illegal, Unreported and Unregulated Fishing; VGSSF = Voluntary Guidelines for Securing Sustainable Small-Scale Fisheries; MDG = Millennium Development Goals; SDG = Sustainable Development Goals; MEA = Multilateral Environmental Agreements; CBD = Convention on Biological Diversity; CITES = Convention on International Trade in Endangered Species of wild fauna and flora; CMS = Convention on the conservation of Migratory Species of wild animals; GPO = Global Partnership for Ocean.

At the international level, fisheries governance operates both under “oceans governance”, and under “international fisheries governance”, such as international fisheries agreements and regional fisheries bodies. Many inland water resources also share boundaries with multiple countries.

3.2.1 Intergovernmental processes and UN agreements related to sea and fisheries

For marine fisheries, international governance is elaborated under the auspices of the UN, with two intergovernmental bodies: the UN General Assembly, for oceans affairs and the law of the sea, supported since 1999 by the United Nations Open-ended Informal Consultative Process on Oceans and the Law of the Sea;[41] and the UN FAO and its Committee on Fisheries, dealing with policies, priority setting, development of instruments and guidance and capacity building with respect to responsible fisheries and aquaculture, management and for enhancing the contribution of fisheries to food security and the alleviation of poverty.

These bodies have framed the two principal high level international agreements, one relevant to the sea, the 1982 United Nations Convention on the Law of the Sea, the other to fish and fisheries, the 1995 Code of Conduct for Responsible Fisheries. Together, these instruments establish rules for exploitation and conservation of the sea and its resources, as well as the way they are to be implemented and controlled, with specific responsibilities for flag, coastal and port states (see Box 13).

There are also other agreements that relate primarily to other domains which are connected to fisheries or that can impact the way fisheries can deliver food security and nutrition: these schemes can either be overarching, broad instruments (such as the ones related to sustainable development, or to human rights), or more specific ones but with an indirect link, such as for instance the various multilateral and bilateral conventions related to the various uses of rivers. Kim and Glaumann (2012), in a review of transboundary water governance found that most existing agreements adopted an utilitarian approach of maximizing use of the resources, with few addressing conflict resolution and ecological and fish sustainability.

The 1982 United Nations Convention on the Law of the Sea (UNCLOS, “the Convention”)

The developments in the international law of the sea and in particular the 1982 United Nations Convention on the Law of the Sea,[42] and the associated agreements and texts provide a system of binding ocean governance and a framework for management of seabed and marine resources. It gives coastal States rights and responsibilities for the management and optimum utilization of fish resources within their exclusive economic zones (EEZ[43]). It also gives coastal and flag states responsibilities to agree, through appropriate international and regional organizations, upon the necessary measures for the conservation of fish stocks that span beyond the EEZ, including migratory species. It provisions, subject to conditions, the right to fish in the high seas, open to all States, and calls States to duty for adopting measures for the conservation of the living resources of the high seas.

There has been a progressive development of international law in the area of fisheries-related Port State Measures, and this since the adoption of the 1982 Convention, which addresses port state jurisdiction to some extent, although primarily concerned with the issue of marine pollution. Port State Measures were included in the binding 1993 FAO Agreement to Promote Compliance with International Conservation and Management Measures by Fishing Vessels on the High Seas in 1993 (FAO Compliance Agreement) and in the 1995 “UN Fish Stocks Agreement”.[44]

[41] http://www.un.org/Depts/los/consultative_process/consultative_process.htm. At its 15th meeting, 27–30 May 2014, the consultative process will have discussed “The Role of Seafood in Global Food Security”.

[42] http://www.un.org/Depts/los/convention_agreements/convention_overview_convention.htm

[43] According to the convention, the EEZ is a zone that cannot extend beyond 200 nautical miles from the coast. The coastal State shall determine the allowable catch of the living resources, and regulate fisheries in its exclusive economic zone. The coastal State can give access to other States to its exclusive economic zone, notably in case of surplus of allowable catch.

[44] 1995 Agreement for the Implementation of the provisions of the United Nations Conventions on the Law of the Sea of 10 December 1982 Relating to the Conservation and the Management of Straddling Fish Stocks and Highly Migratory Fish Stocks.

Box 13 Flag States, Port States, Land-locked States and Market States

Flag States

Countries that have fishing vessels that fish beyond their waters have the responsibility to ensure that these vessels are issued with appropriate certificates, and are allowed to fish. According to the Code, such "Flag States" (those countries that issue a flag to a fishing vessel) should keep detailed records of the vessels that fish beyond a country's own waters, make sure that their vessels are safe, and that insurance is carried.

Port States

According to the Code, countries should adopt procedures, such as inspecting foreign fishing vessels when they enter their ports, to assist in ensuring that the vessel has fished responsibly. Port countries should cooperate with the Flag country when it requests assistance to investigate possible infringements by its vessels. Harbours and landing places should be safe havens for fishing vessels. These places should have facilities for servicing vessels, vendors, and fish buyers. Fresh water supplies, sanitation arrangements and waste disposal systems should also be provided.

Landlocked-states

According to the Convention (Art 69), land-locked States shall have the right to participate, on an equitable basis, in the exploitation of an appropriate part of the surplus of the living resources of the exclusive economic zones of coastal States of the same subregion or region, taking into account the relevant economic and geographical circumstances of all the States concerned. The terms and modalities of such participation shall be established by the States concerned through bilateral, subregional or regional agreements taking into account, inter alia (…) the need to avoid effects detrimental to fishing communities or fishing industries of the coastal State; (…) and the nutritional needs of the populations of the respective States.

Market States

Some countries import large quantities of fish, and are also object of a growing attention. Informal trade of fish has grown and Interpol (OIPC) through its initiative "Project Scale", launched in 2013, to detect, suppress and combat fisheries crime, offers interesting perspectives to fight against black markets of fish and traffick feeding into them.

The 1995 Code of Conduct for Responsible Fisheries ("the Code")

The 1995 Code of Conduct for Responsible Fisheries[45] ("the Code"), which is a voluntary agreement,[46] and its related 41 derivative instruments, comprising international plans of actions,[47] voluntary strategies, voluntary guidelines and technical guidelines, has been the principal text providing guidelines for the development of legal frameworks, policies and activities, at national level or at the level of specific fisheries. The objectives of the Code are reproduced in Box 14.

The code provides guidelines for coastal States, and for activities related to fishing vessels, to flag states and port states.

Even though the Code "recognizes the vital role of fisheries in world food security" and despite having among its objectives to "promote the contribution of fisheries to food security and food quality, giving priority to the nutritional needs of local communities", it mentions food security only four times.

The 2012 external evaluation of the Code (Williams *et al.*, 2012c) found that the "Code pays very little attention to either food security or poverty and mentions [small-scale fisheries] only in passing." The themes were not elaborated further in Code instruments, which have more of a focus on environmental sustainability and technical issues related to aquatic resources rather than on the people who depend on them. The Evaluation Report recommended, among others, that FAO should ensure that developmental objectives such as gender equality, food security and poverty reduction

[45] http://www.fao.org/fishery/code

[46] As per Article 1.1 of the Code, "*The Code also contains provisions that may be or have already been given binding effect by means of other obligatory legal instruments amongst the Parties, such as the Agreement to Promote Compliance with International Conservation and Management Measures by Fishing Vessels on the High Seas, 1993*".

[47] The International Plan of Action for Reducing Incidental Catch of Seabirds in Longline Fisheries (1998), the International Plan of Action for Conservation and Management of Sharks (1998), the International Plan of Action for the Management of Fishing Capacity (1998) and the International Plan of Action to Prevent, Deter, and Eliminate Illegal, Unreported and Unregulated Fishing (2000).

become the primary drivers of its work, across all types of fisheries and aquaculture.Voluntary Guidelines for Securing Sustainable Small-Scale Fisheries in the Context of Food Security and Poverty Eradication

In 2011, the FAO Committee on Fisheries recommended to develop an international instrument on small-scale fisheries, in support of national, regional and international initiatives for poverty alleviation and equitable social and economic development, for improving governance of fisheries and promoting sustainable resource utilization. According to FAO,[48] this is based on the increasing recognition of small-scale fisheries as a principal contributor to poverty alleviation and food security and the guidance provided by a number of global and regional conferences and consultative meetings exploring how to better bring together responsible fisheries and social development in coastal and inland fishing communities. The text is expected to be adopted at the 31st session of the COFI in June 2014.

The text aims, as summarized by FAO (2014b, para 10) to "enhance the contribution of small-scale fisheries to global food security and nutrition, to contribute to equitable development and poverty eradication, to achieve sustainable use of fishery resources, and to promote an economically, socially and environmentally sustainable future of our planet and its people. It proposes guidance that can be used by States and stakeholders for the enhancement of sustainable small-scale fisheries governance and development. It also promotes awareness raising and the advancement of knowledge on small-scale fisheries".

Agreements to Prevent, Deter and Eliminate Illegal, Unreported and Unregulated Fishing (IUU)

Illegal Unreported and Unregulated (IUU) fishing is a serious and increasing concern. Agnew *et al.* (2009) have reviewed available data for 54 countries and on the high seas, and estimated that globally illegal and unreported fishing accounted for between USD 10 billion and USD 23.5 billion annually, representing between 11 and 26 million tonnes of fish. These levels disrupt sustainable management plans and constitute a global threat to sustainable fisheries and to the management and conservation of fisheries resources and marine biodiversity. There is a concern that IUU also impacts small-scale fisheries and food security. According to Agnew *et al.* (2009), *"developing countries are more vulnerable to illegal activities, conducted by both their own fishers and vessels from distant water fishing nations"*.

Box 14 The code of conduct of responsible fisheries

The objectives of the Code of conduct of responsible fisheries are to:

- establish principles, in accordance with the relevant rules of international law, for responsible fishing and fisheries activities, taking into account all their relevant biological, technological, economic, social, environmental and commercial aspects;
- establish principles and criteria for the elaboration and implementation of national policies for responsible conservation of fisheries resources and fisheries management and development;
- serve as an instrument of reference to help States to establish or to improve the legal and institutional framework required for the exercise of responsible fisheries and in the formulation and implementation of appropriate measures;
- provide guidance which may be used where appropriate in the formulation and implementation of international agreements and other legal instruments, both binding and voluntary;
- facilitate and promote technical, financial and other cooperation in conservation of fisheries resources and fisheries management and development;
- promote the contribution of fisheries to food security and food quality, giving priority to the nutritional needs of local communities;
- promote protection of living aquatic resources and their environments and coastal areas;
- promote the trade of fish and fishery products in conformity with relevant international rules and avoid the use of measures that constitute hidden barriers to such trade;
- promote research on fisheries as well as on associated ecosystems and relevant environmental factors; and
- provide standards of conduct for all persons involved in the fisheries sector.

[48] http://www.fao.org/fishery/ssf/guidelines

Key mechanisms in this domain are the 2001 voluntary instrument IPOA-IUU (Plan of Action to Prevent, Deter and Eliminate Illegal, Unreported and Unregulated Fishing), placed under the Code and the legally binding 2009 FAO *Agreement on Port State Measures to Prevent, Deter and Eliminate Illegal, Unreported and Unregulated Fishing*,[49] supported by Interpol. They focus on the international responsibilities of Flag States, Coastal States and Port States (see Box 13). There is a growing reliance on Port States to combat non-sustainable fishing practices and IUU, as flag states can fail to effectively control fishing operations carried out by vessels flying their flag.[50]

Although most of these instruments mention small-scale fisheries they do not provide for or develop specific considerations for the conditions in small-scale fisheries. One difficult issue is that a substantial part of what small-scale fishers catch in developing countries is unreported and could possibly fall under "unregulated fish" – due essentially to the lack of appropriate monitoring systems. As noted by the Special Rapporteur on the Right to Food: *"this is unclear whether these efforts against IUU are well guided. (…) While illegal, unreported and unregulated industrial fishing is a problem, most of the catch of small-scale fishers goes unreported. Analogizing these catches to illegal fishing underestimates their role in contributing to food security and does not encourage the fishers concerned to shift to more responsible practices."* (UN, 2012)

The 2001 IPOA-IUU and the 2009 FAO agreement regulate the obligations and duties of States. It is for the States to put in place minimum standards of measures and means of control to fight IUU. In putting in place such national level regulations, States could make an appropriate distinction between industrial and artisanal fisheries. For example, the European Union, in its regulation 1005/2008 to fight IUU, has simplified the system for catch certificates from artisanal fleets. Addressing IUU fishing requires different approaches in industrial and small-scale fisheries with the latter necessitating more capacity development programmes and stakeholder involvement in developing national/subregional sustainable fisheries management plans leading to enhanced food security. Small-scale fisheries are also particularly vulnerable to the effects of IUU fishing.

3.2.2 Agreements and instruments connected to fish

One can identify three main sets of overarching agreements and instruments that are of broader scope than the fish sector, but which critically touch on the way fisheries and aquaculture can deliver food security and nutrition. The first one is constituted by human rights and particularly the right to food. The second is derived from the general agreements about sustainable development. The third is composed by multilateral environmental agreements (see Figure 10).

Rights-based instruments

Human rights can help understand and organize governance issues related to food security and nutrition by two main ways. A first way is set out for instance in such instruments as the *International Bill of Human Rights*, the *Convention on the Elimination of All Forms of Discrimination against Women*, and the *United Nations Declaration on the Rights of Indigenous Peoples*, which among other specifies how governance should be conducted so as to enable expression of concerned stakeholders and the respect of broad principles of equity, including gender equality.

A second way is set out in international instruments relating to the governance of access to resources and to food security, for instance the *Voluntary Guidelines on Responsible Governance of Tenure of Land, Fisheries and Forests in the Context of National Food Security* and the *Voluntary Guidelines on the Progressive Realization of the Right to Adequate Food in the Context of National Food Security*, which highlight the important role of small-scale fisheries in food security.

Sustainable development instruments

The pursuit of sustainable development has led to a wide spectrum of broad agreements often with an overarching scope, with the ambition to conciliate sustainable management of natural resources, social equity and economic development. As such they have been key in setting globally agreed directions for the sustainable development of the sector within a wider sustainable development

[49] This Agreement aims to prevent illegally caught fish from entering international markets through ports. Under the terms of the treaty, foreign vessels will provide advance notice and request permission for port entry, countries will conduct regular inspections in accordance with universal minimum standards, offending vessels will be denied use of port or certain port services and information sharing networks will be created.

[50] See for example http://www.fao.org/fishery/psm

framework, such as the Agenda 21 adopted in Rio in 1992 and the *2000 Millennium Development Goals*.

The Rio+20 Outcome document *The future we want* (UN, 2013) stresses the importance of sustainable fisheries and aquaculture for food security and nutrition and livelihoods (para. 113). It also re-emphasizes (paras 169–177) t several international agreements and commitments to fisheries action,[51] for instance with regard to restoring fish stocks, implementing fully the Fish Stocks Agreement, eliminating IUU, expediting progress in implementing the Port State Measures Agreement, improving the performance of the Regional Fisheries Management Organizations (RFMO), commitments to eliminate the subsidies that appear inappropriate, reiterating the need for coral reef conservation and area-based management. Of particular relevance, para. 175 commits to ensure access to fisheries and markets for subsistence fishers, women fish workers and indigenous people.

Multilateral environmental agreements

Global fisheries and aquaculture issues are also concerned with multilateral environmental agreements between States, among which:

- the 1973 *Convention on International Trade in Endangered Species of wild fauna and flora* (CITES), which aims to ensure that international trade in specimens of wild animals and plants does not threaten their survival.
- the 1979 *Convention on the conservation of Migratory Species of wild animals* (CMS), which is a framework treaty providing the legal foundation for internationally coordinated conservation measures of migratory animals, their habitats and migration routes.
- the 1992 *Convention on Biological Diversity* (CBD), which aims at "the conservation of biological diversity, the sustainable use of its components and the fair and equitable sharing of the benefits arising out of the utilization of genetic resources, including by appropriate access to genetic resources and by appropriate transfer of relevant technologies, taking into account all rights over those resources and to technologies, and by appropriate funding."[52] As such it is an important source of principles, a good example of which is the ecosystem approach (see Box 15).

Emerging after the Code, the *Ecosystem approach to fisheries* (EAF) and the *Ecosystem approach to aquaculture* (EAA) were developed as vehicles for implementing the Code.

The development of the social and economic elements of the EAF/EAA lagged behind that of the biological and environmental, but are of most relevance to food security and nutrition.

3.2.3 International initiatives

International initiatives of relevance to fisheries governance have grown rapidly in the last 15 years, often linked to a prevailing discourse of a "world fisheries in crisis" (see Section 2.2.1).

Partially contributing to this vision, but also feeding from it, a powerful narrative calling for a substantial reform of the world fisheries has emerged in the last decade, symbolized by the World Bank/FAO report "the Sunken Billion - Economic Justification for Fisheries Reform" (World Bank/FAO, 2009).[53] This narrative can be summarized as follows: "*Billions of dollars are spent every year, putting the world fisheries in great danger by incentivizing too many fishers to operate, and there is a need to curb this irrational "race-for-fish", to put in place the right management systems, reduce the overall number of fishers and tackle IUU fishing. These reforms, if successfully implemented, would allow to maximize the rent extracted from fisheries resources (as it is already done in a few countries – e.g. Iceland, Norway, New Zealand, Australia), and countries could use this rent to lift people out of poverty*".

[51] See COFI/2012/6/Rev.1 for a review of the outcomes of Rio+20 with respect to Ocean governance ftp://ftp.fao.org/FI/DOCUMENT/COFI/cofi_30/6rev1e.pdf

[52] http://www.cbd.int/doc/legal/cbd-en.pdf

[53] Mainly relying on the results of "The Rent Drain" PROFISH funded initiative (Kelleher and Willmann, 2006), this 2009 World Bank/FAO report proposes to estimate the amount of rent that is currently lost at the global (world) level due to overfishing. The report concludes that approximately USD 50 billion per year were lost, representing "the difference between the potential and actual net economic benefits from global marine fisheries" (World Bank/FAO, 2009, p.xiii).

Box 15 A brief overview of the ecosystem approach to fisheries and aquaculture

The ecosystem approach has been defined by the Conference to the parties of the Convention on Biodiversity (COP5) as "a strategy for the integrated management of land, water and living resources that promotes conservation and sustainable use in an equitable way. Thus, the application of the ecosystem approach will help to reach a balance of the three objectives of the Convention: conservation; sustainable use; and the fair and equitable sharing of the benefits arising out of the utilization of genetic resources."(COP 5 Decision V/6).

An ecosystem approach to fisheries (EAF) strives to balance diverse societal objective, by taking account of the knowledge and uncertainties of biotic, abiotic and human components of ecosystems and their interactions and applying an integrated approach to fisheries within ecologically meaningful boundaries. The EAF/EAA is the mechanism to attain sustainable development in fisheries and aquaculture – stressing holistic, integrated and participatory processes. It requires the inclusion of interactions between the core of the fishery – fish and fishers/fishfarmers – as well as other elements of the ecosystem and the human system (i.e. is a social-ecological system).

The purpose of an EAF/EAA is to plan, develop and manage fisheries and aquaculture in a manner that addresses the multiple needs and desires of societies, without jeopardizing the options for future generations to benefit from the full range of goods and services provided by the aquatic ecosystems.

Accordingly, application of the EAF/EAA should address the following principles:

- apply the precautionary approach when faced with uncertainty;
- use best available knowledge, whether scientific or traditional;
- knowledge multiple objectives and values of ecosystem services;
- embrace adaptive management;
- broaden stakeholder participation;
- use the full suite of management measures;
- promote sectoral integration and interdisciplinarity.

Source: FAO (2003; 2009b), De Young et. al (2012)

This "fisheries reform" narrative has echoed in the work of a very large number of international institutions and organizations, including the World Bank, OECD, FAO, a large part of the fishery academic community and much of the environmental NGO community. Funds have been invested to lobby for the "fisheries reform" through various programmes – e.g. the Global Partnership for Ocean (GPO), the World Bank PROFISH and its subprogrammes (e.g. WARFP in West Africa, CRSD in Viet Nam, etc.), the NEPAD-PAF and its subprogramme (e.g. CAFRS), and various documents and reports (e.g. Sutinen, 2008; World Bank/FAO, 2009; Leal, 2010). Some of these programmes are already operating in Africa and Asia with the help and support of the World Bank.

Many parallel and self-organized global ocean-related initiatives have bubbled in the past decade (Box 16). Water governance also impact fisheries' governance, and in the domain of water, international initiative have also proliferated (see also Section 3.4.4).

This growing set of initiatives shows that a broad range of stakeholders are seeking new pathways to sustainability in terms of policy development, investment and innovation

However, this comes with specific governance challenges. First of all how to articulate and coordinate those various parallel initiatives and their objectives, all differing in scope and perspectives, including in their relation to food and nutrition security concerns. It is also unclear how these initiatives will relate to the other instruments, and institutions, across spatial and jurisdictional scales. How they can translate into coherent action on the ground is also a concern, as well as overlapping mandates and fragmented use of funds.

Box 16 A foaming set of international initiatives on oceans, blue growth and water

The *Global Ocean Commission*[a] originated as an initiative of The Pew Charitable Trusts, in partnership with the University of Oxford and philanthropic foundations. The objective of the Commission is to formulate politically and technically feasible short-, medium- and long-term recommendations to address the following issues facing the high seas: overfishing; large-scale loss of habitat and biodiversity; the lack of effective management and enforcement; deficiencies in high seas governance. The *Global Ocean Forum*[b] is another example of international non-profit coalition gathering experts from various groups "dedicated to promoting good governance of the ocean, sustainable development for coastal and island peoples around the globe, and healthy marine ecosystems".

The World Bank-led *Global Partnership for Oceans*[c] (GPO) focuses on the implementation of global commitments and agreed national action plans. It aims at "mobilizing finance and knowledge to activate proven solutions at an unprecedented scale for the benefit of communities, countries and global well-being". The goals of the GPO are, by 2022, to significantly and sustainably increase fisheries and aquaculture production, reduce the open access nature of fisheries by creating responsible tenure agreements and secure access rights for fishers, and rebuild overfished stocks (including through reducing subsidies), to achieve greater economic returns. At the outset, these objectives caused concern among advocacy groups and experts concerned with food security and nutrition. Although the GPO first guiding principle is officially focused on poverty reduction, food access and affordability, various forms of equity, nutritional support, etc., it failed to recognize the political economy of the debate and the trade-offs, competitions and conflicts that can exist between different principles and objectives. As the initiative is in its early stages, it does have the opportunity to put more substance into its first guiding principles.

"Blue Growth" is a new theme on the global oceans agenda, and the concept of a "blue economy" came out of the 2012 Rio+20 Conference. Recently a *Global ocean action summit for food security and blue growth*[d] was held in April 2014 at the initiative of the World Bank and the Government of the Netherlands, backed-up by a series of regional conferences, and aiming at "developing a roadmap with concrete actions linking policies, investments and measures (…) to make long-term sustainability of the living oceans a *bankable proposition*" (our emphasis[e]). FAO has recently launched in January 2014 a *Blue Growth Initiative*,[f] a global framework programme of FAO through which the FAO will assist countries to develop and implement blue economy agenda. In line with this, FAO has also launched in 2013 a *Global aquaculture advancement partnership programme*[g] to promote the sustainable increase in aquaculture production.

Water partnerships and initiatives relating to freshwater have also been developed. They include: the World Bank-led *Global Water Partnership*,[h] the *World Water Council*,[i] and the UNESCO-led *World Water Forum*.[j] Most of these pay little attention to fish or to food security and nutrition related to fish.

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a) http://www.globaloceancommission.org/
b) http://globaloceanforum.com/
c) http://www.globalpartnershipforoceans.org/
d) http://www.globaloceansactionsummit.com/
e) Asia Conference on Oceans, Food Security and Blue Growth, June 2013, http://acofb2013.kkp.go.id
f) http://www.fao.org/news/story/en/item/212685
g) http://www.fao.org/news/story/en/item/202782
h) http://www.gwp.org
i) http://www.worldwatercouncil.org
j) http://www.globalwaterforum.org

As also seen in the case of international instruments, the main focus of these various initiatives is often on the tension between production growth and environmental sustainability, in a context of increasing and competitive economic exploitation of the marine and freshwater resources. When food security and nutrition are acknowledged, it is generally only in rhetoric terms: detailed analysis and strategies linking production growth and sustainability to food security and nutrition are generally lacking (Allison *et al.*, 2013). If getting more attention, in formal international governance tools, to food security and nutrition issues is a real challenge, the current international partnerships and initiatives could provide a way to trigger such changes. However they will need to start, at their level, by ensuring in their processes and outcomes that more attention is paid to food security and nutrition issues and that the interests of millions of end-users are considered – an outcome to which improved internal transparency, inclusiveness and balance could contribute, among other to allow stakeholders and agencies with food security and nutrition knowledge to advocate for it. With the notable exception

of the UN-driven initiatives for which inclusive consultative processes are generally followed, the governance of some initiatives are questioned, especially with regard to their inclusiveness and regional diversity.[54]

3.3 Regional level governance

Regional Fishery Bodies (RFBs) – currently there are more than 50 worldwide – are mechanisms through which States or organizations work together towards the conservation, management and/or development of fisheries. Their mandates vary. Those RFBs, about half of them, with a management mandate are called Regional Fisheries Management Organizations (RFMOs) and can adopt measures that are binding on their members. Their role and work is guided inter alia by the UNCLOS.

RFMOs have been set up to help implement international fisheries governance of transboundary fish stocks. Most are primarily involved in management of industrial fisheries, and although these also have elements related to food security, food security and nutrition have not figured strongly in their work. For example, the five existing tuna RFMOs are concerned with trying to ensure the availability and stability of tuna stocks (Allen, 2010) but do not focus on access and utilization of these fish by local communities. In the case of the Western and Central Pacific fisheries, Bell *et al.* (2009) concluded that *"considerable thought has gone into how to maximize national revenue and jobs from this valuable resource. But even for tuna, there is much room for improved national planning, particularly in how to use tuna for food security"*. Recently, concerns have been raised about the challenges that RFMOs are facing to undertake the necessary research, monitoring, control and surveillance in order to meet their objectives of better resource conservation and management, and their inability in some cases to stem stock declines.

In the European Union, since the 1970s, the Common Fisheries Policy (CFP) provides an example of regional integration of fisheries management, which covers fishing and aquaculture and explicitly includes various objectives: environmental, economic and social sustainability, as well as contribution to healthy nutrition. The policy, as reformed 1st January 2014, aims at making fishing fleets more selective in what they catch, and at phasing out the practice of discarding unwanted fish, through the gradual introduction of a landing obligation. It recognizes the need to set long term sustainable targets in order to maximize catches over the long run. Lastly, the new CFP includes more decentralization and more extensive stakeholder consultation. Management rules set by the CFP includes: rules on access to waters to control which vessels have access to which waters and areas; fishing effort controls to limit fishing capacity and vessel usage; technical measures to regulate gear usage and where and when fishermen can fish; output controls mainly consisting of limiting the amount of fish which can be harvested from a particular fishery, in particular through total allowable catches.

3.4 Governance and management of resources at national and sub-national levels

At national level, relevant governance issues relate to how the fish resources are attributed, how different management systems are set-up and are operated, both directly in the fish sector, and in connected sectors. In addition, national level governance often acts within the framework of international governance.

States have the responsibility to implement international agreements they have subscribed to, including by the control of ships under their flag and entering their ports. They are also in charge of the management of resources under their responsibility, either national or part of an international, multilateral or bilateral agreement. This includes ensuring that captures do not exceed levels which have been fixed.

States use various policies and instrument to ensure that levels of capture are respected (Beddington, Agnew and Clark, 2007). Among these figure management of fishing capacities and fishing rights, including individually allocated annual quotas. Several countries have designed policies to reduce overcapacity, often through economic incentives, including buying back capacity and/or conditioning subsidies for investments to a capacity reduction. However, it has been noted that these programs do

[54] As an example, in the case of the 31-member Interim Working group of the Global Partnership for Oceans, charged to *"guide the design phase of the GPO"* and lend expertise to the framework document that dictates how and where the GPO will work (GPO, 2013), 24 members are from OECD (of which 15 are from the USA), and the group does not count any member from Asia or Africa, regions that concentrate 95% of the world fisher workers and fish farmers.

not remove the economic incentives that drive overcapacity (Beddington, Agnew and Clark, 2007). Systems based on rights of capture, or on rights to access, which in some circumstances can be considered as a proxy, are considered to be more efficient, provided that IUU is properly dealt with (see above). Many countries control access rights, both for marine and inland fisheries, with various juridical arrangements and institutional mechanisms, often with an important place for customary and/or community based rules.

An increasing number of countries, mainly developed but not only, use annual catch quotas to manage resource.

At national and subnational levels potentially, the tension can be high between broad access rights and the need to ensure the sustainability of the resource.

It is at this level, which is the level of implementation, that synergies and trade-offs between preservation of ecosystems, conservation and management of the resource and food security and nutrition concerns need to be considered. In particular how to accommodate (and to who's benefit) access to sea, inland waters, and resource, security of tenure and protection of the resource for the future? What do we know about the impact of various management strategies or measures on food security? What do we know about certain governance schemes to work better for food security and nutrition, for the various communities concerned?

These issues can get particularly complex. Rights to access and use of fisheries resources are often poorly defined, ineffectively enforced, or unfairly distributed, and link with land-use rights and water-use rights (especially for shore and inland fisheries). They are also often, even in industrialized countries, governed by traditional and customary law and rules, not always well recognized and protected by "modern" regulations overlapping at higher levels. In this perspective, how the governance over tenure rights takes place is particularly important, given the links between tenure rights and food security.

The variability and diversity of small-scale fisheries and their close links with communities conflict with traditional top-down command and resource control and management approaches. Moreover, poverty in fishery-dependent communities is not necessarily linked directly to resource overexploitation, but rather reflects wider institutional, political and economic disadvantages in rural (and in some cases urban) populations (Béné, 2003; Béné, McFadayen and Allison, 2007). Marginalization and violation of the rights of fishworkers and fishing-dependent people sometimes result in a lack of access to public services, including health and education, a lack of participation and representation in the policy-making process and, in many cases, a lack of access to efficient markets or trade. There is therefore a need to combine resource management with addressing social and economic development (ICSF, 2007; FAO, 2009c; Allison *et al.*, 2011).

In this section we start by briefly considering two "simple" approaches to the management of resource, the first one focused primarily on fish (quotas, Section 3.4.1), the second focused primarily on the area (Marine Protected Areas, Section 3.4.2), where specific management measures or restrictions can apply, before considering decentralized governance and issues linked to interactions between land-water-sea rights systems (Section 3.4.4), the incidence of aquaculture development, food chains and rights.

3.4.1 Capture quotas

In the capture fisheries sector, one can find a broad spectrum of access, use and management rights' systems, ranging from very weak to very strong and explicitly defined rights. These systems can perform differently in terms of environment, social and economic outcomes, including in food security and nutrition terms.

Individual quota systems are examples of management rights' systems used by a growing number of governments, mainly in developed countries, to regulate the fishing industry,[55] generally for a single species in a single fishing ground exploited by large-scale fleets. Concerns have been raised about the transferability of quotas which tends to favor an accumulation of rights in the hands of those businesses that are able to buy them, with potential effects on food security and the destination of the

[55] In these quota systems, the regulator sets a species-specific total allowable catch (TAC), typically by weight and for a given time period. A dedicated portion of the TAC, called quota shares, is then allocated to individuals. Many countries allow quotas to be bought, sold and leased, a feature called transferability.

fish (Copes, 1986). Moreover, by their very nature, these types of tools are not applicable to small-scale multispecies, multigear fisheries in developing countries.

3.4.2 Marine Protected Areas and food security

Marine protected areas (MPAs) are spatially defined management units, where human activities such as fishing are prohibited or restricted (McCay and Jones, 2011). They are typically created for precautionary or conservation purposes, but also as a fisheries management tool to rebuild stocks, or to restore community structure, under the assumption of increased yields (Worm *et al.*, 2009) or as part of the ecosystem approach to fisheries (Pikitch *et al.*, 2004). Much of the impetus to create MPAs derives from commitments made at the 2002 World Summit on Sustainable Development and the Convention on Biological Diversity, aiming at effectively conserving at least 10% of each of the world's marine and coastal ecological regions (Sharma and Rajagopalan, 2013).

Along with decentralization (co-management and community-based management), MPAs are one of the most widely used management tool in both developed and developing countries (Mascia, Claus and Naidoo, 2010). In 2010, a total number of 5880 MPAs covered 1.17% of the world's oceans, and 4.2% of the continental shelves, almost all MPAs being within areas of national jurisdiction (Toropova *et al.*, 2010).

MPAs differ from local or community-based management areas as MPAs areas and rules are generally designed by the national government, often via a top-down approach (Sharma and Rajagopalan, 2013).

The literature studying links between MPAs, poverty reduction and food security is scarce and contradictory. The establishment of an MPA involves a reallocation of different types of rights (e.g. resource access rights, withdrawal rights or management rights), which can be lost, secured or gained by local communities (Mascia and Anne, 2008).

Sharma and Rajagopalan (2013) reported that there are more situations where tenure rights were weakened or lost following the introduction of an MPA than where they have been strengthened.

On the one hand, there is strong evidence that the establishment of an MPA leads to an increase in biomass (fishery independent estimates), with spillover increases in catches, and potential benefits for poverty reduction and food security (Thorpe, Bavinck and Coulthard, 2011). One study in the Roviana Lagoon of the Solomon Islands showed that residents of villages with effective MPAs had higher energy and protein intake than those who had no MPA or an ineffective MPA (Aswani and Furusawa, 2007).

On the other hand, increases in catches and fish income – such as shown by McClanahan, (2010) in the case of Kenya – have not necessarily translated into poverty reduction (Allison, Delaporte and Hellebrandt de Silva, 2013). Also, a growing number of studies point to the risk of exclusion of the local communities from their traditional fishing areas – see e.g. Foale *et al.* (2013) or Benjaminsen and Bryceson (2012), with detrimental impacts on local population's food security.

Mascia, Claus and Naidoo (2010), in a review of the scientific literature to assess MPAs impacts on five indicators of human welfare (food security, resource rights, employment, community organization and income), found that food security generally remained stable or increased in older and smaller MPAs, but that at least a minority of fishers is always negatively affected.

However, broad evidence of a strong causal positive link between MPAs and local food security is still lacking. It appears that MPAs are neither uniformly good nor uniformly bad for coastal communities, with a need for further research to better document the positive and negative social and food security impacts (Mascia, Claus and Naidoo, 2010), and to better factor in the tenure rights of local communities (Sharma and Rajagopalan, 2013).

3.4.3 Decentralized governance

In the last 30 years in many countries a shift took place from a central management approach to a range of decentralized management systems of fisheries and related resources, ranging from "co-management" to "community-based management", whereby the design, implementation and monitoring of management measures are shared or devolved to various degrees with a range of different stakeholders "closer to the resource" such as local governments, fisheries cooperatives or associations or fishing communities (Pomeroy, 1995; 2001; Pomeroy and Berkes, 1997; Jentoft,

McCay and Wilson, 2010). These decentralization arrangements in the fish sector often occurred in parallel with similar policies in other sectors. They can also be linked to Fisheries Improvement Programme efforts (see Fish certification and food security and nutrition above).

There were several rationales for such movements towards decentralized management, including improving managerial efficiency in cases where the central agencies lacked capacity and resources, reduction of implementation costs, improved compliance with objectives of sustainable management of resources by putting end-users in a position of greater responsibility and accountability (Pomeroy, 2001; Béné and Neiland, 2006; Jentoft, McCay and Wilson, 2010; DAFF, 2011). Another frequently cited reason for entering into co-management agreement was to exclude outside commercial fishers (Almeida, Lorenzen and McGrath, 2009).

Decentralized fisheries governance is often considered as a more ‘‘democratic governance system” (Nielsen *et al.*, 2004), with the involvement of end-users and the delegation of responsibilities to users. As such these schemes have been associated with poverty reduction, pro-poor policy and empowerment (Berkes, 1995, 2009) – even if these agendas were initially absent from the initial arguments (Béné and Neiland, 2004, 2006).

However it is important to consider how well decentralized management performs, as compared to centralized management, with respect to the environmental, economic and social sustainability of fisheries, and in terms of food security and nutrition outcomes.

First, there are methodological challenges relating to assessing the outcomes of these systems. By nature, decentralized schemes must be taken on a case-to-case basis (Pomeroy and Berkes, 1997). Direct and broad comparisons of decentralized schemes are not really possible for a number of reasons. Also, it is not always easy to attribute positive results to the introduction of decentralized management per-se, separately from the effects of other policies or programs, which can be quite varied in nature. The outcomes of such systems are not always immediate but long term, putting in question the results of assessments conducted at a too early stage.

Second, sometimes decentralized management does fail to improve governance, for instance when the distribution of power is biased and is being used by some categories of local actors to advance their own agendas at the detriment of others (Béné *et al.*, 2009b).

Third, centralized or decentralized management often operates in addition to customary regimes with a wide range of authority, rights, rules for monitoring, accountability and enforcement (e.g. Ruddle, 1994; Béné *et al.*, 2003). The performance of decentralized management has to be viewed holistically, including how it overlays and interfaces with these customary regimes, which often resisted drastic changes in the political context (Neiland *et al.*, 2005; Adhuri, 2013). This explains why meta-analysis or reviews on the performance of decentralized management schemes with respect to the management objectives often show mixed results in terms of the ultimate objectives of fish abundance, improved access to the fish resource (or its perception by end-users), and household income (e.g. Béné *et al.*, 2009b; Evans, Cherrett and Pemsl, 2011). In their review of customary marine management and its effect on sustaining resources, Cinner and Aswani (2008) found that customary management was effective in smaller communities with high levels of equality and that are far from markets, but it is was susceptible to be disrupted by economic pressures or by the arrival of new actors.

The governance of the schemes appear to be decisive in explaining the success or failure, and one can identify conditions and principles that the governance process of these schemes would ideally meet in order for them to work well to improve access to the resources and the status of the resource itself – possibly boosting the incomes of these who depend on these resources for their livelihood and food security (see Box 17).

One can list among those conditions and principles: good information and finding ways to integrate local and scientific knowledge and approaches, shared understanding of the issues and of the objectives of stakeholders engaging in the scheme, identify conflicting objectives, agree on common goals, ensure transparency and inclusiveness of the process, including for monitoring and accountability, find ways to manage long term objectives integrating short term perspectives of most of the actors, build upon existing community based management practices, structures and rules. Public authorities have a crucial role to play – even if at a different level and with different management responsibilities.

Box 17 Value and challenges for local governance

Important literature, from Hardin (1968) to Ostrom (1990, 2010), has considered the question of the governance of shared resources, or "pooled resources". There is now a wide consensus to recognize the value of local governance, provided it respects the eight "design principles" of stable local common pool resource management identified by Ostrom (1990):

- clearly defined boundaries (effective exclusion of external un-entitled parties);
- rules regarding the appropriation and provision of common resources that are adapted to local conditions;
- collective-choice arrangements that allow most resource appropriators to participate in the decision-making process;
- effective monitoring by monitors who are part of or accountable to the appropriators;
- a scale of graduated sanctions for resource appropriators who violate community rules;
- mechanisms of conflict resolution that are cheap and of easy access;
- self-determination of the community recognized by higher-level authorities;
- in the case of larger common-pool resources, organization in the form of multiple layers of nested enterprises, with small local common pool resources at the base level.

These models are now facing broad challenges such as transnational resource management or the need to manage resources for more diverse stakeholders with more diverse interests and time scales and, often, with increased pressure on the resource itself.

Source: Adapted from Ostrom (1990, 2010) and Place *et al.* (2013).

Territorial use-rights in fisheries (TURFs) provide an example of decentralized management of resources. A TURF is an area-based fishery management approach in which groups, or in rare cases individuals, are granted secure, exclusive privileges to fish in a specified area. Well-designed TURFs have appropriate controls on fishing mortality and hold fishermen accountable to comply with these controls (Poon and Bonson, 2013).

TURFs have been used in a variety of contexts around the world, and there is increasing interest in using TURFs to manage fisheries. Most TURF systems do not grant ownership of fishing areas. Rather, they typically allocate exclusive harvesting privileges to individuals or groups, for one or more marine species in a specified area (see Box 18). Such approaches, linking an area to a community for a long-term sustainable management of resources, enable to implement ecosystem approaches and could also trigger the organization of small-scale fishers for collective actions towards transformation and market access. TURFs effectively function like community based management with the State delegating the right and responsibility to manage a stock, protecting this right and overseeing the whole system.

3.4.4 Land-water-sea interactions

Fisheries, especially inland and coastal, as well as aquaculture rely on access to resources, fish, land and water which are the object of diverse and complex sets of rules and agreements, both formal and informal and for which they are in competition with other economic activities, often conducted by bigger actors. This situation can lead to various conflicts and to small fishers and fish farmers being deprived of rights of access which can threaten their livelihoods. Where there are disparate property systems and uses are partially or fully exclusive, conflicts are bound to arise. If property rights are ill-defined or if they are spread across a large number of users, solutions may be difficult to find.

As discussed by the HLPE in its report on Investing in Smallholder agriculture for food security, smallholder farming systems are often complex and include a diversity of activities, many of which require access to resources (HLPE, 2013b). It includes rights to diverse wild foods (Bharucha and Pretty, 2010). As shown above fishing rights are often a crucial element in the food security and nutrition of the poorest households. In many cases, losing a fishing right, even if it is only part of a broader set of activities can totally disrupt the food security of a household. Such impacts on food security are difficult to perceive, assess and compensate, unless those who experience them have the opportunity to make them known.

Box 18 Examples of Territorial use-rights in fisheries

The Japanese Common Fishing Rights System is a comprehensive catch share program that manages the nearshore fisheries along Japan's vast coastline by allocating secure areas, or Territorial Use Rights for Fishing (TURFs), to harvesting Cooperatives. The system has evolved over time and is a model for managing mobile nearshore species through a network of scaled Cooperatives. The program depends upon a coordinated system of co-management, including nested layers of governance from the federal level down to the regional level. The program design has promoted innovative approaches—especially by fishermen—including coordination within and across TURFs (and Cooperatives), and pooling of harvesting arrangements to improve economic efficiency and resource sustainability.

The Chilean National Benthic Resources Territorial Use Rights for Fishing Programme is among the largest species and area-based catch share programs in the world. It includes over 17,000 artisanal fishermen co-managing over 550 distinct areas along the coast. The program focuses on managing the artisanal small-boat fishermen targeting nearshore benthic resources. The voluntary system of co-management by the government, industry and fishers primarily manages loco, Chile's most valuable mollusc, and provides secure access to benthic resources to groups of artisanal fishermen. It includes scientific advice from academics to guide management. Loco must be managed within a TURF and numerous other species are also eligible for exclusive use rights within the system.

In the late 1980s and early 1990s, the Samoan government embarked on major efforts to formalize and support customary fishing rights of native communities. Through legislative reforms, and the creation of the Samoan Customary User Rights System, groups of fishermen organized by villages are able to voluntarily establish and manage TURFs over traditional fishing grounds, and regulate the harvests of community members and outsiders fishing in their waters. The program has been designed to meet the goals of sustainable resource use and empowering villages in fishery management. Key design features include the active participation of the Samoan government in guiding the creation and management of TURFs and the integration of traditional management practices to achieve sustainability. In the Safata District, community members have established a district-wide TURF with a network of no-take reserves to increase biological performance and sustain local livelihoods into the future.

Successfully incorporating customary tenure systems into formal TURF systems relies on preserving the elements of the tenure systems that make them successful, while introducing additional institutions that strengthen customary management in the face of improved fishing technology and socioeconomic changes.

Source: Poon and Benton, 2013

Along rivers fishing rights entertain diverse relations to land tenure. They can be linked to land ownership and, as such, sold or rented. They can also be separated from land ownership, sometimes retained by the state, or attributed separately. The rules can even be different according to fish species, with for instance different rules in Scotland for salmon and sea trout fishing rights. When fisheries rights are separated from land tenure they include a right of access, which can be a source of conflicts. Similarly, gleaning, often a customary right, requires access to the shore. Wild Salmon is in many countries the object of difficult juridical battles, between fishing rights owners along the river; or even, as for instance in California, because other uses, especially agriculture, are reducing water available to the fish.

As coastal areas and river banks are the object of diverse activities, including urbanization, aquaculture, etc., access rights which are not linked to land tenure, or to unsecure land tenure, can be threatened (HLPE, 2011). Furthermore, the water ecosystem on which fish is depending can also be threatened by other water users or/and by the development of economic activities. In such cases rarely do water governance schemes properly account for the impacts of water management on fisheries nor on fishers' food security.

For instance, dams, modification of river beds either to exploit materials, or for the creation of waterways, can have important and long term consequences on fish populations and ecosystems, by destroying reproductive or important feeding areas (FAO, 2001). Similarly development projects and urbanization can profoundly modify tidal flows and coastal ecosystems with important consequences on marine resources and thus on populations depending on fishing and gleaning. Water management, its quantity, temperature and pollution can also affect fish ecosystems, for example electricity companies using water to cool down power plants, water use and pollution by other economic activities including agriculture as well as urban consumption. Often fishers' concerns and environmental issues are linked which could provide opportunities for common strategies towards sustainable fisheries for food security and nutrition.

Integrating food security and nutrition concerns would therefore require to appropriately include in the management of resources and particularly of water and land, considerations on fishing rights, impact of water management on fish and therefore on food security and household economy of fishers. This calls for better involvement of fishers and recognition of their rights and needs in water management schemes, especially as the activities that can impact them are often led by powerful actors and interests. A key issue is often to integrate consideration of informal use rights in formalized systems of governance, planning and management.

3.4.5 Aquaculture development and rights of access to land, water and infrastructure

Access to resources for aquaculture can be especially contentious given the specific requirements for this activity which needs to take place on suitable lands, in particular linked to appropriate water resources, in a context of a strong development of the activity, and given competing uses on these specific areas with a wide a range of other activities, including fisheries.

In the aquaculture sector, secured rights to land and water are essential to the development and investments in the sector. Issues of rights are linked to the location of the activity itself.

Aquaculture development and competition between different forms of aquaculture

Rights may even differ among different types of fish-farming, with the effect of favouring some users and types over others, e.g. protecting the larger-scale operators versus the smaller, or men versus women (Ramachandran, 2012).

In India, aquaculture enterprises have suffered bias in the rights to coastal space based on gender and the small scale of these new operations (Ramachandran, 2012). In southern India, mussel farming on the Malabar Coast initially took off as a women's aquaculture industry and "empowerment platform" supported by the Self Help Group movement of Indian Government agencies and NGOs (Kripa and Surendranathan, 2008). However, as mussel farming became successful and profitable, men began to move into the industry and the women's groups could not legally protect their use rights to the mussel farming grounds. Meanwhile, open sea cage culture, requiring larger capital to start up, was developed by men with greater capital and their rights to cage sites were protected by the State from the start (Ramachandran, 2012).

Aquaculture development and competition with fisheries (inland and marine)

Aquaculture and wild-harvest fisheries often interact spatially; the two subsectors can overlap and compete for port access, use of land and water habitat, and investments (Hoagland and Powell, 2003).

Both in fresh- and salt-water environments, complex issues of coastal and land planning arise to deal with competing uses between aquaculture and the capture sector (Place *et al.* 2013).

For instance, the siting of aquaculture facilities, such as ponds, net pens, long-lines or rafts for seafloor grow out, may displace some forms of fishing activity. As more space is progressively allocated for aquaculture on lakes, water-bodies or along the coast, smaller wild stocks and more congestion are likely to affect the fishing activities in the areas remaining open for wild harvest.

Conflicts are particularly common when aquaculture is introduced into a region where fishery activities are already established (Marshall, 2001; Soto *et al.*, 2012). For example, new cage-culture farms are often likely to be placed in areas that were formerly used by fishers directly for fishing or as passage to fishing areas (Halwart, Soto and Arthur, 2007).

In many instances, fishers and fish-farmers gain access to the aquatic system under different sets of rules and legal rights.

Aquaculture development and other activities

Aquaculture requires investments, which makes security of land tenure and water access absolutely crucial. At the same time, being in areas which are the object of high competition for land and especially for inland aquaculture, depending on water, which use is also competed for various activities (irrigation, energy, industry, human consumption, etc.), it requires, especially in countries and areas where aquaculture is of recent development to integrate these specific concerns in land and water management with the objectives of sustainability and food security and nutrition. Food security and nutrition concerns can lead to the necessity to arbitrate between potential trade-offs

between the various activities, which requires to balance not only productive and economic interests, but also social issues.

3.4.6 Governance in fish food chains

As discussed in Chapter 2, many food security outcomes are driven by the organization and governance of fish markets and food chains.

International trade plays a major role in the orientation of production, both by promoting certain types of organization, such as transformation at sea in big boats and by setting quality standards driven by export markets. These are generally initiated and set either by big private operators or/and by non-governmental organizations of importing countries. Better inclusion of exporting countries and of the interest of small-scale fishers in standard setting bodies, such as Codex alimentarius and private standards organizations would help making them take into account developing countries and small-scale fisheries specificities.

In particular, a more inclusive governance of voluntary sustainability standards would enable to make them work better for small fishers and operators, both by including food security and nutrition concerns in the standards and by devising procedures adapted to the needs and capacities of small actors (Mathew, 2011, FAO 2014b).

Such certification schemes also play an important role in the determination of Best Management Practices (BMP), for agriculture in general (FAO, 2014c), as well as for aquaculture. In addition to the Code and its aquaculture-relevant instruments, the generalized use of the BMPs approach as a way forward to address some of the aquaculture sector challenges and in particular the impacts that uncontrolled development of fish farming may have on the environment (see Section 2.3) has been relatively successful in reducing the risk of environmental impacts (Hishamunda *et al.*, 2012). As seen in Chapter 2, these schemes however present the risk to exclude those producers, often small-scale, who lack the necessary awareness, organizational and investment capacity to participate (Stanley, 2000; Vandergeest, 2007; Bush *et al.*, 2013; Khiem, Bush and Coles 2011; Ha, Bush and Dijk, 2013). Also, BMPs and codes of practice need to be adapted to the diversity of situations and provide a suitable range of technical options. With assistance, small-scale farmers can successfully access BMP through cluster farming, as has been shown in the project related to small-scale shrimp farming in five states of India (Umesh *et al.*, 2009), with reduced disease risk and more than doubled annual profit per unit of cash investment.

Box 19 A community based public-private partnership to develop sea cucumber farming in southwest Madagascar

Sea cucumbers have been a dietary delicacy for centuries in Asia. There is today a lucrative international market for sea cucumbers. Sea cucumber populations are threatened in many parts of the world. Sea cucumber aquaculture is currently considered as a substitute to wild catch.

In the region of Toliara (Southwest of Madagascar) few economic opportunities exist beyond fishing and coastal people are highly reliant on the sea for their survival. For Vezo fishers communities, a semi-nomadic coastal people in Madagascar, who inhabit this region, sea cucumber has become a primary source of income. Since the 1990s, overexploitation of marine sea cucumbers led to a marked decline in their abundance, with adverse socio-economic consequences due to the increased scarcity of this high-value export product, and ecological consequences as sea cucumber as macro-detritivores are major components for sustaining coastal ecosystems in tropical areas.

A partnership, initiated in 1999 by the Government of Madagascar with the support of the Belgian university development cooperation, brought together local communities, NGOs and private sector stakeholders to pioneer a form of village-based mariculture in which hatchery-reared juvenile sea cucumbers are raised by coastal communities in simple sea pens, build with locally available materials. It led in 2008 to the creation of the first private company based on sea cucumber aquaculture in Madagascar. The company collaborates with local NGOs to grow out sea cucumbers in a network of 50 village-based mariculture units along Madagascar southwest coast. Sea cucumber reared in pens reproduce before they are harvested, constituting a spawning biomass, and the mariculture network provides a mean of supporting recruitment for severely overexploited wild populations. The partnership connects isolated coastal communities to export markets and enable families to develop their own aquaculture businesses. It provides a novel approach to developing new livelihoods for communities in the region.

Source: Robinson and Pascal, 2009; Toral-Granda, Lovatelli, and Vasconcellos, 2008; McVean *et al.*, 2005

The organization of fish food chains, the way small actors are organized and are interacting with transformers and traders play a crucial role in determining income, both in level and stability, and to provide viable livelihood activities, including to maximize opportunities offered by trade (see Box 19), as well as opportunities offered by the transformation and valorization of the various parts of fish (see Box 12).

3.4.7 Implementation of rights-based approaches at national level

In most countries, too little attention has been given to the ways different individuals and groups (including poorer and marginalized people in the fisheries and aquaculture supply chains, but also poor consumers more generally) will gain, lose, or be excluded from access to fish resources, to other productive supply chain assets, or to fish as a food commodity. In this regard, evidence suggest that rights-based instruments are important effective tools to help ensure that states fulfil their obligations, including those pertaining to the right to food.

The 2012 *Voluntary guidelines on the responsible governance of tenure of land, fisheries and forests in the context of national food security* adopted by the Committee on World Food Security (CFS) in 2012 provide guidance on how to secure rights, in particular for those who directly depend on the resources for their livelihoods. Article 8.3 on collective rights and common resources, is relevant to design and assess policies and programmes especially these which affect the access of fishing communities to natural resources.

In a context where small-scale fisherfolk are faced with increasing competition for declining natural resources from more powerful large-scale fisheries, the implementation of the 2004 *Voluntary Guidelines on the Progressive Realization of the Right to adequate Food in the context of national food security* (VG) can help to ensure that food security and nutrition is realised (Box 20). For example, the Guidelines make it clear that States should refrain from adopting any policy that affects the territories and activities of small-scale, artisanal and indigenous fishers unless their free, prior and informed consent is obtained (de Schutter 2012). The most relevant recommendations in the VGs relate to the access to natural resources, the participation of all stakeholders in decision-making processes, and the preferential treatment for vulnerable sectors of the population (Ekwall and Cruz, 2009).

3.5 Better governance for more food security and better nutrition

A large body of work shows the importance of good governance, policy and practice to realize the full potential of fisheries and aquaculture for food security and nutrition.

We have seen that to a certain extent, in fishing governance schemes, the biggest the scale (international level), the more the object seems to be the fish, and the more the objective seems to be to protect the resource, and/or to optimize its exploitation, mainly from an economic point of view, including a time dimension. This is why, in fishing governance schemes at international levels, the impression is that less importance is given to food security and nutrition, and social concerns in comparison with other concerns related to fisheries' management.

Conversely, downscaling towards national and local scales implies successive "attribution" of the resource, of access to it, or of its management and is often accompanied by enrichment in objectives. At smaller scales, schemes can embrace more diverse objectives, including social aspects, and thus are more inclined to include diverse food security and nutrition concerns.

Box 20 The right to food in action in fisheries in South Africa

"A group of 5,000 artisanal fishers in South Africa launched a class action following the adoption of the Marine Living Resources Act (MLRA) of 1998. The fishers claimed that the national authorities failed to provide them with adequate fishing rights since they were not given legal recognition as 'artisanal fishers' within the MLRA. They argued that the implementation of the MLRA violated their right to food as recognized in the South African Constitution of 1996. A decision issued by the Court, as well as an agreement reached with national authorities, enabled the group of fishers to reach interim relief measures and initiate a negotiation process for a new fishing policy in which their condition would be changed." Ekwall and Cruz, 2009

At all scales, but probably more at larger scales (because of the above and the fact that those international instruments often frame those operating at national level) the way instruments are embracing food security and nutrition dimensions can be a concern.

For instance, food security or poverty and small-scale fisheries themes are not deeply elaborated in Code instruments, which have more of a focus on environmental sustainability and technical issues related to aquatic resources rather than on the people who depend on them.

There is therefore a need to integrate better food security and nutrition concerns into oceans, fisheries and aquaculture development plans, and conversely to ensure that the role of fish for food security and nutrition partakes into broader development plans and strategies (UN, 2014). Both aspects will be crucial to ensure that the sector can meet a more complex set of objectives without being socially, economically or politically marginalized.

The wide range of international partnerships and initiatives could provide a way to pioneer and provoke such changes. To succeed in doing so, they need however to improve transparency, inclusiveness and balance in the governance of their own processes.

This is why there is a need for better, more inclusive governance and to establish governance systems that are more aware of these various dimensions of the problem, allowing and empowering stakeholders to engage actively in decision-making processes, in appropriate management mechanisms and rights definitions, towards making end-users become responsible stewards of the resources.

4 CONCLUSIONS AND RECOMMENDATIONS

Fish plays a crucial role for food security and nutrition as a food and a rich source of nutrients, particularly for some LIFDCs and vulnerable populations. It also provides jobs and income especially through small-scale fisheries and aquaculture in developing countries. However, these roles have often not been fully recognised nor integrated in food security and in fisheries policies. Therefore the HLPE proposes conclusions and recommendations focused on 8 areas: affirming a central position for fish in food security and nutrition strategies, addressing the threats for world fisheries, as well as opportunities and challenges in the aquaculture, recognising the importance of small-scale fishing operations, with a particular attention to trade and markets, improving social protection and labour rights, as well as gender equity, and finally better integrate food security and nutrition in the governance of the sector.

1. Fish deserves a central position in food security and nutrition strategies

Fisheries and aquaculture are often virtually absent in all global reports on food and food insecurity (e.g. FAO SOFA and the FAO food insecurity reports) and food security and nutrition is virtually absent from fisheries and aquaculture status reports (e.g. SOFIA) and in policy (e.g. the Code of Conduct for Responsible Fisheries (CCRF)). These gaps should be filled by integrating situation reports on fish and food security and nutrition in general food reports and in fisheries and aquaculture reports.

The roles of fish for food security and nutrition are often not fully recognised and integrated in agricultural and food security strategies and programmes. In particular because fish is more nutritious than staple plant foods, and provides high levels of animal protein, health promoting long-chain fatty acids (LC-PUFAs) and micronutrients, it can play an extremely important role in improving the nutritional status of individuals, in particular those at risk of malnutrition such as children and pregnant women. Yet, with some few exceptions, fish has so far been only marginally included in the international debate on food security and nutrition. Many nutritional programmes are still not aware of, and not recognizing and building on the potential of fish for reduction of malnutrition and micronutrient deficiency.

States should

1a) Make fish an integral element in inter-sectoral national food security and nutrition policies and programmes with special regard to promoting small-scale production and local arrangements (such as procurement through local markets, e.g. for school meals) and other policy tools, including nutrition education.

1b) Include fish in their nutritional programmes and interventions aiming at tackling micronutrient deficiencies especially among children and women, in the respect of cultural specificities, promoting local procurement, and taking into account costs and benefits.

1c) Strengthen international assistance and cooperation to build the capacity of developing countries to negotiate better terms in fishing agreements to protect the food security and nutrition of their populations.

1d) Eliminate harmful subsidies that encourage over-fishing, to make progress toward halting the current decline in global fish stocks. Revenues available to states from foregone subsidies could be redirected towards public good investments that support food security and nutrition in relation to sustainable fisheries (such as infrastructure and capacity development), or to improve the livelihoods and economic possibilities of fishing community residents.

States, national and international research institutes and development agencies should

1e) Conduct regular intra-household studies to better understand the pathways between fish, gender and the nutritional status of individuals and households, including on the impact of over-fishing. These studies need to be conducted based on gender-disaggregated data.

The global discards of fish (fish dumped overboard due to low quality, partial damage or spoiling, non-targeted species or below regulated size catch) represent a significant part of the world's marine catch – estimated in 2005 to be about 8 percent of the world total capture fisheries, with a lower rate of 3,7 percent for small-scale fisheries. To date, most of the research into fisheries discards has focused on the environmental conservation aspects of the discards and has overlooked the positive and negative

aspects related to food security and nutrition. Waste in other parts of the fish value chain are also substantial and little studied.

States, national and international research institutes and development agencies should

1f) Review fisheries' discarding practices and options through a food security and nutrition lens as well as with regard to resources and ecosystem sustainability.

2. Threats and risks for world fisheries, including effects of climate change

Climate change impacts are already visible, with modifications of the geographic distribution of species and warmer water species moving towards the poles, ocean acidification and changes in coastal conditions that affect habitat. This has various impacts on production. Inland fisheries and aquaculture may face higher mortality due to heatwaves, water scarcity and competition for water. Climate change impacts on fish-dependent populations will depend on the evolution of fishing opportunities (evolution of resources available, entitlements and capacities to fish, evolution of operational costs in production and marketing) and the evolution of prices. Impacts of extreme events are increasing, with more risks of damage or loss of infrastructure and housing. Sea level rise might lead to the relocation of communities.

States should

2a) Mainstream climate change adaptation strategies relevant to fish and food security and nutrition into all aquaculture and fisheries policies and actions at national and subnational levels, including by linking them to climate and weather research and prediction agencies, developing specific studies and introducing, where needed, flexibility in management and governance mechanisms.

2b) Engage in inclusive dialogue and analysis to build scenarios to understand the possible impact of climate change on the food security and nutrition of most vulnerable zones (for example coastal and small island states) that could be affected and develop and implement the necessary actions through inclusive processes.

To meet the growing human demand for food, the sustained long-term production of all food types, including fish, must be secure. In the case of capture fisheries, this requires sustaining the natural fisheries resource base, supported by fisheries resource and ecosystem assessment. The scientific methods and capacity for such assessments need to be greatly expanded, especially in developing countries. The present fisheries resource assessments and their links to fisheries management and governance have been dominated by developed country, industrial-scale single-species fisheries approaches and models aimed at maximizing the biological and economic returns from the resources. Conventionally, assessments stress improving the yields of higher-value species, and generally larger fish, thus often overlooking fish species and sizes of importance to food security and nutrition.

FAO should

2c) Take the lead in a global effort to redevelop resource assessment tools and governance concepts suitable for use in improving the contribution of fish to food security and nutrition, including by developing new approaches for use in the multispecies, multigear fisheries and more adapted to the specific characteristics of small-scale fisheries.

3. Opportunities and challenges in aquaculture

Aquaculture contributes substantially to global fish production and food security and nutrition. With plateauing of production from capture fisheries in the last decade and meagre chances of increasing production substantially in the future, aquaculture has to play a major role in meeting the increasing demand in coming years and contribute to food security and nutrition.

With an expected increase in aquaculture production to meet fish demand, the use of fishmeal in fish feeds needs to be better controlled and reduced. Much of the small pelagic fish used to produce fishmeal is edible and can contribute to food security and nutrition in developing countries.

National and international research organizations (such as the CGIAR Centers), funded by the governments and other agencies, should

3a) Lead research and development initiatives that aim at enhancing sustainability and productivity of aquaculture, both in small and large-scale systems. Research should focus on health control and food safety, improved feed stocks that do not directly compete with human foods, domestication and genetic improvement of key traits contributing to the various dimensions of food security and nutrition,

integration of aquaculture in agroecological models of production at the farm and landscape levels, and improved linkages with food chain, with due consideration to ecosystems' integrity.

States and other private and public stakeholders and international actors should

3b) Put in place appropriate actions to reduce further the use of fish meal and fish oil as feed in aquaculture and livestock production, and should encourage their elimination by the use of alternate sources as well as by the promotion of low trophic level fish (herbivores and omnivores).

3c) Put in place the conditions to develop and implement South-South collaborations to encourage sharing and learning experience in aquaculture.

4. Small-scale versus large-scale fishing operations

The importance of small-scale fisheries (in particular inland fisheries) in rural household diets is often underestimated or even ignored because catches from subsistence fishing are rarely included in national catch statistics. Yet sufficient evidence is available that demonstrates that small-scale fisheries are a crucial entry point for food security and nutrition interventions in developing countries.

Governments and other private and public stakeholders should

4a) Recognize the contribution of small-scale fisheries to food security and nutrition, and take into account their characteristics in the design and implementation of all national and international policies and programs related to fisheries, including through appropriate and inclusive representation.

4b) Support self-organized, local professional organizations and cooperatives, as these arrangements strongly contribute to foster the integration of small-scale operators into markets.

National and regional agencies responsible for fisheries should

4c) Give high priority to the support of small-scale fisheries through adequate planning, legislation and the recognition or allocation of rights and resources. Where small-scale fisheries are in competition with larger-scale operations, governments should promote the former's contribution to food security and nutrition and, in particular, develop national policy regulations that protect small-scale fisheries.

5. Trade and markets

Evidence suggests that international fish trade can have mixed impacts on the well-being and food security and nutrition of local fishing populations. On one hand, some analysts point to the contribution that export revenues from fisheries could make to local economies and extra government revenues, with opportunities to redeploy those for pro-poor interventions, including support for food security and nutrition. Additionally the growth and employment effects of fisheries development can have positive indirect consequences on the food security and nutrition of the poor. Other studies, on the other hand, have shown that in many cases very remunerative international fish trade generating millions of dollar of revenues co-exist with miserable living conditions for the local communities who have been displaced by industrial scale operators, or excluded from the trade by stringent commercial regulations, losing access to employment and to a rich food source. Existing evidence also suggests that developing nation governments have not always negotiated good agreements with foreign fishing operators for the resources extracted from their fisheries.

The large number of small-scale, informal producers and traders (mainly women) – who are usually marginalized by the globalization of fish trade oriented to a small number of globally traded species – would be able to better engage with the market opportunities created by domestic or regional trade, where demand exists for a diverse set of local species and products that small-scale fisheries can produce, and that are easier to commercialize at these levels. Focusing more policy attention, carefully devised interventions (such as development and market infrastructure) and research, on regional/domestic trade in developing countries would therefore help make more fish available locally, contributing to reduce a growing tension -which fish imports cannot alone alleviate- between the demand and supply of fish. In Africa, renewed focus on local trade of products could also provide a further stimulus for aquaculture, which has been contending with production challenges. Increased demand for fish by the growing urban (and rural) population could also boost investments in, for example, peri-urban aquaculture.

States should

5a) Ensure that food security and nutrition are better taken into account in the objectives of policies and mechanisms related to international, regional and local fish trade, including by the inclusive development of guidelines, procedures and regulations to protect the food security and nutrition of local populations.

International agencies, regional economic and fisheries bodies and national ministries should

5b) Allocate more policy attention and resources to develop, promote and support domestic and regional fish trade. Investment should take account of the voluntary guidelines for land, fisheries and forests and respect the Principles for Responsible Investment in Agriculture. They should redirect resources to and support capacity building for the different actors involved in local, national or regional fish trade activities, especially through the value chains involving small-scale fisheries, aquaculture and marketing.

Governments, international organizations, private sector and civil society should

5c) Support the development and use of existing or new sustainability certification standards which include food security and nutrition criteria and facilitate the engagement of small-scale operators by adequate support and capacity building.

6. Social Protection and labour rights

At all scales, many women and men in fisheries and aquaculture production work in low-paying jobs, often under difficult and dangerous work conditions. In the fish sector food security and nutrition is negatively impacted by the difficult, dangerous and informal labour conditions of many of its workers, including the large numbers who are self-employed. To improve social protection for fishworkers is a critical factor for achieving their food security and nutrition

States should

6a) Ratify the ILO No. 188 Work in Fishing Convention to ensure improved working conditions and social security of those working in the fishing sector.

States, in particular national government labour agencies, in collaboration with fisheries agencies, should

6b) Improve national level regulations for fishworkers, including women workers in processing factories and markets, migrant and local crew on fishing vessels. Owners should guarantee that their vessels are sea-worthy and that at-sea working conditions are safe.

6c) Take measures to put in place social protection systems in the form of minimum wages and social security schemes for both fishers and fishworkers, including self-employed workers, women and migrant workers.

7. Gender equity

Women make up half the workforce (by number) in capture fisheries value chains and a large share in aquaculture chains but their contributions are underrecognized, underenumerated and frequently informal. The fish sector has a major knowledge gap on gender and therefore cannot progress on gender-equitable and well-targeted approaches to sector development, particularly with regard to food security and nutrition. The work of participants in fish value chains is highly gendered and fraught with inequalities, creating food security and nutrition challenges. The impacts of major transitions occurring in the fish sector are also highly gendered, although the policies and practices that are driving the changes are typically gender-blind. Within fisheries and aquaculture-linked communities, intrahousehold information, including the gender dimension, on the links between fish-related activities, fish intake and nutritional status, is scarce. There is a need to promote greater equality in the fish sector, improve knowledge and to better inform policy and action to achieve food security and nutrition and gender equity.

States should

7a) Ensure that their aquaculture and fisheries policies and interventions do not create negative impacts on women and encourage gender equality.

7b) Enshrine gender equity in all fisheries rights systems, including licensing and access rights. The definitions of fishing must cover all forms of harvest including the forms typically practised by women

and small-scale operators, such as inshore and inland harvesting of invertebrates by hand and the use of very small-scale gear.

The FAO Committee on Fisheries (COFI) should

7c) Develop policy guidance on gender equality and economic contributions, e.g. technical guidelines on gender in aquaculture and fisheries within the Code of Conduct on Responsible Fisheries.

The CFS should

7d) Urge international and national fish sector organizations to fully address the gender dimension of the fishery and aquaculture sectors in their policies and actions to overcome the unintended gender-blindness of present approaches.

Development assistance programmes should

7e) Be gender-aware and give priority to gendered projects.

8. Governance

Governance is particularly important to determine access to fisheries resources, integrity of fisheries resources and distribution of fish benefits. In most countries, too little attention has been given to the ways different individuals and groups (including poorer and marginalized people in the fisheries and aquaculture supply chains, but also poor consumers more generally) will gain, lose, or be excluded from access to fish resources, to other productive supply chain assets, or to fish as a food commodity. In this regard, evidence suggest that human rights instruments are important effective tools to help ensure that states fulfil their obligations, including those pertaining to the right to food.

In the face of increasing and competitive economic exploitation of the oceans and freshwater, fish and food security and nutrition interests are usually acknowledged at the international level, but only in general and rhetorical terms. Analysis of existing international partnerships and initiatives reveals that detailed strategies linking production growth and sustainability to food security and nutrition are lacking. Global partnerships are often deficient in the way they associate representation of the small-scale operators from developing countries.

At national level, the limited number of recent meta-analyses that are available show that both in terms of direct effects through access to and improved status of the resource base, and indirect pathways through income derived from fishing-related activities, co-management of fisheries' resources has not yet delivered the expected improvements in food security and nutrition.

States must

8a) Comply with their obligations under international human rights treaties, including the International Covenant on Civil and Political Rights and the International Covenant on Economic, Social and Cultural Rights.

States should

8b) Assess policies, interventions and investments with direct and indirect links to fisheries and fishing communities in terms of their impacts on the right to food of the affected communities.

8c) Use the Voluntary Guidelines on the Good Governance of Tenure of Land, Fisheries and Forests in the Context of National Food Security, recognising the particular relevance of article 8.3 on collective rights and common resources, to design and assess policies and programmes especially these which affect the access of fishing communities to natural resources.

8d) Ensure that fishing communities and fish workers actively and meaningfully participate in all decisions that impact their enjoyment of the right to food.

8e) Ensure that food security and nutrition, that are gender-sensitive, are an integral element of fish-value-chain governance mechanisms, including national government policies, certification standards and corporate social responsibility policies.

8f) Formally protect the rights and ongoing tenure over sites for food-insecure people, fishing communities and indigenous and tribal peoples.

8g) Support the development of small and medium enterprises, by e.g. helping them access best management practices and credit schemes to stay profitable.

FAO should

8h) Lead reform of international fisheries and ocean governance with the objective of improving the transparency and representativeness of all the major international programmes and initiatives to guarantee that the small-scale fishers are fully included in these programmes. These programmes should go beyond their early focus on economic growth with ecological sustainability and aim to prioritize food security and nutrition and poverty alleviation.

The CFS and COFI should

8i) Convene a special joint session involving international fisheries and aquaculture bodies and related actors to share views on how to coordinate their policies and programmes towards progress in the food security and nutrition outcomes of their activities.

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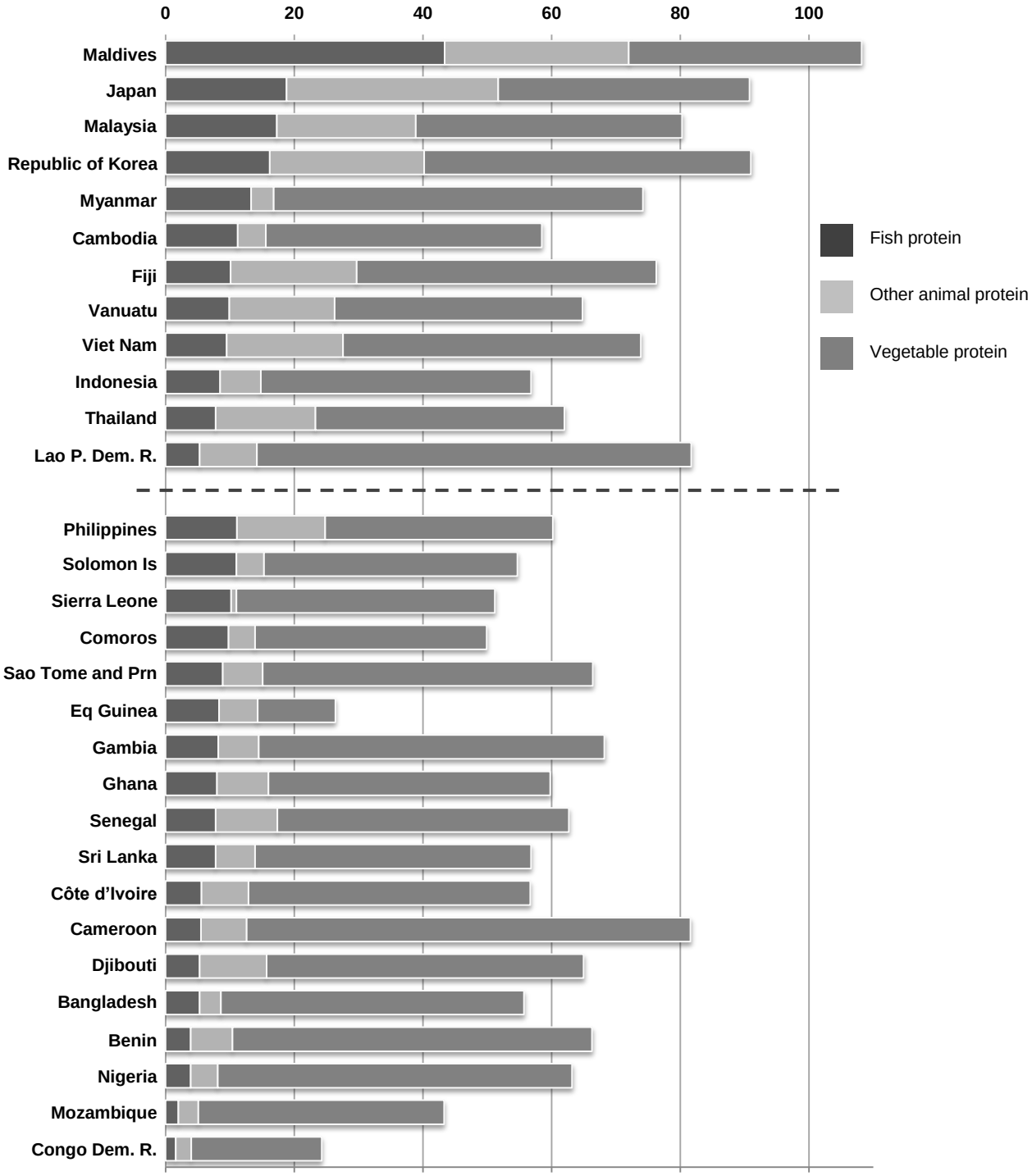
APPENDICES

A1 Total protein consumption in g/capita/day the countries with the highest part of fish in total animal protein consumption in 2010



Countries below the dashed line are part of the Low-Income Food Deficit Countries (LIFDC) 2014 list. Cambodia, Indonesia, Lao's People's Democratic Republic and Vanuatu were in the 2010 LIFDC list. The updated list of LIFDCs can be found at: http://www.fao.org/countryprofiles/lifdc/en/

Source: updated from Kawarazuka and Béné (2011).

A2 Nutrient content of fish and other foods (per 100 g)

	Scientific name/Common name	Protein	Fat					Calcium	Iron	Zinc	Vitamin A	Notes	Source
			Total lipid (fat)	Total saturated	Total poly-unsaturated	EPA	DHA						
	Units	g	g	g	g	g	g	mg	mg	mg	RAE[a]	per 100 g[b]	
Large freshwater fish and prawn	Carp	17.83	***5.60***	1.08	1.431	0.238	0.114	41	1.24	1.48	9	raw, edible	1
	Catfish	15.60	***7.59***	1.77	1.568	0.067	0.207	9	0.50	0.74	15	farmed, raw, edible	1
	Channa striatus (Snakehead)		***0.99***	0.34	0.475	<0.001	0.133					raw, whole, Thailand	2
	Tilapia	20.80	***1.70***	0.77	0.476	0.007	0.113	10	0.56	0.33	0	raw, edible	1
	Macrobrachium nipponense (Prawn)		***1.13***	0.37	0.020	0.008	0.061					raw, whole, Thailand	2
Small freshwater fish	*Amblypharyngodon mola* (Mola)							776	5.70	3.20	>2 680	raw, edible. Bangladesh	3
	Esomus danricus (Darkina)							775	12.00	4.00	500-1 500	raw, edible. Bangladesh	3
	Esomus longimanus (Chanwa phlieng)							350	45.10	20.30	100-500	raw, edible. Cambodia	4, 5
	Helostoma temmincki (Kanthtrawb)							432*	5.3*	6.5*	100-500	raw, edible. Cambodia	4, 5
	Puntius ticto (Puti)							992	3.00	3.10	500-1 500	raw, edible. Bangladesh	3
	Rasbora tornieri (Changwa mool)							700*	0.70*	2.7*	>1 500	raw, edible. Cambodia	4, 5
	Anabas testudineus (Climbing perch)		***0.99***	0.34	0.384	<0.001	0.088					raw, whole, Thailand	2
	Puntius brevis (Swamp barb)		***0.90***	0.31	0.314	0.000	0.047					raw, whole, Thailand	2
	Rasbora borapensis (Blackline rasbora)		***0.86***	0.33	0.319	0.002	0.083					raw, whole, Thailand	2
Marine fish	Anchovy	20.35	***4.84***	1.28	1.637	0.538	0.911	147	3.25	1.72	15	raw, edible, European	1
	Herring	16.39	***9.04***	2.04	2.423	0.969	0.689	83	1.12	0.99	32	raw, edible, Pacific	1
	Mackerel	18.60	***13.89***	3.26	3.350	0.898	1.401	12	1.63	0.63	50	raw, edible	1
	Milkfish	20.53	***6.73***	1.67	1.840			51	0.32	0.82	30	raw, edible, Philippines	1
	Sardine	24.60	***10.5***	2.5	2.5	0.6	0.9	275	2.0	1.9	11	canned in oil, drained solids with bone	1
	Farmed Atlantic salmon (*Salmo salar*)	20,1	***12.9***	2.2	3.6	0.6	0.9	4.7	0.2	0.3	8.5		6
	Tuna (*Thunnus alalunga*)	27.3	***1.1***	0.5	0.4	0.1	0.3	2.9	0.9	0.4	3.5		6
Other animal-source foods	Beef ground	14.30	***30.00***	11.29	0.696			24	1.64	3.57	0	raw, 70% lean meat 3% fat	1
	Chicken breast	14.70	***15.75***	3.26	3.340			19	1.11	0.78	0	breast tenders, uncooked	1
	Chicken egg	35.60	***9.94***	3.10	7.555	0.004	0.037	171	3.23	1.11	140	raw, whole	1
	Chicken liver	16.90	***4.83***	1.56	1.306			8	8.99	2.67	3 292	all classes, raw	1
	Cow milk	3.28	***3.66***	2.28	0.136			119	0.05	0.37	33	3.7% milk fat	1
Plant-source foods	Cassava	1.40	***0.28***	0.28	0.048			16	0.27	0.34	1	raw	1
	Rice	2.69	***0.28***	0.28	0.323			10	1.20	0.49	0	white, long-grain, cooked	1
	Kidney beans	8.67	***0.09***	0.09	0.278			35	2.22	0.86	0	mature, cooked	1
	Carrot	0.93	***0.17***	0.04	0.117			33	0.30	0.24	835	raw	1
	Kale	3.30	***0.70***	0.70	0.338			135	1.70	0.44	769	raw	1
	Spinach	2.86	***0.39***	0.39	0.165			99	2.71	0.53	469	raw	1
	High content: threshold	>15.00			>2.000	>0.400	>0.400	>100	>3.00	>3.50	>500		

Note: Shaded cells in the table indicate high content values. Blank: no data available. Data compiled by Kawarazuka (2010); (a) RAE: Retinol Activity Equivalent; (b) Nutrition information is presented in 100g for comparison only; *Raw, cleaned parts. References: 1=USDA (2011); 2=Karapangiotidis, Yakupitiyage and Little (2010); 3=Roos (2001); 4=Roos *et al.* (2007a); 5=Roos *et al.* (2007b); 6= http://nutraqua.com/component/option,com_neocomposition/Itemid,53/lang,en/

A3 The HLPE project cycle

The HLPE has been created in 2009 as key element of the reform of the Committee on World Food Security (CFS), which is the foremost inclusive international and intergovernmental platform for a broad range of committed stakeholders to work together in a coordinated manner and in support of country-led processes towards the elimination of hunger and ensuring food security and nutrition for all human beings.[56]

HLPE's key functions are: to assess and analyse the current state of food security and nutrition and its underlying causes; to provide scientific and knowledge-based analysis and advice on specific policy-relevant issues, utilizing existing high quality research, data and technical studies; to identify emerging issues, and help members prioritize future actions and attentions on key focal areas.

The HLPE receives its mandate from CFS and reports to it. It produces its reports, recommendations and advice independently from governmental positions, in order to inform and nourish the debate with comprehensive analysis and advice.

The HLPE has a two-tier structure:

- A Steering Committee composed of 15 internationally recognized experts in a variety of food security and nutrition related fields, appointed by the Bureau of CFS. HLPE Steering Committee members participate in their individual capacities, and not as representatives of their respective governments, institutions or organizations.
- Project Teams acting on a project specific basis, selected and managed by the Steering Committee to analyse/report on specific issues.

To ensure the scientific legitimacy and credibility of the process, as well as its transparency and openness to all forms of knowledge, the HLPE operates with very specific rules, agreed by the CFS.

The project cycle to elaborate the reports, in spite of its being extremely time constrained, includes clearly defined stages. Starting from the political question and request formulated by the CFS, the HLPE organizes a scientific dialogue, policy-oriented. This includes the work of a topic bound and time bound Project Team under the Steering Committee's scientific and methodological guidance and oversight. It includes also external open consultations and an external scientific peer-review on a pre-final draft. The report is finalized and approved by the Steering Committee during a face-to-face meeting (Figure 11).

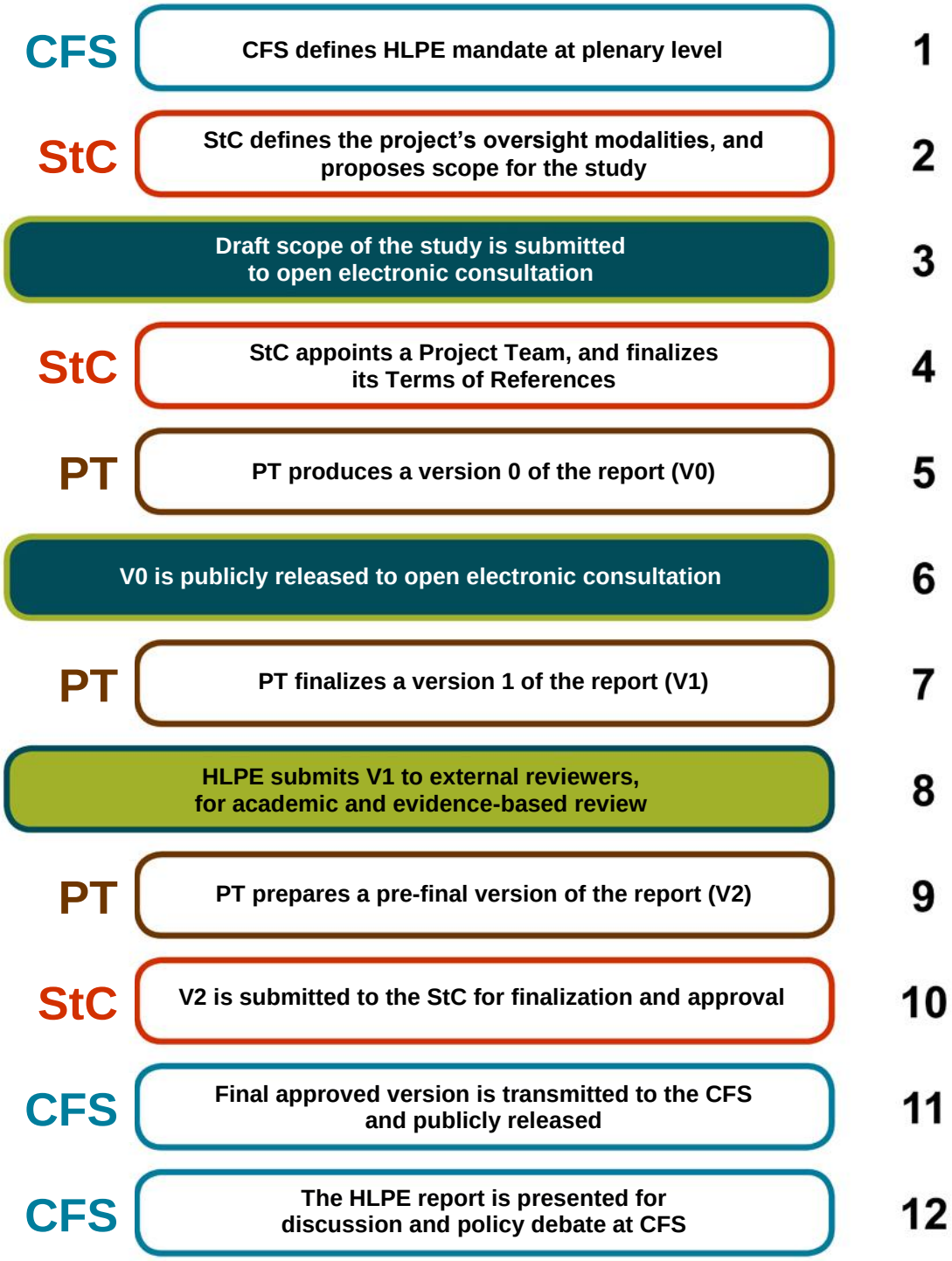
The HLPE runs two open consultations per report: first, on the scope of the study; second, on a V0 "work-in-progress" draft. This opens the process towards the experts HLPE roster (there are currently more than 2000 of them), and all experts interested and as well as to all concerned stakeholders, which are also knowledge-holders. Consultations enable the HLPE to better understand the issues and concerns, and to enrich the knowledge base, including social knowledge, thriving for the integration of diverse scientific perspectives and points of view.

The final approved report is transmitted to the CFS, published and translated in the 5 other official languages of the UN (Arabic, Chinese, French, Russian and Spanish), and serves to inform discussions and debates in CFS.

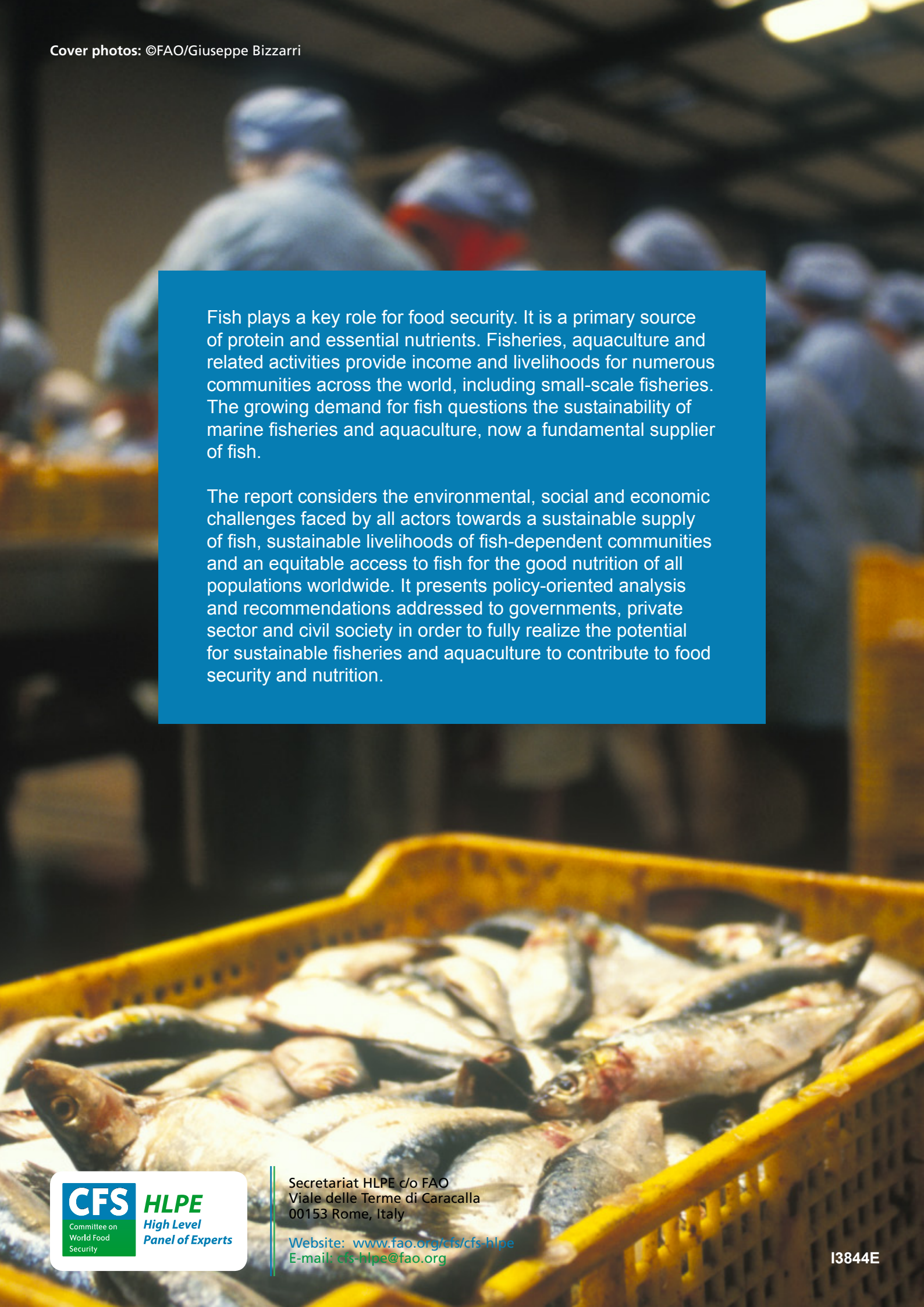
All information regarding the HLPE, its process, as well as all former reports are available at the HLPE website: www.fao.org/cfs/cfs-hlpe.

[56] CFS Reform Document, available at www.fao.org/cfs

Figure 11 HLPE project cycle



CFS Committee on World Food Security
HLPE High Level Panel of Experts on Food Security and Nutrition
StC HLPE Steering Committee
PT HLPE Project Team



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Fish plays a key role for food security. It is a primary source of protein and essential nutrients. Fisheries, aquaculture and related activities provide income and livelihoods for numerous communities across the world, including small-scale fisheries. The growing demand for fish questions the sustainability of marine fisheries and aquaculture, now a fundamental supplier of fish.

The report considers the environmental, social and economic challenges faced by all actors towards a sustainable supply of fish, sustainable livelihoods of fish-dependent communities and an equitable access to fish for the good nutrition of all populations worldwide. It presents policy-oriented analysis and recommendations addressed to governments, private sector and civil society in order to fully realize the potential for sustainable fisheries and aquaculture to contribute to food security and nutrition.

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