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Aquaculture, Fisheries, Poverty and Food Security

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Edward H Allison

Principal Scientist

Policy, Economics and Social Sciences

The WorldFish Center

Penang, Malaysia

Email: e.allison@cgiar.org

Table of Contents

List of Tables	3
List of Figures	3
Glossary.....	4
Acronyms and abbreviations	5
Executive Summary	6
Aims, rationale and structure.....	6
Pathways linking fisheries and aquaculture to poverty and food security.....	6
Impacts of recent policy reform in fisheries and development investment in aquaculture	7
Policy recommendations.....	9
1. Fisheries and aquaculture reform and the global food security agenda	12
1.1 The need for a food and nutrition security orientation in fisheries and aquaculture policy	12
1.2 Food security at the top of the development agenda	13
1.3 Representation of fisheries and aquaculture in global food security initiatives	14
2. The contribution of fisheries and aquaculture to poverty reduction and food security.....	15
2.1 GDP and trade.....	17
2.1.1. Contribution to GDP	17
2.1.2. Contribution to trade.....	17
2.2 Employment and growth linkages.....	18
2.3 Nutrition	19
2.4 Data weaknesses and their implications for policy.....	22
3. Policy reform in fisheries and aquaculture: poverty and food security implications	25
3.1 The transition to rights-based fishing: will the additional wealth reach the poor?.....	26
3.1.1. Failing fisheries and the need to reform fishing access rights	26
3.1.2. Models of fishery sector reform. emphasis on wealth and welfare.....	26
3.1.3. Fisheries governance reform: are there documented impacts on poverty and food security? ...	31
3.1.4. Conclusion	33
3.2 Does the globalization of fish trade benefit the poor?	34
3.2.1 Trade, poverty reduction and food security. global aggregate analysis	34
3.2.2 Trade, poverty reduction and food security. case studies from Lake Victoria and Bangladesh ...	37
3.2.3 Conclusion	38
3.3 Commercial versus small-farms and fish for health or wealth. debates in aquaculture	39
3.3.1. Aquaculture in Africa.....	39
3.3.2. Aquaculture in Asia.....	40
3.3.3 Aquaculture, the fishmeal industry and export of small-pelagics: do they reduce the supply of fish to the poor?	41
3.3.4 Aquaculture: pathways to poverty, food security and environmental sustainability	42
4. Improving the contribution of fisheries and aquaculture to poverty reduction and food security: policy recommendations	45
4.1. Strive for policy coherence	45
4.2 Avoid blueprints: fit reforms to context and sequence them appropriately	48
4.2.1 Matching reform goals to existing sector role and economic potential	48
4.2.2 Sequencing development interventions	50
4.3 Invest in evidence-based political economy analysis	51
4.4 Engage stakeholders in dialogue over reform goals.....	53
4.5 Build on what already works	53
5. References.....	56

List of Tables

Table 1: Contribution of fish production to Gross Domestic Product and Agricultural Gross Domestic Product. Source: Scholtens and Badjeck, 2010.....	17
Table 2: The global export value of selected agricultural commodities in 2007 in \$US billion. (Source: FAOStat and FAO TradeSTAT 2007).....	18
Table 3: Measures of importance of the fisheries sector to employment and nutrition, derived from two sources: (i. FAO statistical databases. used to calculate national fishery dependency indices in Allison et al (2009), and as calculated from the WorldFish/FAO 'Big numbers' project (BNP, 2009), and from the QUEST_FISH project (Scholtens & Badjeck, 2010).....	23
Table 4: Comparison of the wealth-based and welfare models in small-scale fisheries. (Source: modified from Bene et al., (2010a)).....	30
Table 5: Overview of links between trade and food security in 11 countries (Kurien, 2004).....	34
Table 6: Origin and average price of farmed and wild fish species from 15 markets across Bangladesh (adapted from Little et al., 2009).....	41
Table 7: Summary of observed links between poverty and aquaculture development in developing countries, derived from Stevenson & Irz, (2009) and literature cited therein, supplemented by more recent work at the WorldFish Center.....	43
Table 8: Cross-sectoral issues to consider in developing coherent fishery and aquaculture policies that support poverty reduction and food security.....	46
Table 9: Matching pro-poor and pro-food security fisheries policies to resource characteristics and national political-economic context.....	49

List of Figures

Figure 1: Like other food commodities, fish prices globally showed a 'spike' in 2007-8. (Source: FAO, 2011).....	13
Figure 2: Aquaculture and poverty reduction: potential impact pathways (Source: Stevensen & Irz, 2009) ...	16
Figure 3: Global distribution of Fish protein consumption, 2005-2007 average, from FAO food balance sheets (Source: FAO, 2011).....	19
Figure 4: Relative and absolute contributions of fish to protein consumption in the 30 countries with the highest proportion of fish in the animal-based part of their diet.....	20
Figure 4a: Fish protein as a percent of animal protein consumption (%).....	20
Figure 4b: Total protein consumption (g/capita/day).....	20
Figure 5: Index of fisheries dependency, based on proportion on contribution to animal protein (nutrition indicator) labour force involved in fisheries and aquaculture (employment) and contribution to GDP and export revenues (macro-economic indicator) . Data are from re-analysis of national statistics, carried out by BNP (2009) and Quest_Fish (www.quest-fish.org.uk), (Scholtens & Badjeck, 2010).....	24
Figure 6: Gordon-Shaefer bioeconomic surplus production model for exploited fish stocks.....	27
Figure 7: Forecasted supply of coastal fish in the Western Pacific, relative to projected need in 2030 (Bell et al., 2009).....	32
Figure 8: Example time series (1976-2007) of fish consumption (g/capita/yr) and trade (\$ per capita) for selected Least Developed or Low Income Food Deficit Countries. Fish consumption = red line; export values = blue line. Data source. FAOSTAT, accessed Dec 2010.....	35
Figure 9: Real unit prices of internationally traded seafood for developed and developing countries. Prices are in 2005 constant dollars adjusted by US GDP deflator (Source: Smith et al., 2010 – supplementary material).....	37
Figure 10: Generalized sequencing of development activities to improve fisheries and aquaculture.....	51
Figure 11: A policy-relevant research agenda to support the improved contribution of fisheries and aquaculture to poverty reduction and food security (WorldFish Center, 2011).....	52

Glossary

Definitions related to food security and poverty

Sources: drawn from references cited in Bene et al., 2007; DFID, 2009 and Sowman & Cardoso, 2010.

Food security: When all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life.

Food sovereignty: “The right of peoples to define their own food and agriculture policies; to protect and regulate domestic agricultural production and trade in order to achieve sustainable development objectives.... Food Sovereignty does not negate trade, but rather, it promotes the formulation of trade policies and practices that serve the rights of peoples to safe, healthy and ecologically sustainable production” (via Campesina)

Hunger is often used to refer in general terms to MDG1 and food insecurity. Acute hunger is when lack of food is short term, and is often caused when shocks such as drought or war affect vulnerable populations. Chronic hunger is a constant or recurrent lack of food and results in underweight and stunted children, and high infant mortality. ‘Hidden hunger’ is a lack of essential micronutrients in diets.

Malnutrition: An abnormal physiological condition caused by deficiencies, excesses or imbalances in energy, protein and/or other nutrients.

MDG 1 – Eradicate extreme poverty and hunger – has two associated indicators for its hunger target:

1. **Prevalence of underweight among children under five years of age** measures malnutrition at an individual level, collated by WHO and maintained in a global database on nutrition that allows comparability across countries.
2. **Proportion of the population below a minimum level of dietary energy consumption** measures hunger and food security, and is measured only at a national level (not at an individual level) through national food balance sheets based on aggregate data on food availability and assumed patterns of food distribution in each country. However, increased aggregate food availability is not synonymous with improving nutrition.

Nutrition security is achieved when secure access to appropriately nutritious food is coupled with a sanitary environment, adequate health services and care, to ensure a healthy and active life for all household members.

Poverty encompasses different dimensions of deprivation that relate to human capabilities including consumption and food security, health, education, rights, voice, security, dignity and decent work (from OECD Development Assistance Committee).

Undernutrition: is when the body contains lower than normal amounts of one or more nutrients i.e. deficiencies in macronutrients (carbohydrates, proteins) and/or micronutrients (amino acids, vitamins, minerals), such that stunting, wasting and illness will occur.

Acronyms and abbreviations

CCRF	Code of Conduct for Responsible Fisheries (from FAO)
EEZ	Exclusive Economic Zone (referring to marine areas claimed by nation states)
FAO	Food and Agriculture Organization
GDP	Gross Domestic Product
HIPCs	Highly Indebted Poor Countries
ILO	International Labour Organization
ITQ	Individual transferable quota
IUU Fishing	Illegal, Unregulated and Unreported Fishing
LDCs	Least Developed Countries
LIFDCs	Low Income Food Deficit Countries
LME	Large Marine Ecosystem
MEY	Maximum Economic Yield (from a fishery)
MSY	Maximum Sustainable Yield (from a fishery)
MPA	Marine Protected Area
NAMA	National Mitigation plan of Action (for climate change)
NAPA	National Adaptation plan of Action (for climate change)
NGO	Non Governmental Organization
OECD	Organization for Economic Cooperation and Development
OAE	Open Access Equilibrium (in fisheries models)
PRSPs	Poverty Reduction Strategy Plans
PUFAs	Polyunsaturated fatty acids
REDD	Reduced Emissions from Degradation and Deforestation avoided
SIDS	Small Island Developing States
SME	Small and Medium Enterprise
SSF	Small-Scale Fisheries
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNFCCC	United Nations Framework Convention on Climate Change
WTO	World Trade Organization

Executive Summary

Aims, rationale and structure

Fisheries and aquaculture play important roles in providing food and income in many developing countries, either as a stand-alone activity or in association with crop agriculture and livestock rearing. The aim of this paper is to identify how these contributions of fisheries and aquaculture to poverty reduction and food security can be enhanced while also addressing the need for a sustainability transition in over-exploited and over-capitalized capture fisheries, and for improved environmental performance and distributive justice in a rapidly growing aquaculture sector.

The focus of the paper is on the poverty and food security concerns of developing countries, with an emphasis on the least developed. It is therefore most relevant to the OECD states' roles as donors, signatories to multilateral agreements relevant to fisheries and food security, and as trading partners with developing countries. The emphasis is on food security rather than poverty reduction policies and strategies, although the two are of course related. The food security agenda is very much to the fore at present; fish prices rose along with other food prices in 2007-8 and as fish provide important nutritional benefits to the poor, food security has become a primary concern for sector policy.

After examining the evolving food security policy context, the paper articulates pathways linking the fisheries sector with poverty reduction and food security. The main analytical section then examines:

1. The poverty and food security implications of a restructuring of global fisheries to improve sectoral economic performance, through capacity reduction and rights-based management.
2. The links between domestic food security and policies to increase fish exports from both capture fisheries and aquaculture, to contribute to GDP growth.
3. The relative benefits to food security from policies favouring the development of small-scale and larger-scale aquaculture.

Finally, recommendations are made to ensure that fisheries sector policy reform supports the need to sustainably reduce levels of poverty and hunger, not just among those employed in the sector, but among populations of developing countries where fisheries and aquaculture are important sources of revenue and food.

Pathways linking fisheries and aquaculture to poverty and food security

The global aggregate wealth generated from both aquaculture and fisheries in marine and freshwater environments is unquantified but, based on an estimate of US\$ 225 to 240 billion for marine capture fisheries alone, is likely to be of the order of US\$ 500 billion per year. The sector's economic output provides important contributions to poverty and food security through three main, interlinked pathways: (1) nutritional benefits from the consumption of fish; (2) income to those employed in the sector and multiplier and spillover effects in fishery-dependent regions; and (3) through generation of revenues from exports, taxation, license fees and from payment for access to resources by foreign fleets or foreign investment in aquaculture.

1. Nutritional benefits from fish

The harvest, sale and processing of fish contribute indirectly to food security by increasing purchasing power at individual or household level and also regionally, and nationally. Demand for fish is expected to increase substantially, at least in line with other animal-based foods, particularly in South and South-east Asia. Current global per-capita supply of fish is 17 kg per year; nearly half comes from aquaculture. The availability of fish is unevenly distributed, with supply constraints faced by some undernourished populations in developing countries with high dependence on fish, particularly in sub-Saharan Africa, the least developed countries of South and South East Asia, and small island states in the Pacific Ocean.

Developed and developing country perspectives on the links between fish and health differ considerably. In developed countries the major focus has been on fish safety and the health benefits of poly-unsaturated fatty acids from fish and fish oil, which are thought to lower blood pressure and reduce risk of heart disease. In developing countries, the focus has been on the role of fish in tackling undernutrition, maternal and child health.

Although fish is usually linked to food security concerns through analysis of its contributions to protein supply, it is much more important as a source of micronutrients and lipids. More than two billion people in the world are undernourished through deficiency in essential vitamins and minerals, especially in vitamin A, iron and zinc. These deficiencies are especially important at key stages of human life (pregnancy, breastfeeding, childhood) and can have severe and often irreversible impacts for health and physical and mental development. This is the so-called 'hidden hunger'. Fish can potentially contribute to reducing micronutrient deficiencies and reducing this health burden.

Some fish species – in particular the small fish important in the diets of the poor – have high nutrient content, including some of polyunsaturated fatty acids (such as 'Omega-3'), vitamin A, iron, zinc and calcium. These fish can therefore be used as a key component in strategies aimed at reducing essential fatty acid and micronutrient deficiencies in developing countries. Although fish availability per capita is increasing globally, it is decreasing in much of sub-Saharan Africa. Moreover, there are concerns that the farmed fish most affordable to the poor are of less nutritional value. A combination of diet, food preparation and intra-household distribution can result in reduced and less equitable benefits from farmed fish than from the previously-consumed wild-caught small fish that are most nutritious eaten whole.

2. Employment and economic multipliers

Over half a billion people (workers and dependents) are wholly or partly supported by fisheries, aquaculture and related industries, 95 percent of them in developing countries, with increases in aquaculture likely. Employment in fisheries is likely to stabilize or decrease due to combinations of labour substitution by technological change and management measures to reduce over-capacity in the sector.

There is little direct quantitative evidence of the size of growth-multiplier effects from fisheries and aquaculture development, although there is strong qualitative evidence that the fishery sector boosts the amount of cash in circulation in rural areas, fostering market-driven development. Aquaculture and related processing industries provide new economic opportunities, particularly for female employment.

3. Revenues from trade, taxation and fishery resource access payments

Trade in fish is worth around US\$ 100 billion a year, and the export of higher-cost species from developing to developed countries, and import of lower-cost (but often higher nutritional value) fish by developing countries generates a positive trade balance.

The fishery and aquaculture sector contributes more than 10 per cent of GDP in some major fish-producing countries, including Mauritania and Vietnam. Contributions to GDP from the sector are complicated by variable methods of calculation. Typically they are based on the sale-value of fishery production, but do not include revenues from access agreements for other countries to access fishery resources, and license fees paid by domestic fleets.

Impacts of recent policy reform in fisheries and development investment in aquaculture

1. Rights-based fisheries

Concerns for over-exploitation and economic inefficiencies in the capture-fisheries sector are leading to widespread calls for reforms. Governance reform seeks to eliminate illegal, unreported and unregulated fishing and production-related subsidies. These currently 'drain' over US\$ 55 billion a year from the potential economic contribution of the sector. It is too early to assess the impacts, ex-post, of such reform on poverty reduction and food security, and no ex-ante impact assessment has yet been conducted to assess the costs and benefits of reform.

A dominant element of governance reform proposes a transition to rights-based fishing, motivated by the critical insight that inefficiencies in the fishery sector have produced a major squandering of assets—and

that there is a development opportunity if the economic rents from fisheries are more rationally captured and reinvested in public goods. The degree to which revenue generated through such an approach is likely to be reinvested in public goods will be heavily influenced by broader mechanisms of public accountability. Without such mechanisms in place, reform measures that support economic growth and private sector development objectives may undermine local welfare and food security.

Too much emphasis on wealth creation and sectoral economic efficiency can ignore the welfare functions of fisheries and the trade-offs that may have to be made between increasing resource rents and sustaining displaced or excluded fisherfolk, or overlook the wider governance constraints that obstruct optimal efficiency of resource utilization or reinvestment of revenue from the sector in public goods. Conversely, too much emphasis on improving access rights by the poor can overlook the potential for wealth generation and rural development from fisheries resources, and may not pay sufficient attention to the ecological limits of resource productivity.

2. Food security impact of trade

The increasing engagement of developing countries in global fisheries trade has resulted in a positive trade balance; the value of exports of fish from developing-countries exceeds the value of imports. The evidence that this positive trade balance has resulted in benefits for food security and poverty reduction is less clear. While some analyses have found both significant positive and negative benefits, according to country context, another study, on sub-Saharan Africa, has been unable to demonstrate any link between increasing trade and improved food security and national poverty indicators.

Examination of a 30-year time series of exports and per capita domestic availability of fish in 14 countries suggests that fish availability has increased along with increases in exports for 7 of the 14 countries. These 'win-win' increases seem to be related to growth in either aquaculture or offshore (e.g. tuna) fisheries. In countries with high domestic fish consumption, high population growth and persistent poverty (e.g. Philippines, Solomon islands), increasing trade appears to have compromised domestic fish supplies. Whether this is a concern for food and nutritional security will depend on the availability of substitutes that are affordable to the poor and food-insecure.

Improved economic dynamism and purchasing power from trade will not result in welfare gains for vulnerable, food-insecure people unless the sources of vulnerability are also addressed. In the fisheries and aquaculture sectors, vulnerabilities arise from large inequities in relations of power between producers and buyers, or fishers and processing factory owners and exporters, or between men and women in fishing and farming communities. Examples of negative impacts of engagement with global value chains by the poor, from the Nile perch fishery in Lake Victoria and the shrimp sector in Bangladesh, suggest that addressing gender inequities are a pre-requisite for positive food security and poverty reduction outcomes from trade.

3. Aquaculture development pathways

Aquaculture growth, most of which has taken place in Asia, has been driven by rising demand from growing and urbanizing populations, stagnating supplies from capture fisheries, investment in education and technology research, a dynamic private sector and high levels of public investment in infrastructure to support agricultural development. The past fifteen years has seen the emergence of a vibrant small and medium enterprise (SME) sector, particularly in China, Vietnam, Thailand, Indonesia and the Philippines, which targets both domestic and international markets.

Aquaculture for poverty reduction and food security is developing fast, but not always in ways promoted by many development agencies. Rather than being a means to secure nutritional gains and income directly for the poorest smallholder farmers, it is increasingly a means to increase domestic fish supply to low-income consumers, develop opportunities for employment, support local economic multipliers, and to generate revenue from trade.

Impact assessment studies in Malawi, Bangladesh and the Philippines demonstrate positive income employment and consumption effects for poor households adopting small-pond or cage aquaculture systems. Overall, however, greater gains for wider food security can be expected from SME development of specialist aquaculture. The policy emphasis in aquaculture development is therefore shifting away from aquaculture as an income-

generating opportunity for the poorest, and towards meeting national fish supply-demand gaps and ensuring a supply of fish to lower-income consumers. Larger-scale enterprises and SMEs, which don't face the constraints to investment that small, resource-poor farmers do, are now thought to be a better target for aquaculture investment in the service of wider food security. This support for a mix of small-scale and larger-scale aquaculture parallels developments in agriculture, where calls for support to smallholders to reduce the numbers of the rural poor co-exist with support for commercialization of agriculture to accelerate its role in promoting macroeconomic growth.

The aggregate data on Asian aquaculture all show increases in the volume and value of trade, increased contribution of production to agricultural GDP, and, in some cases, increased availability of fish in domestic supply as well. That this translates into improved food security and reduced incidence or prevalence of poverty is then often simply assumed, although this is not necessarily the case if revenues accrue largely to a small number of wealthy people, or the growing middle classes in Asian cities increase their fish consumption, but nothing changes for the poor and hungry. Deeper analysis is needed before causal linkages can be inferred and poverty and food security benefits for aquaculture can be claimed.

4. Fishmeal and food security relationships

Small pelagic fish comprise around 30% of marine capture fisheries landings, with the proportion going into fishmeal production decreasing since the 1990s, as aquaculture producers aim to substitute fishmeal for other feeds to reduce input costs.

It is often stated that there is competition between direct human consumption and reduction for animal (including aquaculture) feed of small pelagic fish (herring, sardine, anchovy, mackerels etc). There is, however, no direct evidence that an increase in fishmeal production results in a decrease in consumption of these fish by the poor.

Policy recommendations

Given the great diversity of fisheries and aquaculture industries, there is no single recipe for governance reforms to maximize their contribution to food security and poverty reduction. Critical, instead, is the process of arriving at goals considered politically legitimate by relevant stakeholders and the identification of the pathways linking sectoral policy with poverty reduction and nutritional outcomes. The paper identifies five principles to guide policy reform processes in fisheries and aquaculture towards maximizing development and food security benefits.

1. Strive for policy coherence

To support coherence between development policies, food security initiatives and the governance and development of the fisheries sector, the following actions are recommended:

- i. Work more in partnership with development economists, planners and practitioners to avoid a narrow fishery-sector perspective and to ensure the sector's development goals fit with wider national economic development policy priorities.
- ii. Make poverty and food and nutrition security goals and strategies explicit in fisheries and aquaculture sector policy. FAO Code of Conduct for Responsible Fisheries guidelines are available to inform this process.
- iii. Ensure coherence between major cross-sectoral development policies and programs and sectoral policy, using the OECD Policy Coherence framework for guidance. The key areas for coherence are between fisheries and aquaculture and poverty reduction strategy plans, agriculture policy, nutrition and health initiatives, national plans of adaptation for climate change, water resources policy, energy and trade policy.

2. Avoid blueprints: fit reforms to context and sequence them appropriately

Aquaculture and fisheries are heterogeneous industries that exist in a diversity of political, economic, social and cultural contexts. Guiding principles, frameworks and typologies are useful in addressing some of this complexity. Blueprint solutions are not. In the Post-Washington Consensus era, most development policy, from macro-economic reforms to sector support strategies, are now based on a country or district-specific diagnostic process.

Depending on the production and fishery characteristics and national and local economic context, poverty reduction and food security aims in capture fisheries may be best served by:

- i. a policy that seeks to maximize resource rents and export revenues;
- ii. a policy, management and development package that supports local and regional market development and local multiplier effects through management of small-scale fisheries. Some potential rent is traded off against improved likelihood of that benefits will be captured locally and be more widely distributed;
- iii. a policy that supports quasi-open access or flexible access regimes to enable the poor to gain a seasonal, temporary or supplementary livelihood from aquatic resource exploitation.

The choice of overall strategy will depend on the size of the potential payoff (related to the size and productive potential of the resource, and on linkages to markets), the costs of transforming the current governance system to one capable of delivering greater benefits, and the political and administrative feasibility of doing so, and, perhaps most importantly, the risks involved in shifting benefits upstream and relying on efficient markets and effective economic governance mechanisms to redistribute them in the service of poverty reduction and food security.

Sequencing policy reforms and investments appropriately can enhance their joint effectiveness. A sequence of investing is proposed, first in securing basic human rights of vulnerable resource users, next in strengthening resource governance, and finally in strengthening linkages with global markets.

If there are likely to be problems of social exclusion and violations of rights associated with fishery governance transitions or transformation of aquaculture production systems, then these have to be dealt with first, if deepening inequality is to be avoided. Investment in strengthening governance will ensure that the resource's productive capacity is protected and enhanced when producers engage with markets. In the absence of effective resource or environmental governance, linking with global markets can accelerate resource degradation. Strengthening links with global markets will generate greater and more sustained development benefits when both human rights and property rights have been secured.

3. Invest in evidence-based political economy analysis

There are serious inadequacies in the knowledge-base available at global level to inform investments for poverty reduction and food security from fisheries and aquaculture. Examples of such weaknesses include:

- i. the paucity of rigorous ex-post impact assessments of completed fishery sector investment programs;
- ii. the limited utility of national level indicator data in assessing causal relationships between changes in fish production, trade and development outcomes;
- iii. fragmented case-study research on poverty and food security that cannot address questions on the scale of benefits derived from the sector at more aggregate levels;
- iv. biases in fishery statistical systems (e.g. the underrepresentation of small-scale and inland fisheries);
- v. limited research on linkages between fisheries and other sectors, and therefore on the potential benefits of improved policy coherence across sectors;

- iv. weak (and untested) specification of impact pathways in proposed policy reforms.

This suggests a need to invest in a stronger research base, usefully framed within the discipline of political economy analysis.

4. Engage stakeholders in dialogue over reform goals

Where changes in government policy and law or support to reform efforts through official development assistance are concerned, explicit recognition of multiple goals and values of main stakeholder groups is key. Often goals will be in competition, and there is no technical solution to reconcile these. Only meaningful engagement with and deliberation among stakeholders can yield goals that will be seen as legitimate. While sound goal-setting may seem obvious, it often fails to get adequate attention: one recent global review of countries' efforts to implement the Code of Conduct for Responsible Fisheries found that over half of the world's major fisheries lack clearly defined management goals.

In the context of the achievement of poverty reduction and food security goals, there is a particular requirement to link fishery sector actors and agencies with those shaping the wider development agenda. This would help ensure that the sector's development does not take place in isolation or opposition to national economic and social policy, and global food security imperatives.

5. Build on what already works

Half of the world's fisheries are not biologically overexploited and aquaculture food output is growing faster than population growth, resulting in record global per capita availability of fish. Trade revenues are increasing and there is a positive balance in the value of fish traded between developing and developed countries. There are examples of successful fishery governance reforms using both private and community rights. Environmental and social equity performance of aquaculture is in many cases improving. There is much that is good to build on.

The most effective linkages between the fishery and aquaculture sector and poverty reduction and food security benefits are currently found in the small-scale fisheries sub-sector, and in the development of small and medium enterprise-scale aquaculture. Recommendations for their support are to:

- i. support the continued operation and development of small-scale fisheries where this is possible, in accordance with the FAO Code of Conduct for Responsible Fisheries;
- ii. promote the adoption of rights-based fishing, but include consideration of human rights, as well as fishery rights, and use the most appropriate rights regime; this could be privately-owned individual transferable quotas, community rights, or state-controlled licensing systems, according to context;
- iii. ensure that compensation schemes or livelihood alternatives are included in programs to reduce fishing capacity or transition to more exclusive access rights regimes;
- iv. support the growth of the SME aquaculture sector, and particularly its role in increasing the availability of nutritious, affordable food in domestic markets;
- v. in countries with nascent aquaculture sectors, particularly in Africa, support innovation systems capable of contributing to the growth of the sector. This will help sustain and build from donor-funded projects or externally-driven export-orientated aquaculture developments;
- vi. address nutrition, equity and environmental dimensions of aquaculture development to ensure sustainability and poverty-reduction benefits of aquaculture development are maximized.

1. Fisheries and aquaculture reform and the global food security agenda

1.1 The need for a food and nutrition security orientation in fisheries and aquaculture policy

Fisheries and aquaculture play an important role in providing food and income in many developing countries, either as a stand-alone activity or in association with other income generating activities, such as crop agriculture and livestock rearing. The sector also acts as an economic multiplier in marginal rural areas. In countries endowed with valuable natural fisheries or conditions favoring aquaculture development, they can also provide important contributions to the national economy through trade, tax revenues and license fees. The aim of this paper is to identify how these contributions of fisheries and aquaculture to poverty reduction and food security can be maintained or enhanced. The key policy challenge is to improve contributions to food security and poverty reduction while also addressing the need for a sustainability transition in over-exploited and over-capitalized capture fisheries, and improved environmental performance and distributive justice in a rapidly growing aquaculture sector. The paper's aims thus align with the OECD policy orientation towards 'green growth' (OECD, 2009a), rights and equity (OECD, 2006) and to fostering coherence between fishery sector policies and policy related to trade, food security, employment, environment and economic growth (OECD, 2008).

The intended outcomes of this work are to increase the visibility of the fisheries and aquaculture in national and global food security agendas and to ensure that the issue of food security is appropriately and explicitly considered in on-going processes of fisheries and aquaculture reform. The paper draws on published sources from the recent literature, supported by analysis of both published and unpublished data on fisheries and aquaculture production, trade and consumption. The focus of the paper is on the poverty and food and nutrition security concerns of developing countries, with an emphasis on the least developed. The paper is therefore most relevant to the OECD states' roles as donors, signatories to multilateral agreements relevant to fisheries and food security, and as trading partners in the net global flow of fish trade from developing to developed countries. I place greater emphasis on the food security issue than on details of poverty reduction policies and strategies (although the two are of course linked). This is because the food security agenda is very much to the fore at present, and the fisheries sector makes important direct and indirect contributions to food security. The paper is structured as follows: first, the policy context for the rising interest in the links between food security and fisheries and aquaculture is set out. Next, pathways linking the sector with poverty reduction and food security are articulated, with quantitative support where data are available. Key gaps and weaknesses in existing datasets are highlighted. The main analytical section of the paper then outlines the current policy reform agenda in fisheries and main development trends in aquaculture, and assesses their implications for poverty reduction and food security. I focus on three key issues in particular, which are the ones most discussed in contemporary policy, with respect to fisheries and aquaculture and food security and poverty reduction:

- i. The implications of a restructuring of global fisheries to improve sectoral economic performance, through capacity reduction and rights-based management.
- ii. The links between domestic food security and policies to increase fish exports from both capture fisheries and aquaculture, to contribute to GDP growth.
- iii. The relative benefits to food security from policies favouring the development of small-scale and larger-scale aquaculture.

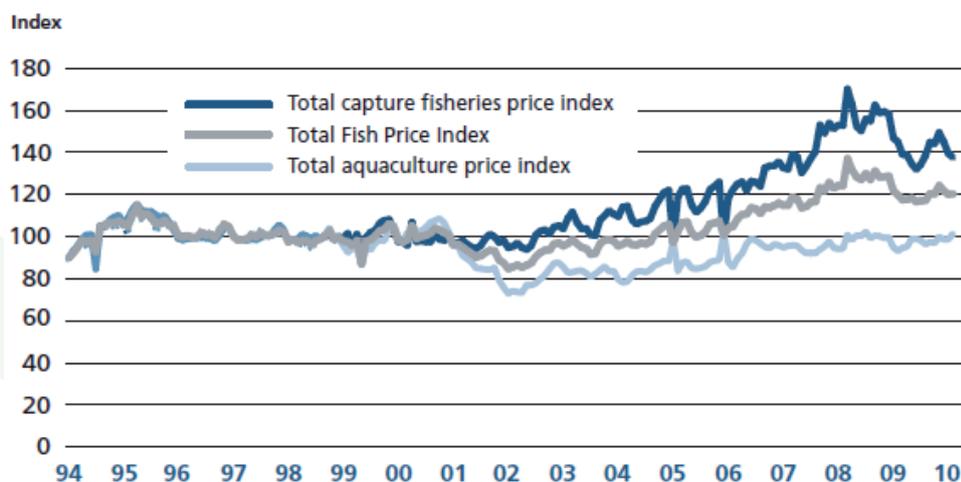
Reassuringly, these discussions do not need to be as polarized as they sound (and have been). Often they represent either false dichotomies based on misunderstandings, or alternative pathways to achieve positive impacts on poverty and hunger. Finally, I recommend ways to ensure that fisheries sector policy reform supports the need to sustainably reduce levels of poverty and hunger, not just among those employed in the sector, but among populations of developing countries where fisheries and aquaculture are important sources of revenue and food.

1.2 Food security at the top of the development agenda

In 2006-2008, after over three decades of historically low prices, a rapid rise in global staple food prices led to riots around the world. The 'food crisis' was triggered by a sharp rise in international oil prices in 2006-7, resulting in a substantial increase in the cost of energy-based inputs to food production systems, such as fuel, fertilizer and irrigation. This was followed by downward pressure on commodity prices exerted by the global financial crisis and depreciation of the US dollar (Headey & Fan, 2008; OECD, 2009b). A variety of other confounding factors have been proposed as a cause of the food price 'spike', from market speculation and weather shocks, to hoarding, export restrictions and diversion of land and staple crops into biofuel production, but the evidence for their global importance is mixed (Headey & Fan, 2008). Fisheries products also rose in value, according to the FAO Fish Price Index (Figure 1), which is derived from ex-vessel or ex-farm prices of the major, highly traded species, such as tuna and shrimp (FAO, 2011). The rise appeared to be more pronounced in the capture fisheries sector, where fuel costs for fishing vessels are a major input. These price rises can be traced through to increases in food expenditure, including for fish, in the household budgets of the rural poor in developing countries where such data have been collected (see section 3.3).

The surge in food prices had an important outcome for development policy: it drew the world's attention to the decreasing likelihood of achieving the first Millennium Development Goal, which is to halve between 1990 and 2015, the number of people who live in poverty and endure hunger. In 1990, around 845 million people around the world were hungry. Between 2006 and 2009 the incidence of hunger rose from 873 million to just over 1 billion people, falling again slightly in 2010 to 925 million, along with signs of global economic recovery (Fan, 2010; Foresight, 2011). In the wake of this economic volatility, the question of how to produce and distribute enough food for a projected global population of 9 billion people in 2050 has become a central concern of development policy. Demand for fish is expected to increase substantially, at least in line with other animal-based foods, particularly in South and South-east Asia. The challenge of feeding current and future populations is made harder by the potentially negative impacts of climate change on agricultural production, the increasing competition for land, water and energy and the need to maintain regulatory environmental services. Also, many people are likely to be wealthier and to create demand for more varied, high-quality diets requiring more inputs to produce. Globalization may also create novel policy challenges. This unprecedented confluence of pressures on the global food system requires a focused, coherent response that links the food sector with major strands of public policy. These concerns have led to concerns for food security rising to the top of the international development agenda.

Trends in the FAO Fish Price Index and underlying indices



Note: 1998-2000 = 100.

Figure 1: Like other food commodities, fish prices globally showed a 'spike' in 2007-8. (Source: FAO, 2011)

Key outlines of a proposed global food security policy in one recent analysis (Foresight, 2011) are:

- i. The need for interconnected policy-making, so that policy in all areas of the food systems should consider their implications for volatility, sustainability, climate change and hunger, but also policies for energy, water supply, land use, maritime, ecosystem service and biodiversity should be coordinated with those for food security.
- ii. There is a need for improved productivity through the implementation of existing knowledge and investment in new science and institutional innovation to enable food producers to benefit from new technologies. Alongside this, demand for the most resource-intensive types of food must be contained and waste in all areas of the food system must be minimized.
- iii. Addressing climate change and achieving sustainability in the global food system are dual imperatives, suggesting the need to reduce the emissions from agriculture while raising its productivity and capacity to feed the world.
- iv. Increase the priority given to agricultural and rural development as a driver of broad-based income growth, through investments in gender equity and reduction in subsidies and trade-barriers that disadvantage low-income countries.
- v. Craft food system governance to maximize the benefits of globalization and ensure they are distributed fairly.

All the above measures will need to be considered in the specific context of aquaculture and fisheries, and will be elaborated in this paper.

1.3 Representation of fisheries and aquaculture in global food security initiatives

The fisheries sector, neglected in the context of food security policy in the past, is becoming better integrated in recent global reviews. In the 2011 State of the World report “Innovations that Nourish the Planet”, the opening chapter begins with a story about improved governance, production innovations and market diversification in an artisanal oyster fishery in the Gambia (Worldwatch, 2011, p3-4), but the report does not include aquaculture or rights-based fishing among the key innovations in the food system, as it is focused on crops and livestock only. In contrast, a report on the CGIAR’s research programs (“Millions Fed” - Yosef, 2009) highlights genetic improvements to farmed tilapia as a key success in supporting improved food security. The UK Government-led Foresight study on the future of food and farming has fully integrated fisheries and aquaculture into its background studies and policy summary (Foresight, 2011) and, in modeling food futures, the IFPRI IMPACT model (a commodity-based supply-demand analysis) has been applied to fisheries (Delgado et al, 2003) and an update (‘Fish to 2030’) is currently under way. Another modeling study (Agrimonde – Paillard et al., 2011) also includes scenarios for the projected role of fish in diets in 2050.

Much of this recent analysis is science-driven and technically focused, although it points to the importance of institutional levers and market mechanisms in supporting and channeling technical gains in food productivity, safety, storage and distribution. While they all seek transformative change (e.g. ‘business as unusual’- Fan, 2010) these analyses remain, perhaps of necessity, somewhat apolitical. This is despite widespread recognition that food insecurity and hunger often result from political processes and social structures that deny people the right to access food (‘entitlement failures’, in the language of Amartya Sen, 1981). These recent technical studies have not yet merged with contemporary development-focused initiatives such as the ‘Right to Food’, where food security is recognized as one of the social, economic and cultural rights articulated in the Universal Declaration of Human Rights (FAO, 2006). The human rights conventions provide a framework for FAO’s work on food security, and, along with other human rights (e.g. the right to decent work, gender equity), are increasingly influential in shaping FAO’s programme to implement the FAO Code of Conduct for Responsible Fisheries (FAO, 2005; 2007; 2011; Skonhoft & Gobena, 2009). Finally, cultural dimensions of food policy are also under-represented in much analysis, yet the world’s food cultures are changing rapidly – the rise of globalized fast-foods like hamburgers and fried chicken, and the growing global popularity of Japanese sashimi and sushi are just a few examples. Culture, identity and health are powerful and changeable structuring forces in world food systems (Dixon, 2009).

The rise in policy interest in food security has also led to a rush of recent global fisheries and aquaculture-sector analysis highlighting the contribution of fisheries to food security and nutrition and the potential threats of overfishing or unsustainable growth of aquaculture (e.g. Naylor et al., 2009; Tacon & Metian, 2009; Garcia & Rosenberg, 2010; Kawarazuka & Bene, 2010; Smith et al., 2010; Srinivasan et al., 2010). The next section distills the key findings of these studies to support an overview of the pathways that link the fisheries and aquaculture sector to poverty reduction and food security.

2. The contribution of fisheries and aquaculture to poverty reduction and food security

Capture fisheries and aquaculture supplied the world with about 142 million tonnes of fish in 2008. Of this, 115 million tonnes was used as human food, providing an estimated apparent per capita supply of about 17 kg (live weight equivalent), which is an all-time high. Of the fish destined for direct human consumption, fish in live or fresh form was the most important product, with a share of 49.1 percent, followed by frozen fish (25.4 percent), prepared or preserved fish (15.0 percent) and cured fish (10.6 percent). The value and volume of preserved and cured fish may be underestimated, as much of this is from small-scale fisheries and enters domestic and regional value chains that are poorly represented in production and trade statistics. Aquaculture accounted for 46 percent of total food fish supply (FAO 2011). Global capture fisheries production in 2008 was about 90 million tonnes, with an estimated first-sale value of US\$93.9 billion, comprising about 80 million tonnes from marine waters and a record 10 million tonnes from inland waters. Inland water catches may be under-estimated, as reporting systems tend to be weak.

World capture fisheries production has been relatively stable in the past decade with the exception of marked fluctuations driven by catches of anchoveta – a species extremely susceptible to variations in oceanographic conditions. As opportunities for expansion of capture fisheries have diminished and some stocks have been over-exploited, capture fisheries production has no longer shown an increasing trend. With the recognition of limits on biological productivity, policy focus has shifted from trying to increase capture fisheries production, towards regulating fisheries to achieve increases in value and profitability from similar or lower levels of production.

Aquaculture continues to be the fastest-growing animal-food-producing sector and to outpace population growth, with per capita supply from aquaculture increasing from 0.7 kg in 1970 to 7.8 kg in 2008, an average annual growth rate of 6.6 percent (FAO, 2011), with poultry showing the next largest rate of increase over this period at 5 percent.

The value of production from capture fisheries and from aquaculture in 2008 was roughly similar – 98.4 billion from aquaculture (excluding aquatic plants) and 93.9 billion tonnes from capture fisheries. When considering value-addition and multiplier effects, the estimated total output value of marine capture fisheries is between 225 and 240 billion USD per year from current production levels (Dyck & Sumaila 2010). If similar multipliers apply to inland fisheries, and to aquaculture production, then the output value of global fisheries and aquaculture is likely to be around US\$ 600 billion a year. The capture and production sector employs around 44 million people or 180 million if jobs in the supply chain are included. If each income-earner supports an average of three dependents, then 540 million people are partly or wholly dependent on the sector for income.

In 2008, trade in fish and fishery products was valued at over US\$ 102.8 billion dollars – about 10 percent of the value of total agricultural exports and 1 percent of world merchandise trade. The share of fishery and aquaculture production (live weight equivalent) entering international trade as various food and feed products increased from 25 percent in 1976 to 39 percent in 2008, and the overall value of trade, in real terms, has increased by 50 percent since 1998, reflecting the sector's growing integration in international trade (FAO, 2011).

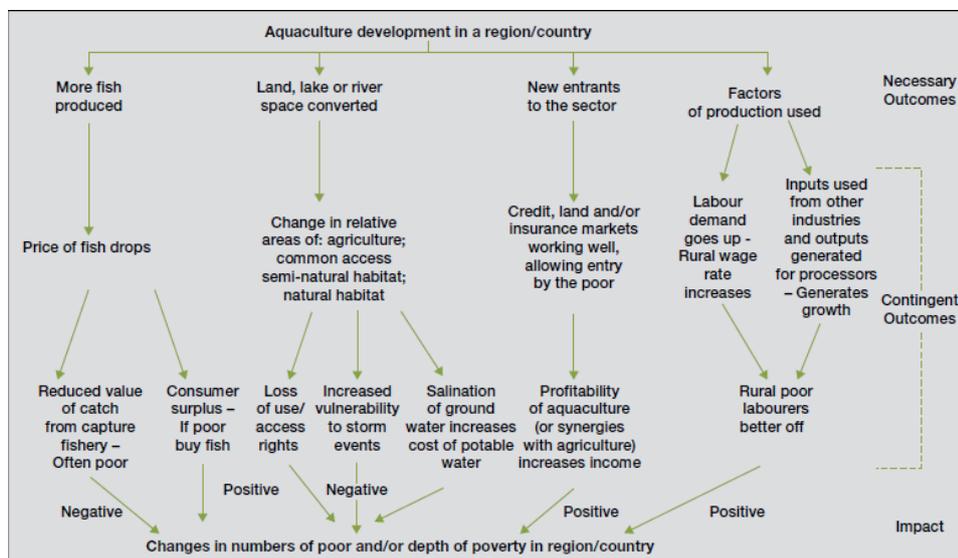
While the stabilizing of capture fisheries and the rapid rise of aquaculture, the record per capita global supply, increasing levels of trade and the growing economic contribution of the sector all suggest a thriving industry, there are serious concerns around overfishing and the environmental and social impact of aquaculture, and equity concerns around trade. These can only be investigated by disaggregating the global statistics, and also by also looking at the input costs and profitability of the sector (See section 3.1).

AQUACULTURE, FISHERIES, POVERTY AND FOOD SECURITY

The global aggregate wealth generated by the sector is considerable, and provides important contributions to poverty and food security Through four main, interlinked pathways: (i) nutritional benefits from the consumption of fish; (ii) income to those employed in the sector; (iii) multiplier and spillover effects in fishery-dependent regions; and (iv) through generation of revenues from exports, taxation, license fees and from payment for access to resources by foreign fleets or foreign investment in aquaculture. The harvest, sale and processing of fish thus contribute indirectly to food security by increasing purchasing power at individual or household level and also regionally, and nationally. Examples of pathway through which aquaculture can contribute to poverty reduction are summarized in Figure 2.

Where fisheries or aquaculture are significant activities, contributions to poverty reduction are in the form of economic multipliers; for example many fisherfolk are landless and have daily cash incomes to spend in areas sometimes remote from markets, which helps sustain markets for agricultural produce, consumption goods and various services and ensures that the income from fishing stays in the local area (Allison, 2005; Bene et al., 2007; Thorpe et al., 2007). Taxation on fisheries access and license fees sometimes contribute to local government revenue. The macro-economic effects of fisheries trade and revenue generation from taxes, licenses and access agreements contribute towards foreign currency generation and government budgets. If the revenues are significant and they are spent effectively, they can contribute towards macro-economic growth as the most effective way of large-scale poverty reduction. Except in a few cases (e.g. Pacific island states with major tuna resources, countries with large shrimp farming enterprises) fisheries and aquaculture are unlikely to be a major national 'engine of growth', but they can be at local level. Even when the value of fisheries benefits to trade and GDP can be increased, the track record of governments in the effective use of natural resource revenues is not always exemplary, as the persistence of poverty and underdevelopment in oil, mineral and timber-rich states testifies.

Figure 2: Aquaculture and poverty reduction: potential impact pathways (Source: Stevensen & Irz, 2009)



The following sections expand on the main pathways linking the sector to poverty and food security: - contributions to GDP and trade, employment and economic multipliers, and to nutrition.

2.1 GDP and trade

2.1.1. Contribution to GDP

Fish production generally contributes 0.5 – 2.5 percent of GDP, globally (Bene et al., 2007), which makes the sector appear a minor contributor to the world economy. However, countries selected for a detailed analysis in an on-going study of fishery dependence in relation to climate change vulnerability (Quest_Fis. www.questfish.org. have higher values, with Mauritania and Vietnam having fisheries which contribute more than 10 percent of GDP, and around 50 percent of agricultural GDP (Table 1). In these countries, clearly the fish resources are central to economic development, poverty reduction and food security. This analysis, like most, only measures the value of fish production. If processing, trade and services are added (these are generally counted in other sectoral accounts), the overall contribution of fisheries can be much higher.

Table 1: Contribution of fish production to Gross Domestic Product and Agricultural Gross Domestic Product. (Source: Scholtens and Badjeck, 2010.)

Variable	Year	Total value of fish production	Production value as percent of Agricultural GDP	Productio. value as percent of total GDP
Unit		1000 US\$ current	%	%
Bangladesh	2006	2,952,104	24.33	4.77
Cambodia	2004	397,688	23.13	7.22
China	2006	55,549,810	18.50	2.09
Ghana	2006	877,328	19.38	6.90
India	2004	7,887,011	5.86	1.13
Indonesia	2007	8,144,222	13.76	1.89
Malaysia	2007	1,932,785	10.15	1.04
Maldives	2006	46,094	55.33	5.04
Mauritania	2004	193,000	48.71	12.47
Mozambique	2007	245,439	11.10	3.06
Namibia	2005	492,000	59.96	6.78
Peru	2002		25.00	2.00
Philippines	2006	3,344,274	20.04	2.85
Senegal	2007	313,736	20.42	2.78
Sri Lanka	2007	512,638	13.54	1.58
Thailand	2004	4,382,453	26.37	2.72
Viet Nam	2007	6,960,385	49.95	10.14

2.1.2. Contribution to trade

Fish is one of the most traded of food commodities – second only to fruits and vegetables in value (Table 2). Developing countries, in particular China, Thailand and Viet Nam, accounted for 80 percent of world fishery production in 2008 with their exports accounting for 50 percent (US\$50.8 billion) of world exports of fish and fishery products in value terms (FAO, 2011). Unfortunately country trade statistics do not distinguish between aquaculture and wild capture as the source of imports. It is, therefore, difficult to draw firm conclusions at a global level about the proportion of total international fish trade volume that aquaculture provides. A 2006 estimate for China, however, is that 39 percent by volume and 49 percent by value of the country's aquaculture production was exported.

Table 2: The global export value of selected agricultural commodities in 2007 in \$US billion. (Source: FAOStat and FAO TradeSTAT 2007)

Plant Commodities		Animal commodities	
Fruit & Vegetables	150.89	Fish/Seafood	92.80
Wheat	36.40	Pigs	30.21
Tobacco	29.06	Cattle	28.99
Sugar	18.58	Poultry	22.10
Coffee	17.67	Sheep and Goats	4.35
Rice	13.48		
Pulses	4.82		

World imports of fish and fish products reached a historical maximum of US\$107.1 billion in 2008, up 9 percent from the previous year (FAO, 2011). Preliminary data for 2009 indicate a 9 percent decrease, due to the economic downturn and consequent contraction in demand from key importing countries. Japan, the United States of America and the European Union (EU) are the major markets, with a total share of about 69 percent in 2008. Latin America and the Caribbean are net fishery exporters as is Oceania and the developing countries of Asia. By value, Africa has been a net exporter since 1985, but it is a net importer in quantity terms, reflecting the lower unit value of the imports (mainly small pelagics). Europe and North America have a fishery trade deficit, as they are net importers of high value species.

2.2 Employment and growth linkages

Employment in fisheries and aquaculture has grown substantially in the last thirty years, with an average rate of increase of 3.6 percent per year since 1980, although some of this increase may simply represent improved counting in employment statistics (see section 2.4). In 2008, an estimated 44.9 million people were directly engaged, full or part time, in capture fisheries or in aquaculture production. For each person employed in capture fisheries and aquaculture production, about three jobs are produced in secondary activities, including post-harvest, resulting in an estimated total of more than 180 million jobs in the whole of the fish sector. If, on average, each jobholder provides for three dependants or family members, the primary and secondary sectors support the livelihoods of a total of about 540 million people, or 8 percent of the world population (FAO, 2011). Dyck & Sumaila (2010) additionally estimated that wages from marine capture fisheries amounted to US \$63 billion in income. Such figures have not yet been calculated for inland fisheries and aquaculture.

In 2008, 85.5 percent of fishers and fish farmers were in Asia, followed by Africa (9.3 percent), Latin America and the Caribbean (2.9 percent), Europe (1.4 percent), North America (0.7 percent) and Oceania (0.1 percent). China is the country with the highest number of fishers and fish farmers, representing nearly one-third of the world total (FAO, 2011). Although capture fisheries continue to provide by far the greater number of jobs in the primary sector, the share of employment in capture fisheries is stagnating or decreasing and increased opportunities are being provided by aquaculture. In 2008, fish farmers accounted for one-quarter of the total number of workers in the fisheries sector, totaling almost 11 million people. Most of the growth in aquaculture employment has been in Asia, particularly in China. Employment in fishing is decreasing in capital-intensive economies, in particular in most European countries, North America and Japan. This is the result of several factors, including decreased catches, programs to reduce fishing capacity and increased productivity through technical progress.

Small-scale capture fisheries contribute more than half of the world's marine and inland fish catch, almost all of which is destined for direct human consumption. These fisheries employ more than 90 percent of the world's 35 million capture fishers and they support another 84 million people employed in jobs associated with fish processing, distribution and marketing. There are also millions of other rural dwellers, particularly in Asia and Africa, involved in seasonal or occasional fishing activities. Almost half (47 percent) of the people employed in the primary and secondary sectors associated with small-scale fisheries are women (Mills et al., 2011). More than 95 percent of small-scale fishers and related workers in post-harvest sectors live in developing countries.

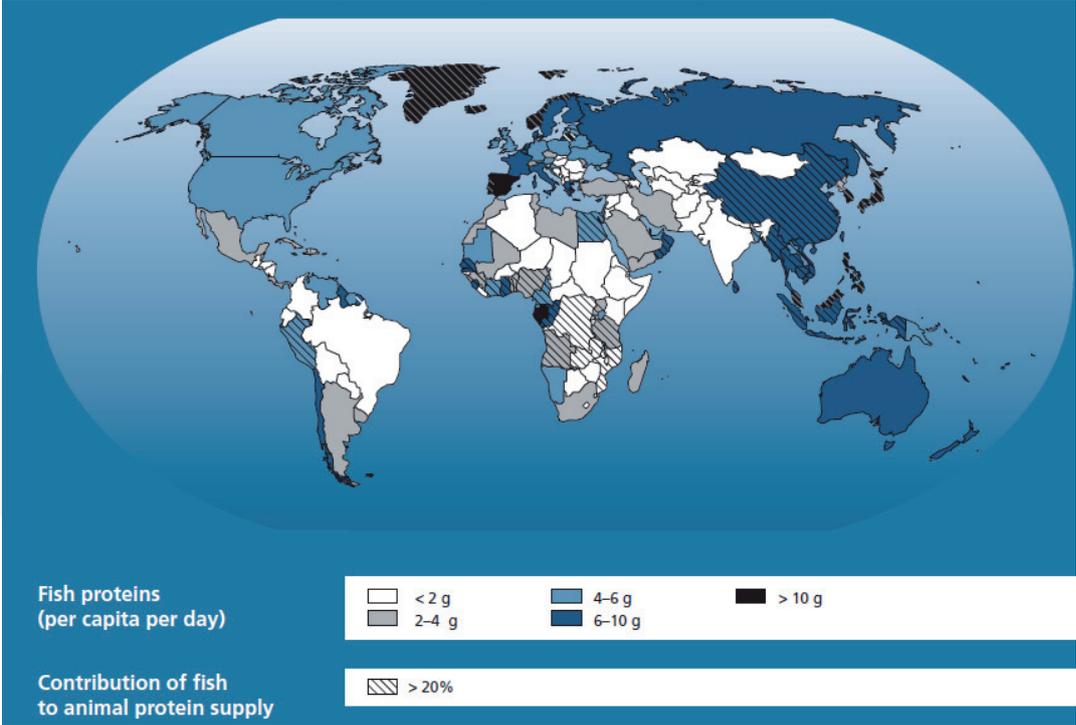
Much of the discussion around the linkages between poverty reduction, food security and fisheries is thus focused on small-scale fisheries, as it is in this highly significant sub-sector that the linkages are most direct (Bene et al., 2007).

Although a number of field studies have observed or argued for the importance of cash income from capture fisheries in boosting local economies, I know of no explicit quantification of these growth-linkage effects. Perhaps the best-known example is the Nile perch 'boom' around Lake Victoria, the effects of which – positive and negative – have been extensively debated, but which have unequivocally acted to boost economic dynamism in the region, albeit with the kinds of social, equity and environmental costs that are seen wherever rapid economic development takes place in the context of existing social inequities and weak governance (Geheb et al., 2008). For aquaculture, one of the few studies to quantify growth linkages relates to the shrimp farming industry in southern Honduras (Stanley, 2003). The study found that export-orientated commercial aquaculture exhibited low backward and strong forward linkages, but those were likely to be reduced with increased reliance on imported inputs as vertical integration and concerns for disease and quality management shaped the development trajectory of the industry (Stanley, 2003). The fiscal linkages were minor – mainly in the form of municipality taxes. Strengthening the local economic impact of larger-scale, capital intensive export-orientated production is a key area of challenge for policy, if 'enclave development' is to be avoided and the potential for such business to act as growth poles is to be maximized.

2.3 Nutrition

Interpretation of the importance of fisheries for human nutrition depends on the units and scale of analysis. In terms of energy, less than 1 percent of the daily world gross consumption of food products (33,000 giga calories per day in 2003) comes from aquatic products, with 88 percent coming from plants and 11 percent from land-based animal production (Paillard et al., 2011). In terms of protein, however, the picture changes. In 2007, fish accounted for 15.7 percent of the global population's intake of animal protein, and 6.1 percent of all protein consumed. Globally, fish provides more than 1.5 billion people with almost 20 percent of their average per capita intake of animal protein, and 3 billion people with 1. percent of such protein (FAO, 2011).

Figure 3: Global distribution of Fish protein consumption, 2005-2007 average, from FAO food balance sheets (Source: FAO, 2011)



AQUACULTURE, FISHERIES, POVERTY AND FOOD SECURITY

Per capital fish consumption is higher in developed countries (Figure 3), but that merely reflects higher overall consumption of food, and of animal source food in particular. Mean daily calorific availability in OECD countries is 4,000 kcal per person per day, and less than 2,500 in sub-Saharan Africa. The difference is largely due to the consumption of animal products – which contribute 30 percent of calorific value in OECD countries, and <6 percent in Sub-saharan Africa (Paillard et al., 2011). The latest available global data on fish supply is for 2007 (FAO, 2011) and indicate that in the least developed countries, per capita fish supply (production + imports – exports) is 9.5 kg/person/year, while in industrialized countries, it is three times higher - 28.7 kg/person/year. Africa has an average per capita supply of 8.5 kg/person/year, while Oceania has 25.2. While in the least developed countries, the absolute amount of fish protein is lower than for developed countries, the relative contribution of fish to animal protein supply is usually higher; Fig 3 highlights the west coast of South America, much of sub-Saharan Africa and South and South-east Asia as areas where fish consumption makes up a significant.

Figure 4: Relative and absolute contributions of fish to protein consumption in the 30 countries with the highest proportion of fish in the animal-based part of their diet.

Figure 4a: Fish protein as a percent of animal protein consumption (%)

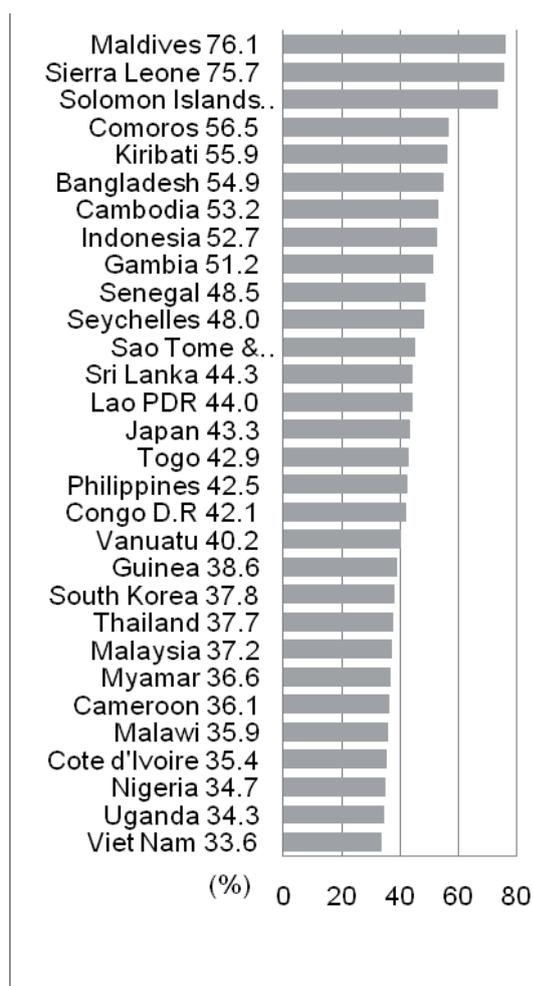
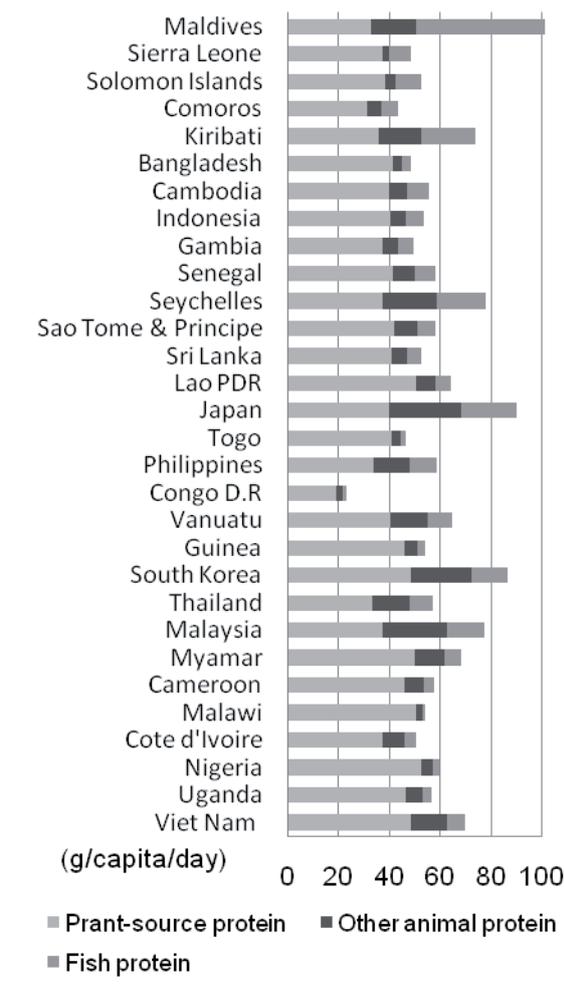


Figure 4b: Total protein consumption (g/capita/day)



Source: Kawarazuka & Bene, 2011. Calculated from FAO food balance sheets.

The 30 states with the highest relative fish consumption (percent of animal protein) are highlighted in Figure 4a, above. The list is dominated by small island developing states, tropical Asian and sub-Saharan African countries. It also includes a number of landlocked states (e.g. Malawi, Uganda, Lao PDR) and those with major freshwater fisheries (e.g. Congo DR, Bangladesh, Cambodia), highlighting the importance of considering freshwater fisheries and aquaculture production, and not just marine ones. A closer look at total sources of protein in these countries (Figure 4b) shows, however, that the total share of animal source protein is relatively low in many of the poorer countries – it is noticeably higher in the developed and transitional economies of Asia (Malaysia, Japan, South Korea) and in small island developing states (e.g. Maldives, Kiribati, Seychelles).

One conclusion that could be drawn from this aggregate data is that the role of fish as an essential source of protein for the poor is somewhat overstated by fishery sector analysts. The poor get most of their protein from plant sources, and ensuring an adequate supply of protein-rich staples and pulses (beans, peas etc) is likely to be more important in terms of protein supply. This conclusion is, however, overly simplistic, for a range of reasons elaborated on below, but principally because the use of national-level data in food security analysis should be treated with caution. There will be populations within many of the countries in Figure 4a and b (and others) who are highly fish-dependent in their diets. These may include the landless poor, indigenous hunter-gatherers in forests (e.g. in Amazonia and Congo, consumption of fish is higher than meat among these groups) and people living on wetlands and near coasts, who may have more limited access to plant-based sources of dietary protein than the agrarian and urban majority. Consumption surveys within countries are needed before nutritional benefits of fish can be traded off against other potential development benefits on the basis of perceived limited importance at national level.

If fish is only critically important in protein consumption terms in some sub-populations, what is its key role in broader context. The answer has been emerging from more localized, detailed nutritional studies conducted over the last 20 years (e.g. Thilsted et al., 2007; Roos et al., 2007) which have recently been reviewed by 1 (2010) and Kawarazuka & Bene (2010 and 2011). Key points from these reviews are:

- i. Developed and developing country perspectives of the links between fish and health differ considerably. In developed countries the major focus has been of fish safety (particularly the issue of mercury contamination) and on the health benefits of poly-unsaturated fatty acids (PUFAs) from fish and fish oil, which are thought to lower blood pressure, reduce risk of heart disease and boost infant growth and cognitive development. In developing countries, the focus has been on the role of fish in tackling undernutrition.
- ii. More than two billion people in the world, particularly in developing countries, are estimated to be undernourished through deficiency in essential vitamins and minerals, especially in vitamin A, iron and zinc. These deficiencies are especially important at key stages of human life (pregnancy, breastfeeding, childhood) and can have severe impacts for health and physical and mental development, in some cases leading to irreversible effects in later life. This is the so-called 'hidden hunger'. Fish can potentially contribute to reducing micronutrient deficiencies and reducing this health burden.
- iii. Protein from fish, while it may contribute less to diets than plant sources, is 5-15 percent more digestible. Staple foods such as rice or maize contain little lysine, an essential amino acid, which aids absorption of protein. When fish is added to a plant-based diet, the total protein intake increases as lysine in fish compensates for the shortage of lysine in the rest of the diet.
- iv. Some fish are rich in lipids or PUFAs, beneficial for adult health and child development. Of the types of fish accessible to consumers in developing countries, small pelagic fish such as anchovy and sardine are some of the richest sources of PUFAs, while large freshwater fish such as carps and tilapia are relatively low in PUFAs. The lipid composition of many small fish from inland and coastal waters has not been determined.
- v. The micronutrient content of different types of fish also varies considerably. Key micronutrients are vitamin A, calcium, iron and zinc. Small freshwater fish are especially rich in these micronutrients and when consumed frequently in everyday diets contribute substantially to nutrition and health and mental development of children. For example, detailed studies in Bangladesh have shown that daily consumption of small fish contributes 40 percent of the total daily household requirement of vitamin A, and 31 percent of calcium. In Cambodia, fish and other aquatic animals contribute 51 percent of calcium, 39 percent of zinc, and 33 percent of iron intake for women.

- vi. As well as the species type consumed, nutritional benefits from fish consumption will be influenced by local processing methods and eating patterns. Small fish species that are consumed whole with bones, heads and viscera play a critical role in micronutrient intakes, as these are the parts where they are concentrated. Small fish also offer many other nutritional advantages. They can be processed and stored more easily, are more affordable to the poor as they can be purchased in a small portion, and can also be more easily divided among household members. Small fish of low market value, often sold fresh, sun-dried or smoked, or processed into sauces or flour, plus a variety of other aquatic animals (mollusks, amphibians, reptiles, aquatic insects etc) play a very important role in the diet of the poor, not only through subsistence fishing, but through extensive market networks. The small dried fish from Africa's great lakes and large reservoirs are traded throughout east and southern Africa – including to coastal cities.
- vii. Health and nutrition policy advice would suggest dietary diversification strategies for improving micronutrient intakes, by promoting production and consumption of locally available nutritious foods. Micronutrients can be sourced in alternative ways, however. Food supplements and staple crop enrichment are key elements of contemporary nutrition science for food security. These strategies make populations dependent on external resources and expertise to gain access to a healthy diet, rather than help them retain control over their own nutritional needs. Food is also about more than nutrition, as is demonstrated by the recent recognition of the Mediterranean diet as an 'intangible cultural heritage of humanity' on the UNESCO World Heritage listings (UNESCO, 2010). The designation of this diet explicitly includes fish.

2.4 Data weaknesses and their implications for policy

To inform choices on investment and trade-offs between different policies towards the fisheries and aquaculture sector, an accurate picture of the contributions the sector makes is helpful. Incomplete or biased statistics can lead to damaging interventions. For example, portraying small-scale fisheries in the Mekong River as being overexploited and capable only of keeping poor people in poverty undervalues the contribution the sector makes to the region's economies and makes it easier to justify the case for putting the fisheries at risk through hydropower development by minimizing the cost calculation in cost-benefit analysis (Arthur and Friend, 2010). It has long been known that small-scale fisheries tend to be under-valued in statistics, and that estimates of the number of fishers are not very reliable. There are also concerns that current accounting methods for compiling the statistics in global databases undervalue the contribution of the sector to GDP by counting only the first-sale values, while processing and services associated with the sector may add considerable value, as do revenues from licenses and access fees (see section 2.1).

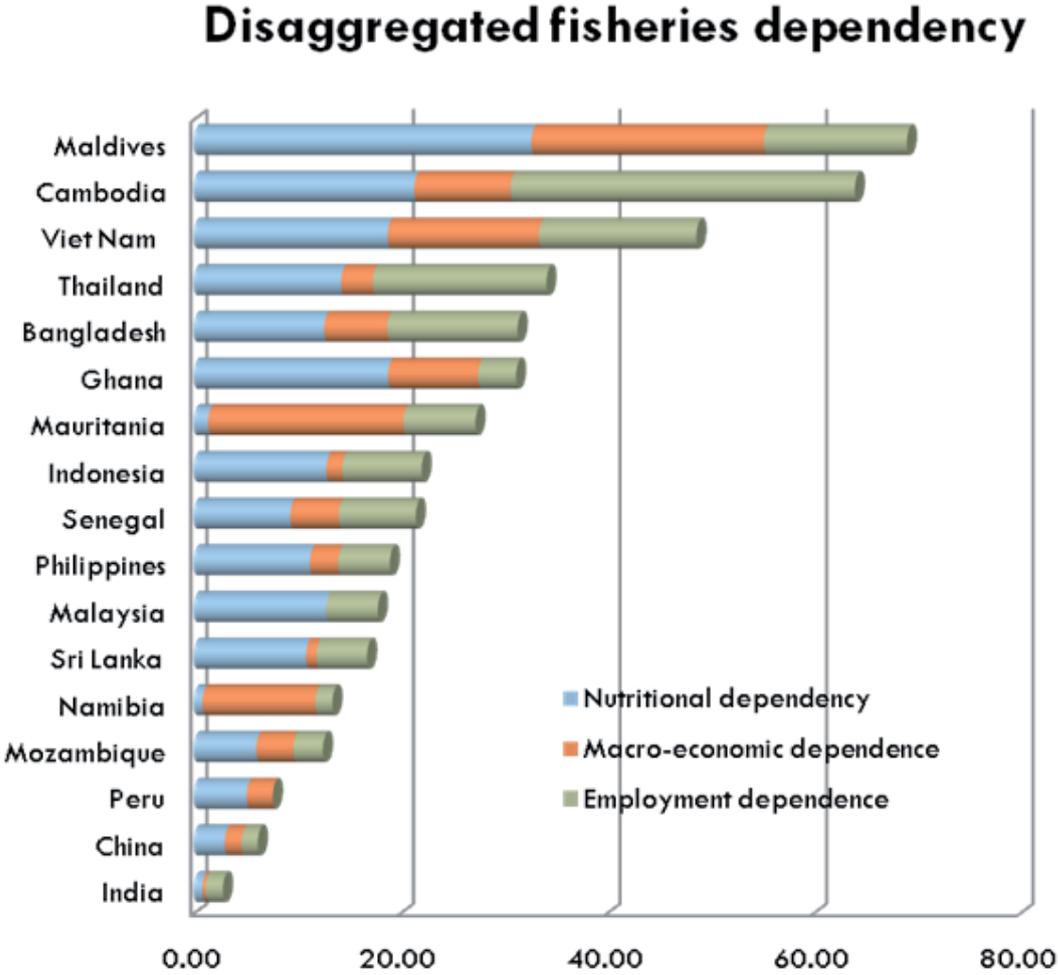
A process of improving the statistical databases to account for these issues is underway, but at present most global analyses continue to rely on the standard databases. For example, Allison et al (2009) used an index of dependency on fisheries as part of an exercise to rank countries in their vulnerability to climate change impacts on their fisheries, where vulnerability is a function of climate change exposure, economic dependency on the sector, and adaptive capacity. They constructed the index using standard FAO statistics. Table 3 presents a comparison between the data used for that analysis, and results of recent more in-depth research into available national statistics based on scrutiny of national statistics not available without direct contacts and enquiry. Getting this data is a time-consuming exercise, and it is not yet available for more than the countries shown below. In all but one case digging deeper into the data reveals that the importance of fisheries to employment and diet is underestimated in global databases and food balance sheets. The differences are in some cases startling (e.g. 23 percent of Cambodians are employed full or part-time in fisheries-related occupations, not 1.2 percent as indicated in the global statistical database). This would have an impact on the calculated climate change vulnerability ranks. If such analyses are used to allocate development assistance to the most vulnerable, then the implications of misleading statistics are clear and serious.

Table 3: Measures of importance of the fisheries sector to employment and nutrition, derived from two sources: (i. FAO statistica. databases. used to calculate national fishery dependency indices in Allison et al (2009), and as calculated from the WorldFish/FAO 'Big numbers' project (BNP, 2009), and from the QUEST_FISH project (Scholtens & Badjeck, 2010)

	fisherfolk as percent of total labour force			percent of animal protein from fish		
	Allison et al. 2009	QUEST Fish	percent/difference	Allison et al. 2009	QUEST fish	percent difference
Bangladesh	2.12	9.51	449	50.0	59.88	19.8
Cambodia	1.24	23.38	1883	57.1	81.00	41.8
China	1.66	2.09	26	15.6	15.84	1.4
Ghana	2.61	3.50	34	60.0	73.01	21.7
India	1.52	2.19	44	10.0	15.20	52.0
Indonesia	5.28	6.20	17	46.2	57.26	24.1
Malaysia	1.03	4.40	426	38.5	41.45	7.8
Maldives		10.33			78.32	
Mauritania	0.76	5.73	757	9.1	12.16	33.8
Mozambique	0.23	2.97	1272	0.0	36.89	∞
Namibia	0.45	2.16	484	11.5	11.77	2.0
Peru	0.57	1.20	209	25.0	25.19	0.8
Philippines	3.21	4.40	37	37.5	44.88	19.7
Senegal	1.28	6.05	472	42.1	41.90	-0.5
Sri Lanka	1.84	4.33	235	50.0	54.05	8.1
Thailand	1.04	12.31	1187	37.5	54.10	44.3
Viet Nam	2.63	8.97	341	23.5	68.80	192.4
Average			492.1			>31.3

Examining fisheries dependency statistics can give a rapid indication of where there are likely to be significant trade-offs between policy objectives for the sector's development. In a country where fish are important for nutrition and employment, as well as growth, there are likely to be costs in any policy reform to reduce fleet size. that will have to be accounted for in assessing the potential benefits of the change. For example, two countries often used to argue for a wealth-based approach (maximizing resource rents) – Mauritania and Namibia – have limited dependence on fisheries and aquaculture for nutrition or employment, so there are few costs to adopting such a policy and it is likely to be of economic benefit and uncontroversial politically. In Vietnam, where a major capacity-reduction programme is underway (Pomeroy et al., 2009) there will clearly be trade-offs in terms of potential loss of employment in the sector, and perhaps reduced availability of fish in local markets, but the macro-economic contributions from the sector should increase to compensate for these losses, resulting in net benefits to coastal populations if markets and government policy both work effectively to distribute the benefits in support of food security and poverty reduction. These issues are evaluated further in Section 3 of this paper.

Figure 5: Index of fisheries dependency, based on proportion on contribution to animal protein (nutrition indicator) labour force involved in fisheries and aquaculture (employment) and contribution to GDP and export revenues (macro-economic indicator) . Data are from re-analysis of national statistics, carried out by BNP (2009) and Quest_Fish (www.quest-fish.org.uk), (Scholtens & Badjeck, 2010).



3. Policy reform in fisheries and aquaculture: poverty and food security implications

Several development agencies including the World Bank and DFID have demonstrated renewed interest in investing in fisheries for development (World Bank 2004; DFID 2005; Cunningham et al. 2009; Leal 2010), recognizing not only the crisis but also the opportunity that improvements in fisheries could yield in promoting growth and reducing poverty in developing countries. As developing-country fisheries include a substantial small-scale or artisanal sector, which employs over 90 percent of the world's fisherfolk, the discussion inevitably concerns the role of small-scale fisheries, paralleling a debate on the role of small farms in agricultural development (Wiggins et al., 2010). There is also growing interest in improving the effectiveness of public-sector investment in aquaculture development. Here, a long-standing focus on small-scale aquaculture development for the poorest is giving way to interest in supporting the development of small and medium enterprises and using aquaculture as both an 'engine of growth' as a means to meet dietary demands, including those of people currently undernourished. (Beveridge et al. 2010, OECD, 2010a; Belton et al., in press).

National fisheries and aquaculture policies are often vague and contradictory in their aims – they pledge support for the wide-ranging declarations in the FAO Code of Conduct for Responsible Fisheries (FAO, 1995) and usually set targets for production increases and/or resource conservation, but not for development outcomes (Allison, 2005; Bene et al., 2010a; Sowman & Cardoso, 2010). Poverty reduction and food security could, however, become more explicit goals of fisheries and aquaculture policy in developing countries now that a range of broader processes provide an enabling policy environment for a focus on these aims. The widespread adoption at international level of the millennium development goals (MDGs) and, at national level, the formulation of poverty reduction strategy plans (PRSPs) in the highly-indebted poor countries (HIPC). are helping to align sectoral policies with national economic policy in developing countries. At global level, these have been supported by donor harmonization policies, driven by the Paris Declaration on Aid Effectiveness (OECD, 2005).

While international instruments provide useful policy guidance, national policy, legislation and institutional arrangements have not yet widely adopted poverty and food-security related objectives for fishery and aquaculture development, and the importance of fisheries to poverty reduction is not always reflected in national PRSPs and national food security policies and in government budget allocations (Thorpe et al., 2005; 2006; Sowman & Cardoso, 2010). The sector is also insufficiently integrated with a range of broader development policies, including climate change adaptation, social protection, health and education, sometimes leading to increased social and economic marginalization and vulnerability of fishing-dependent people (Allison et al., 2011a, b). These are important dimensions of poverty that are not measured in income surveys.

In general terms, fishery and aquaculture production and trade can contribute to all the MDGs, particularly those of halving poverty and hunger and improving health (Heck et al., 2007). There is, however, a need to ask more specific questions on how to optimize these benefits. The key issue lies in the distinction between the consumption and income sides of the story, i.e., do we reduce poverty more by making fish more accessible for more people or by increasing the incomes of people who fish, or farm for a living. More specifically, should fish resources be used primarily to generate wealth through private-sector development as a contribution to macro-economic growth, or to generate revenue for national and local governments to spend on social service provision for poverty reduction. Perhaps near-shore and inshore fish production can provide a source of livelihood to the landless rural poor, or a 'safety net' income source for those experiencing temporary or seasonal hunger or unemployment? Or maybe the primary function of fisheries and aquaculture should be to provide healthy, nutritious and affordable food to those most in need of it, and who have least access to alternatives.

Fisheries and aquaculture are very diverse sub-sectors, and they may be able to provide some or all of these functions to some degree but there are inevitably trade-offs between them. There are also likely to be synergies. For example, increasing the efficiency of production and minimizing wasteful over-investment may reduce prices, making fish more affordable. Policy should therefore make explicit which of the pathways that link fisheries and aquaculture to poverty reduction is to be emphasized and supported and what the synergies and trade offs are likely to be. For example, a policy to use all available coastal waters for subsistence fisheries and nature conservation would stifle the possibility of developing a productive shrimp-farming sector which could contribute to export revenues, waged employment and GDP growth as an effective means of reducing poverty. In this complex context, relevant generic policy questions may include:

- i. In any given country or region, which of the functions of fisheries and aquaculture (revenue, jobs, food) provides the greatest sustained contribution to poverty reduction and food security?

- ii. What policies are needed to support those functions?
- iii. What are the trade-offs between one kind of benefit and others? (both in quantity, distribution and sustainability)?
- iv. What is needed to implement the required reforms and what are the risks involved?

This report uses these four questions to guide analysis of what is needed to maximize fisheries and aquaculture contributions to development. It is beyond the scope of this short study to quantify and model these benefit streams and trade-offs. At present, we are able to offer only review of theory and existing empirical evidence that can help inform development and management strategy in the sector.

3.1 The transition to rights-based fishing: will the additional wealth reach the poor?

3.1.1. Failing fisheries and the need to reform fishing access rights

Fisheries management is failing; not always and not everywhere but widely enough to cause global concern. The proportion of stocks estimated by FAO (2011) to be overexploited, depleted, or recovering from previous over-exploitation rose from 10 percent in 1974 to 33 percent in 2008 (of which only one per cent of stocks were in the 'recovering' phase). The proportion of stocks that remain underexploited or moderately exploited is, by contrast, diminishing: from 40 percent in the mid-1970s to 15 percent in 2008. The proportion of fully exploited stocks – those at or close to their maximum biologically sustainable production with no room for further expansion - has remained relatively stable at about 50 percent since the 1970s. At first sight, this may be interpreted as saying that half the world's fish stocks are optimally managed, but many of these 'fully exploited' stocks may be delivering a biological maximum sustainable yield, but may not be delivering maximum economic benefits, if the capital invested in taking this yield is excessive, or if the yield is maximized by depleting larger, more valuable species from mixed-species stocks.

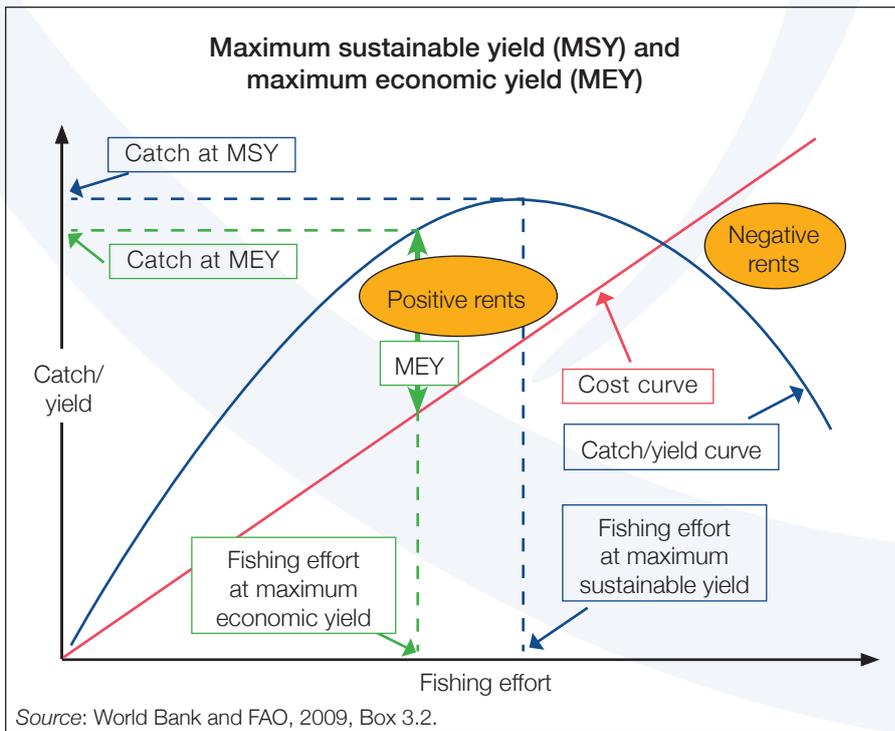
To get to this situation, many fisheries worldwide have followed similar evolutionary pathways, moving from 'frontier economy' exploitation of abundant resources to a period of expansion characterized by the use of ever more effective fishing technology, expanding fishing area, and increasing catches, followed by stock decline and fishery closure – the classic picture of boom and bust. Poor governance in general and ineffective fisheries management in particular, are putting this highly valuable economic and food resource at severe risk. The underlying causes of this are institutional. There has been a wide-ranging failure to deal with free and open (or too cheap and insufficiently well-regulated) access to fisheries. More effective institutions are urgently needed to manage fisheries resources, generate wealth from them and direct this into profitable investment (Bostock & Walmsley, 2009).

As well as addressing structural weaknesses in access regimes (i.e. the design of fishing rights), there is a need to also minimize the 'rent drains' resulting from inappropriate subsidies (e.g. fuel subsidies), the prevalence of illegal and pirate fishing, the exclusion from or marginalization of poorer people in global value chains, and the neglect of environmental externalities in fisheries and aquaculture development (Willmann et al., 2009; Love, 2010, OECD, 2010b). Addressing these elements of the governance context points to the need to think beyond the boundaries of the catching process when thinking about fisheries governance, to include the value chain and other critical elements of the fishery 'social-ecological system' (Andrew & Evans, 2011). Aquaculture alone will not address the rising demand for fish, and governing capture fisheries more effectively is an essential element of meeting demand for fish and generating benefits from wise use of natural resources.

3.1.2. Models of fishery sector reform. emphasis on wealth and welfare

The standard surplus-production bio-economic model found in all fishery text books, although much criticized for oversimplification, provides the conceptual basis for many of the currently suggested reforms to fisheries governance (Figure 6).

Figure 6: Gordon-Shaefer bioeconomic surplus production model for exploited fish stocks



The basic requirement for sustainable capture-fisheries management is that at the end of each fishing year, sufficient spawning-stock of fish should remain in the water to sustain future harvests. The Gordon-Shaefer model and its derivatives quantify this principle. This model proposes an equilibrium between catch (or yield) and fishing effort, so that fishing effort can be regulated to achieve a maximum sustainable yield (F_{MSY}), maximum economic yield (F_{MEY}) and related targets. Failure to regulate fishing effort is thought to lead to a situation where fishing effort tends towards the point where economic returns from the fishery equal the costs of exploiting the resource – the ‘open access equilibrium’ (F_{OAE}). Beyond this point, where the cost curve crosses the catch/ yield curve, resource rents are negative. At this point, harvesters make no net income. Normally, harvesters would stop at this point or earlier, but if signals of resource scarcity are distorted or masked by subsidies to the fishing industry (in the forms of grants for modernising fishing technology, compensation for poor fishing seasons, fuel subsidies that lower costs etc), then fishing effort can even exceed the open access equilibrium, possibly leading to stock extinction and certainly to a situation where the fishery is a net drain on the economy. This model, linked to property and use rights ideas from institutional economics, is the theoretical underpinning of current policies on “wealth-based fisheries governance” (Cunningham et al., 2009).

Policies to maximize rents will aim to regulate fishing activity to levels that generate Maximum economic yield (MEY). This, in the long run, will generate the maximum 'rent' (indefinitely renewable economic surplus) from the fishery. It also corresponds to the point at which the fishery is maximally efficient (input-output ratio) in sectoral terms. This target corresponds with the recent calls for 'wealth based fisheries management' (Cunningham et al., 2009), elaborated further below. If the aim was to get the maximum sustainable amount of fish into markets, then regulation of fishing might target maximum sustainable yield. Profitability of the fishery sector will be lower and the marginal gains are likely to be small, and will lower both fishermen's incomes and reduce the overall profitability of the sector. This target reference point may be relevant if a multi-criteria optimization between resource rents, fish supply and employment is required – neither rents nor employment will be maximized, but the trade-offs between them will be less than if either MEY or Open Access Equilibrium (OAE) is pursued as a management objective. Allowing a fishery to creep towards the OAE (or beyond) will maintain the highest levels of employment, but with low profit and therefore income, reduced fish supplies, and increased risk of stock collapse. Weak governance and absence of property rights tend to push fisheries in this direction, while subsidies may push them beyond that point. Allowing fisheries to be open-access may make sense where they have little prospect of generating substantive rents, are difficult or expensive to regulate, and where people have limited employment and livelihood options. This is essentially a 'safety net' function, but this function is not really adequately described by an equilibrium model.

Although the Gordon-Shaefer model provides an elegant and persuasive overview of how a fishery bioeconomic system works there are many practical difficulties with the model: it is difficult to identify the target reference points until they have been exceeded; it is difficult to disaggregate the models in fisheries where one stock is fished by many fleets, or one fleet fishes many stocks; and it is based on catch and effort data that are often unreliable or unavailable (Hilborn & Walters, 1992). There are also difficulties with the equilibrium assumptions, particularly as many fisheries never reach an ecological equilibrium point and economic responses to resource changes are invariably time-lagged (rather than instantaneous as implied) or complicated by factors external to the fisheries sector. Nevertheless, the model and its target reference points remain central to national and international fishery policy and even to legislation (Lugten & Andrew, 2008).

The related goals of biological sustainability and economic efficiency are addressed through regulating fishing effort (which reflects input costs). There are numerous technical measures for regulating fishing effort, but those most prominent at the moment are regulation of access rights. Whereas fisheries regulation for much of the last fifty years has been the preserve of often under-resourced government fishery departments, widespread failures have led to change. Institutional innovation in fisheries governance has been rapid, with governments, market mechanisms and fishers combining in various ways to regulate fishing activities and fish supply chains. There are success stories from management using combinations of all of these institutional arrangements, for example, from ITQ-managed fisheries (Costello et al., 2008) and state-community partnership arrangements (Gutierrez et al 2011) which may deploy one or more of a range of regulatory instruments, including territorial use rights, marine protected area management, and group or individual quotas. The choice of the most suitable will depend on the context.

Many fisheries economists advocate regulation through allocation of individual transferable quotas (ITQs) which add up to a total allowable catch (TAC) equivalent to catch at MEY. ITQs end the 'race for fish' (the competition between boats to catch the largest individual share of the resource before someone else does) by allocating a defined share to each vessel. This encourages individual quota owners to catch their share as efficiently as possible, thereby contributing to keeping overall fishing effort as low as possible and maintaining positive rents. Those unable to catch their share profitably can lease or sell it to those who can, thereby both increasing the efficiency of the sector and generating a market for quota, which adds further value to the fishery (e.g. Hannesson, 2004). Less efficient in theory but sometimes administratively and technically more feasible are approaches to limit access to defined groups (e.g. through community based management) or simply to limit effort by governments issuing fewer licenses to fish, and continuing to enforce a range of technical measures to prevent damaging fishing methods from being used. These, too, have their successes (Cunningham and Bostock, 2006). These ideas are outlined at some length because they underpin current debates on how best to derive benefits from fisheries for poverty reduction and food security.

Wealth-based fisheries (e.g. DFID, 2005; Cunningham et al., 2009; Bostock & Walmsley, 2009) essentially aims to maximize rents, which will increase the contribution of fisheries to GDP and growth, and growth is an effective means of achieving poverty reduction and, by raising average incomes and reducing the number of people living in poverty, it will also lead to food security through improved food purchasing power. The idea is simple

and attractive, and fits well with the empirical observation that, on average, growth is effective at reducing the incidence of poverty; just as economic contraction increases it (e.g. Ravallion, 2001). In order for wealth-based fisheries to contribute substantively to wider poverty reduction (i.e. beyond benefits to fisherfolk and fish consumers), the following conditions would, however, need to apply:

- The losses in welfare functions (employment, availability of low-priced fish, subsistence access) are more than compensated for by the gains in wealth.
- The fishery sector is large enough so that the rents generated will have a detectable impact on national GDP growth.
- There exists the institutional capacity to designate, distribute and enforce property or use-rights.
- The mechanisms to capture revenues from the sector are effective and efficient.
- The policies, capacities and accountability frameworks to ensure that rents are channeled towards poverty reduction are in place.

These conditions, by and large, apply to countries where these approaches have been successful, such as Iceland and New Zealand. Bostock and Walmsley (2009) point to Namibia and Mauritania as examples of developing countries where strengthening fishing rights are also helping to generate wealth. These, are, however, somewhat exceptional in the developing country context. They are both sparsely populated countries with exceptionally productive marine resources where few nationals make a living from the fishery sector and national fish consumption demand is low. There are therefore no trade-offs involved in a move towards wealth-based fisheries in this context. It is these trade-offs and the achievability of the wealth-based approach that concern Bene et al. (2010a), who highlight the welfare function of small-scale fisheries (Table 4).

The wealth and welfare models (Table 4) essentially present different pathways, through which fisheries can prevent, alleviate or reduce poverty and food insecurity. The wealth-based model has the potential to generate more substantive economic benefits, make most efficient use of resources, and supports ecological sustainability, but it makes greater demands on the quality of governance in the wider economy. The welfare model emphasizes existing, rather than potential, benefits and the ability of the poor and food insecure to access these benefits directly, rather than depending on their arrival through a long chain of causality beginning with wealth in fisheries and ending with enhanced alternative employment prospects in a growing economy and improved service delivery from a government with more fishery-generated revenue at its disposal, which it will spend in ways that support pro-poor development.

The welfare model also has its weaknesses. It is pessimistic in its assessment of the likely consequences of sectoral reform and optimistic about the resilience of both the fish stocks and the people who depend on them. Observations on the resilience of people and resources in the context of unpredictable climatic, economic and political contexts have clearly influenced its key proponents (Bene et al., 2010; Kolding and Van Zweiten, 2011). Wealth-based advocates are less optimistic, with Bostock and Walmsley (2009) saying that, under open access, there may be short-term gains to be had but "...eventually, the fishery will collapse, leaving the dependent population more vulnerable than they were before."

These two models (wealth vs. welfare) confront policy makers with, on the one hand, the prospect of continued subsistence-level benefits and risk of resource collapse from over-exploitation, and, on the other hand, the risk that governments will fail to effectively capture and channel gains from a wealth-based approach towards poverty reduction. There is ample reason to fear both risks. Unregulated fisheries have collapsed, or at least become degraded and less profitable, all over the world. This includes small-scale fisheries in developing countries (OECD, 2010b; FAO, 2011). There are also numerous instances of governments failing to channel their countries' natural resource endowments effectively in the service of poverty reduction. Oil, mineral and timber resource revenues are well-known examples (Robinson et al., 2006). Is there any reason to suppose the efficiency and equity of distribution of fishery resource rents should fare any better.

Where there is no substantive expected loss of the welfare functions of fisheries there is no harm in trying to improve rents and trusting that the increased revenue will indeed lead to growth and redistribution for poverty reduction. The more difficult decision is when there are substantial trade-offs to be made between the relative certainty of short-term welfare support and the relative uncertainty of distant future opportunities from macro-economic growth. As with small-scale agriculture in Africa, people will only abandon a subsistence orientation and escape poverty traps by switching to cash-crops and engaging in trade, or selling land, when they trust in

AQUACULTURE, FISHERIES, POVERTY AND FOOD SECURITY

the ability of property rights, markets and governments to substitute for their direct access to food security (Ellis & Freeman, 2004). Building the institutions that allow the poor to escape poverty-traps is an economy-wide project. Fisheries may not always be the best place to start.

Table 4: Comparison of the wealth-based and welfare models in small-scale fisheries. (Source: modified from Bene et al., (2010a))

Wealth-based model			Welfare model	
Poverty reduction: Fishery contributes to lifting people out of poverty			Poverty and vulnerability prevention: Fishery contributes to maintaining a minimum standard of living	
Level	Contribution	Mechanisms	Contribution	Mechanisms
Household level/ sector	Generation of wealth	Effective capture of fishery rent (capital accumulation) High level of commercialisation Access to effective market mechanisms Fish as cash crop for investment and diversification Food security through increased income for food purchases and health expenditures	Safety-net function (transient poverty)	Reduces vulnerability and mitigates poverty effects Food security through direct contribution (subsistence) but also fish as immediate source of cash income to cover basic needs (health, education, food)
Local level	Engine for rural development	Increased demand for goods and services Rise in wages	Labour buffer / safety valve for the poor (chronic poverty)	Alternative sources of income, food and/or employment, support for development of a market economy through cash expenditure in local area.
National level	Economic growth Improved trade balance	Revenues to government from licences, taxes and foreign-exchange earnings (regional or international trade) Increased government revenues available for expenditure on social services and infrastructure Food security through improved access through centralized and globalized marketing systems; efficiencies of scale lower prices	Social-redistributive system (welfare)	Income and employment multipliers Food security through nutritional benefits to the poor who access fish via extensive small-scale networks trading in low-cost fishery products (e.g. sun-dried small fish)
Type of management system	Restricted access (exclusive management system)		Common pool / semi-open access (inclusive management system)	
Institutional context	Enabled by: Secure property rights, effective markets, good political and economic governance, growing economy able to absorb displaced labour, government with sufficient revenue to provide social services to the poor, pro-poor development policy		Enabled by: Good local-level leadership, strong social capital, availability of alternative livelihood opportunities, ability to regulate access by migrant populations	
	Hindered by: Elite capture, corruption, capital flight, market failures, barriers to trade, poor quality of social service delivery, weak enforcement and monitoring capacity of fisheries departments, weak state accountability		Hindered by: Inequitable power relations, weak local leadership, strong penetration of global markets without capacity to govern, disenabling local governance context, high levels of cross-border migration	

3.1.3. Fisheries governance reform: are there documented impacts on poverty and food security?

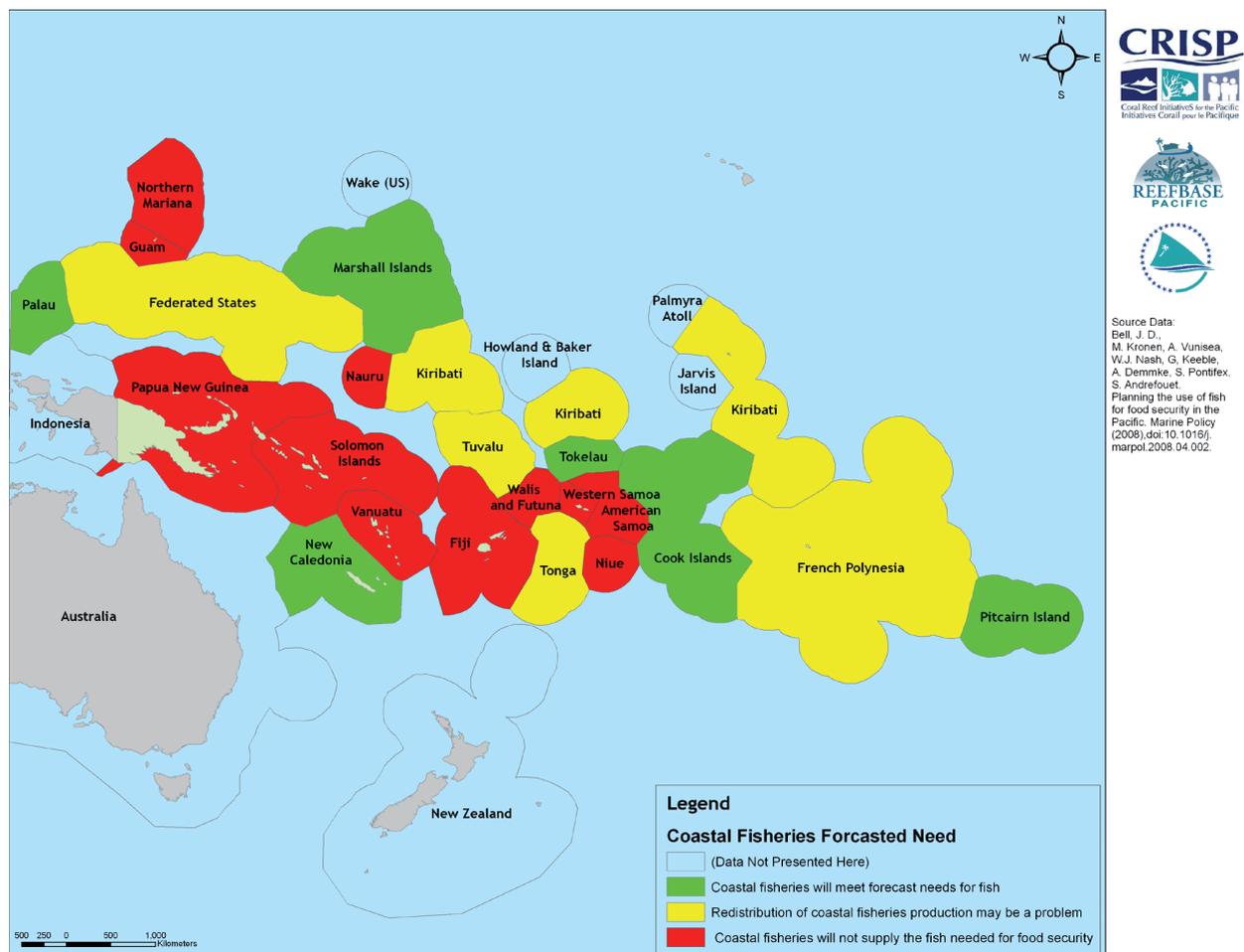
There is little direct evidence for successful poverty reduction through maintenance of traditional quasi-open access conditions in order to support welfare functions in small-scale fisheries. What exists is generally based on inferences drawn from worsening of some dimensions of poverty when access to the resources by the poor is denied, or when there are unsuccessful attempts to introduce new forms of access regime (Bene et al., 2009). Similarly, the evidence for successful outcomes through addressing other non-income and non-resource related dimensions of poverty is suggestive, rather than conclusive (Allison et al., 2011b), as is the evidence for the 'local engine of growth' function of existing state or traditionally-managed small-scale fisheries (Thorpe et al., 2007; Bene et al., 2007). Fishery development projects and programmes generally lack adequate baselines, final evaluations and ex-post impact assessments (MacFadayan, 2008; NORAD, 2009) and even if they are present, such systems have seldom been designed to capture the complex linkages between institutional changes affecting resource access and poverty and food security impacts beyond the sector.

Emerging experiences of successful fisheries governance using private rights (individual transferable quotas), community rights and state-managed marine protected areas are reported in three review studies (Costello et al. 2008; Gutierrez et al. 2011; McClanahan, 2010). The success of these three very different approaches reinforce the earlier views of common-pool resource scholars that it matters less what kind of property rights regime is in place, and more that it is adapted to local ecological, economic and cultural context, clear to all, is enforceable and has legitimacy (Ostrom 1990; Hanna 1999). Although all demonstrate improvements in fishery biomass and yield, income of fisherfolk and/or fishery economic output, none of them are able to demonstrate an effect beyond fisheries. This distinction is important because the explicit claim of wealth-based management is to demonstrate impacts beyond the sector. It is not enough to show that the welfare of fisherfolk improves, as this is not the primary objective of wealth based management. Indeed, welfare approaches have been criticized for limiting their interest to those who have access to resources, and not considering the interests of the larger population.

None of the assessments of fisheries governance effectiveness cited above can answer the specific question posed by this paper: which policy goals and management instruments combine most effectively to maximize the potential benefits to poverty reduction from fisheries? The lack of evidence is understandable, given the complex and piecemeal process of fishery policy reform and the multitude of confounding factors that hinder the assessment of impacts, positive or negative. Perhaps the work closest to capturing these effects concerns governance reforms to capture wealth from tuna in the Pacific, where Papua New Guinea, Cook Islands and Fiji have moved away from simple access agreements and have various forms of licensing (a form of access right) that favour domestic involvement and onshore investment. The Marshall Islands, while still having extensive access agreements, has also attracted substantial trans-shipment activity, with flow-on economic benefits (Barclay & Cartright, 2007). More recent work in Pacific small island developing states (SIDS) has extended the analysis of the links between fishery governance options, poverty reduction and food security to include inshore fisheries and food security concerns and provides a qualitative example of the contextualized, diagnostic analysis needed to link these policy arenas coherently (see case study overleaf).

Fisheries and Food Security Issues in the Pacific

Figure 7: Forecasted supply of coastal fish in the Western Pacific, relative to projected need in 2030 (Bell et al., 2009)



Bell et al. (2009) used current consumption rates (assumed indicative of needs and preferences) and population growth data to forecast fish requirements in the future for each country of the Western Pacific region. They identify many of the larger Melanesian Islands as facing shortfalls in overall supply by 2030 (red shading), with other countries able to meet requirements with some redistribution of fish through improved trade (yellow) and others having available resources to meet anticipated needs. To provide the red-shaded countries with access to the fish required for food security to 2030 and beyond, national planners and managers need to: assess whether the potential sustainable production from oceanic (tuna), coastal and freshwater fisheries, and aquaculture, can meet future demand for fish; identify how best to “allocate” access to the necessary proportions of production available from these various sources; develop systems for catching/producing and distributing fish to deliver these allocations effectively; implement policies to support the necessary systems and allocations; and oversee efficient management of the systems. This analysis, with additional information from Gillett (2009) further suggests the following:

- Countries made up of atolls and small islands that attempt to export food fish from inshore and reef areas may end up creating food security problems through declines in food fish availability. Tokelau and some of the Micronesian economies may be in this category.

- An analysis of fish requirements for a country (including that for local resident nutrition, food necessary for a tourist population, and nonextractive value of fish resources) may suggest merit in discouraging the export of food fish from inshore/coastal areas. This has been considered in Palau and the Maldives.
- Objective economic scrutiny of subsidized aquaculture operations intended to enhance food security suggests there are more efficient mechanisms to produce the same nutritional benefits (e.g. fisheries management, fish imports, importing diet substitutes).
- In view of the likely increased availability of tuna from industrial fishing operations in localized population centers, some consideration should be given to the development of systems for distribution to the more remote areas.

3.1.4. Conclusion

Fisheries governance reform in LDCs and LIFDCs aim to identify ways of turning rent ‘drains’ into ‘gains’ (Munro, 2010) and to ensure that the gains are – as much as possible - enjoyed by those who are currently living in poverty and food insecurity, whether they are producers, traders or consumers of fish, or merely citizens of countries in which fish could generate more wealth for all.

The rights-based approach is motivated by the critical insight that inefficiencies in the fishery sector have produced a major squandering of assets—and that there is a development opportunity if the economic rents from fisheries are more rationally captured and reinvested in public goods. Yet advocates of this approach have not yet explicitly considered the important welfare functions of developing country small-scale fisheries that would be affected by a reallocation of resource rights and rents. In other words, they have evaluated the benefits, but not the costs. Also they have not yet critically evaluated the institutional preconditions necessary to make such reforms equitable and to ensure that resulting revenues would indeed be reinvested in public goods such as health, education and rural roads, rather than captured by elites for their private gain (Wilson & Boncoeur 2008). The degree to which revenue generated through such an approach is likely to be reinvested in public goods will be heavily influenced by broader mechanisms of public accountability (Grindle 2007). Without such mechanisms in place, reform measures that support economic growth and private sector development objectives may undermine local welfare and food security.

Yet the fundamental concerns of the wealth-based approach are sound: how to identify the unrealized wealth potential in the sector, how to channel that wealth in a way that contributes most effectively to poverty reduction, and how to create the incentives for sustainable resource management. In our view, the most suitable approach to fisheries governance reform builds on and integrates insights from considerations of a range of perspectives – wealth, rights (including human rights), welfare and wellbeing. Evaluating these concerns in the context of an analysis of the costs, risks and political feasibility of reforms, requires a political economy approach to the analysis and planning of policy reform. Although OECD and the World Bank are increasingly talking about the political economy of fisheries policy reform, the approach has so far been underutilized in fisheries (Sutinen, 2008).

Too much emphasis on wealth creation and sectoral economic efficiency can ignore the welfare functions of fisheries and the trade-offs that may have to be made between increasing resource rents and sustaining displaced or excluded fisherfolk, or overlook the wider governance constraints that obstruct optimal efficiency of resource utilization or reinvestment of revenue from the sector in public goods (Béné et al. 2010a). Too much emphasis on improving access rights by the poor can overlook the potential for wealth generation and rural development from fisheries resources, and may not pay sufficient attention to the ecological limits of resource productivity (Cunningham et al. 2009). A preoccupation with minimizing downside risks and vulnerabilities in the context of social-ecological resilience may divert attention from maximizing opportunity, and particularly the “windows of opportunity” that allow for positive institutional and policy reform (Folke et al. 2010).

3.2 Does the globalization of fish trade benefit the poor?

"Trade tends to move fish away from poor people" (Kent, 1997, p403)

Food in general and fish in particular are now increasingly exported across countries or even continents. In recent years, issues relevant to international fish trade have been prominent in both fisheries and trade policy debates. They include labeling and traceability requirements; eco-labeling; illegal, unreported and unregulated (IUU) fishing; the sustainable development of aquaculture; technical barriers to trade, subsidies in production, and the equity and environmental effects of export promotion and trade agreements. In addition, substantial attention in the media and the NGO, policy and academic communities has focused on the potential nexus between fish trade and local food security (Bene et al., 2010b). In this section, we look first at the evidence of relationships between trade and food security in macro-economic analyses. We then examine some of the linkages between trade, poverty reduction and food security at more local levels, focusing on two case studies. Once again, the emphasis is on food security, for reasons given in Section 1.

3.2.1 Trade, poverty reduction and food security. global aggregate analysis

Table 5: Overview of links between trade and food security in 11 countries (Kurien, 2004)

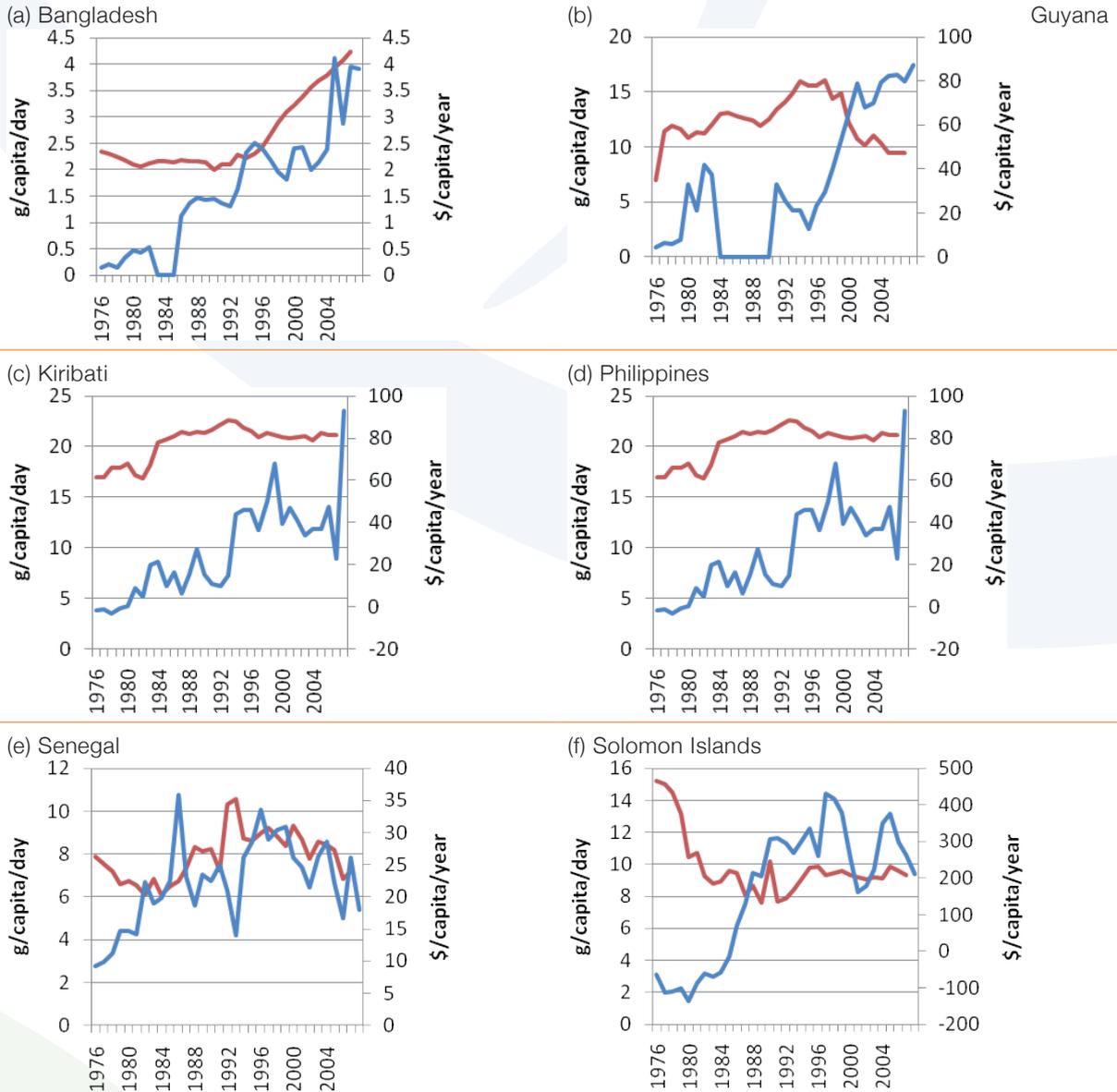
Impact of fish trade on food security	Country
Positive and Large	Namibia
Positive and Significant	Chile, Sri Lanka, Fiji, Nicaragua, Thailand
Positive and Small	Senegal, Brazil
Negative and Small	Kenya, Philippines
Negative and Significant	Ghana

Several recent studies have explored whether the increased value of global trade is bringing benefits to poverty reduction, and whether or not it is compromising nutritional security (e.g. Kurien, 2004; Bene et al., 2010b, Gillett, 2009; Smith et al., 2010). Kurien, for example, uses country review programs and expert evaluations to assess the food security impacts of trade in 11 countries, finding a range of impacts in different circumstances (Table 5), while Bene et al. (2010b), in an extensive statistical analysis, find no correlation – positive or negative – between macro-level indicators of poverty and food security and export values or export orientation in African fisheries. Their analysis cannot substantiate claims of either harm or good from trade, but concedes that such effects may well occur more locally. Kurien's analysis, while using less formal assessment methods, has the advantage of considering some of these localized effects.

We add further to this body of work here by examining a 30-year time series of fish exports and apparent per capita fish consumption (grams of protein per person per day), to assess if increasing levels of exports during the period 1976-2007 have led, at aggregate level, to decreased fish supply (Figure 8). We first identified 33 countries among the LDCs, HIPC, LIFDC. that either rely on fish as a source of protein in the total protein diet or have an important share of fish in animal protein (>25 percent share). We then selected 14 for which complete or near-complete time series were available: Bangladesh, Cambodia, Gambia, Guyana, Indonesia, Kiribati, Maldives, Myanmar, Philippines, Senegal, Sierra Leone, Sri Lanka, Solomon Islands and Vanuatu. We have not attempted any formal statistical analysis at this stage.

Examining the trends over 30 years shows that the fish protein supply (g/capita/day) increases along with the increase in exports (\$ value/capita/yr) for seven of the 14 countries. Bangladesh, Cambodia (until 2000), Gambia (until 1990, decrease in both since), Indonesia, Maldives, Myanmar and Sri Lanka. While Kent (1997) showed that fish protein supply in Bangladesh was falling between 1960 and 1990, we can see (Fig 8a) that Bangladesh's fish protein supply increased dramatically after this date.

Figure 8: Example time series (1976–2007) of fish consumption (g/capita/yr) and trade (\$ per capita) for selected Least Developed or Low Income Food Deficit Countries. Fish consumption = red line; export values = blue line. Data source: FAOSTAT, accessed Dec 2010

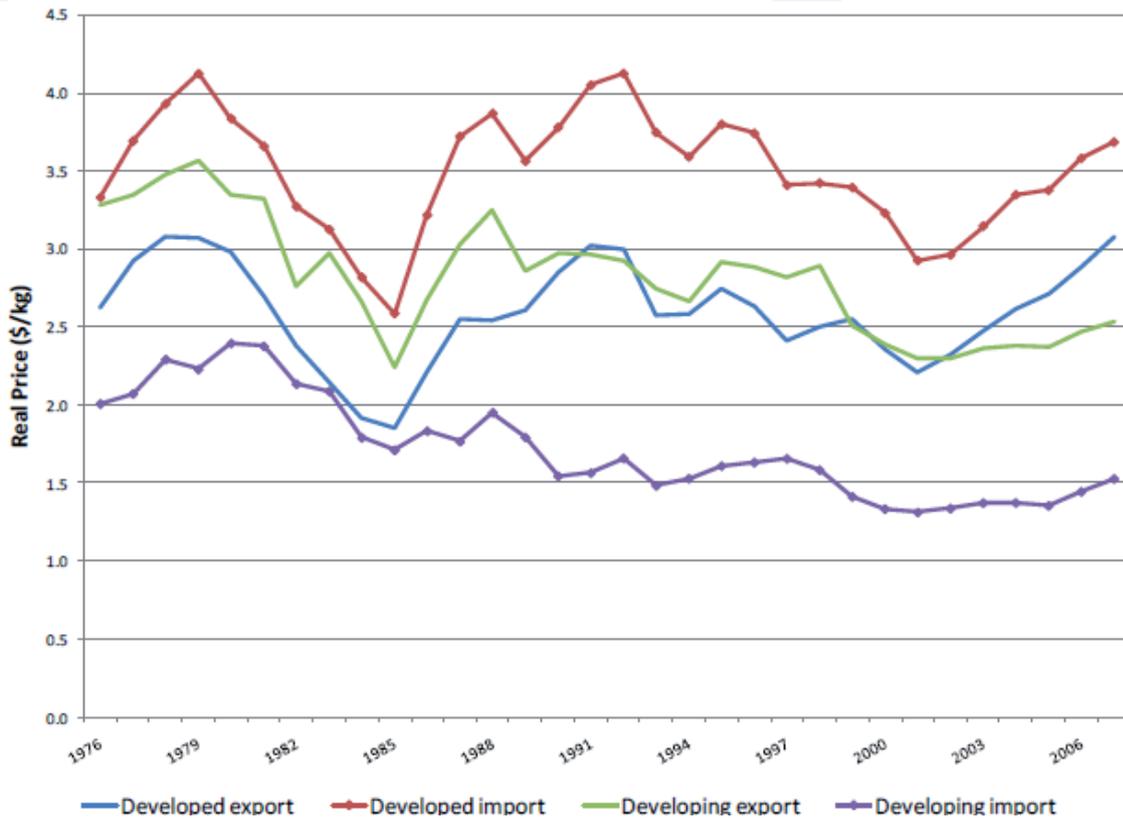


Sustained increase in both per capita consumption and the value of trade over this period seemed to happen in two circumstances – either when there is a strong growth in aquaculture (as for Bangladesh, Indonesia, Sri Lanka) or when there are offshore export-oriented fisheries for tuna (as for Indonesia, Maldives, Sri Lanka). The growth of one or other (or both) of these sub-sectors does not guarantee the maintenance of both consumption and trade values, however, as the decreases in both food availability and trade values for the Philippines and the Solomon Islands indicate (Fig 8d and 8f), despite the growth of both coastal and inland aquaculture in the former and a large tuna industry in the latter. In both cases, pressure on coastal fisheries leading to overexploitation are likely to have resulted in reduced availability of fish for domestic consumption, while conflict or weak governance also affected the growth of trade in farmed and offshore products. In Guyana (Fig 8b), increasing exports appear to have resulted in decreased domestic supply, although as with all such data, any causal link must be interpreted cautiously. Other countries (Vanuatu, Kiribati, Senegal, Sierra Leone) show more complex patterns, indicating the influence of governance reform or factors external to the sector (e.g. changes in the tuna sector in the Pacific (Fig 8c), civil conflict in Sierra Leone, climate-driven fluctuation in available fish stocks in Senegal (Fig 8e)).

If evidence for the negative impacts of fish trade on food security (in the form of aggregated national per capita availability) is generally limited, what, then, is the evidence for positive benefits. The most relevant analysis at global level is that of Smith et al (2010), which indicates that exports of seafood by developing countries have a higher unit value than imports, providing trade benefits to these countries (Figure 9, overleaf). Real prices of developing country imports are also trending down, which the authors interpret as evidence that low-value fish protein is becoming more affordable. It is not clear, however, whether this price data includes the global trade in fish meal and oil products, which is of lower unit value than most fish destined for direct human consumption. Developing countries are responsible for 92 percent of global aquaculture production, so the import of fishmeal – some of which is from developed countries – is considerable. Some of the subsequent aquaculture production is then exported to developed countries. The aggregate figures presented here do not allow these issues to be investigated, and a disaggregation into the major value-chains and trade flows should be a priority for future analysis of this kind.

The analysis of Smith et al. also claims this data “suggests that developing countries purchase low-valued seafood with export earnings and have surplus earnings for other uses”. At present, there are no data to confirm or deny that such close links between fish import and export revenues exist – it may also be that fish export revenues are captured by private sector and government elites and spent on luxury imported goods, rather than being used for poverty reduction, as has been suggested for the commercial shrimp export trade in Madagascar (Wilson & Boncoeur, 2008). However, in general terms, anything that contributes positively to trade balance could contribute to food security. For example, Senegal's fish export trade was of similar value to the value of its staple grain imports through the 1990s (FAO, 2006), suggesting one mechanism through which fish trade could be enhancing food security.

Figure 9: Real unit prices of internationally traded seafood for developed and developing countries. Prices are in 2005 constant dollars adjusted by US GDP deflator (Source: Smith et al., 2010 – supplementary material)



3.2.2 Trade, poverty reduction and food security. case studies from Lake Victoria and Bangladesh

To understand the impacts that trade is having on people, micro-economic surveys or social and ethnographic analysis is required to test hypotheses generated from observing trends and correlations in macro-economic data. Reviewing all micro-economic survey data related to fisheries and trade would be a study in itself. Here I present two examples of this kind of work, for illustrative purposes, one from Lake Victoria (with a focus on Uganda), and one from Bangladesh.

Nile Perch and the hungry of Lake Victoria (Geheb et al., 2008)

Lake Victoria supports Africa's largest inland fishery, and Nile Perch is its most valuable export. It has been argued that there is a direct relationship between the exports of a large share of Lake Victoria's fish production potential, and the high rates of child malnutrition along the lake's shores. Geheb and colleagues show that this presumed link is an over-simplification and that it is the way that the income benefits from the Nile perch export business are distributed, likely compounded by poor sanitation and high prevalence of diseases such as malaria and AIDS that explains the persistence of malnutrition in the face of a booming export sector. In essence, men control the catching sector and choose to sell to factories. They also control household expenditure. The incomes they make are not always spent to provide food for their dependents, and women's lack of bargaining power on household expenditure decisions was identified as a key reason for the persistence of under-nourishment.

There is a clear policy message here: one cannot expect improved economic dynamism from trade to result in welfare gains for vulnerable, food-insecure people unless the source of that vulnerability is also addressed. In this case, vulnerabilities arise from large inequities in relations of power between factories and fishermen, and between fishermen and women in their households. It is these relationships that allow malnutrition of dependents – principally young children - to persist in the context of a lucrative export industry. It is nothing to do with the export of protein from the region.

Gender, employment and poverty in Bangladesh's shrimp industry (Islam 2008)

Bangladesh is among the top-ten shrimp producers in the world, and shrimp is second only to the garment industry in export value terms. The labour force, involved in shrimp fry collection from the wild (since banned), casual jobs in processing factories and in the feed industry, is mostly female. The pond and factor ownership and the management and technical jobs in the sector are almost exclusively male. Women get significantly lower wages than men for doing the same jobs, averaging around 80 percent of the male wage. Women's earnings averaged around a dollar a day, for a 12 hour day, and lacked secure employment contracts and were subject to arbitrary dismissal, unhealthy and unsafe working conditions, various forms of harassment and discrimination. Overall, comparative advantage in trade has been gained through exploitation of women's comparative disadvantage. Yet, despite these conditions, competition for jobs is high, because there are few other options in rural southern Bangladesh, where the shrimp industry is concentrated, and a dollar a day in wages can make the difference between being above or below the national poverty line, or between being able to afford sufficient food to maintain health, or not. So the shrimp trade does, technically, contribute to food security and poverty reduction, but it does so through labour standards and practices. Since this study was undertaken, several reviews of working conditions in the shrimp sector have been published (e.g. by the Environmental Justice Foundation) and pressure is being put on the sector to improve a whole range of standards – in quality, safety, environmental impact and labour. One result has been the periodic closure of various shrimp farming sectors around the world as they have adjusted to these market-driven demands. This illustrates nicely that in the context of inequities of power, trade without regulation does not necessarily support pro-poor or green growth, and while regulatory instruments might operate through the market, they have their origins in political processes and democratic governance.

3.2.3 Conclusion

At first glance, the idea that a low income food deficit country whose population suffers high rates of malnutrition should be exporting nutritious food to over-fed consumers in wealthy countries appears abhorrent. This is surely a market without morality, little better than the 'noxious markets' trading in, say, human kidneys (Satz, 2010). Apparently equally problematic is the idea that low cost fish that could be eaten by undernourished low-income consumers is instead fed to poultry, pigs and (mostly) farmed fish, destined for the tables of the over-nourished (see section 3.3, for a partial refutation of that argument). Such views are, however, based on an over-simplified and sometimes simply inaccurate representation of the globalized trade in fishery products. This is not to deny that such criticisms may be valid in some circumstances, but to demonize trade in general closes down an important route out of poverty (and hunger) through economic growth. Equally, to uncritically state that trade is - under all conditions and for everyone - good for poverty reduction, and therefore food security, is also an over-simplification.

In the analysis of the poverty and food security impacts of global trade, what is needed to move the debate beyond polarizing rhetoric or speculative interpretation of macro-economic indicators, is some theoretically-grounded data at the levels where it matters: the fishery-dependent region; the vulnerable consumers; the income and food consumption of the poor who previously, currently or potentially benefit from fishery-sector employment. Examples of this kind of work can be found, but they are usually scattered case studies addressing only parts of the issue. One clear message that emerges from most of them is that benefits to poverty reduction and food security from trade are dependent on existing relations of power. This is particularly evident in gendered outcomes of engagement with global commodity chains (Weeratunge et al., 2010). These are the types of analysis that can usefully inform coherence between trade policy, fisheries governance, aquaculture development, and food security, health and economic development policies. More of them are required, more systematically conducted as a standard part of fisheries and aquaculture planning processes. There are excellent analytical tools available – e.g. the Gendered value-chain analysis methods developed by ILO (Mayoux & Mackie, 2007), but these have not yet been much applied in the fishery sector.

In the meantime, awareness of the potential positive and negative impacts of trade, and how to address them with appropriate policy, is required. Social movements of peasants, small-scale farmers and fishers across the world attest to their own widespread perception that food security cannot rely on efficient and equitable operation of global markets interlocking with efficient national policies for the distribution of benefits to those most in need. This challenge from the poor and food insecure – the very people supposed to benefit from trade and growth - is behind the demands for agrarian and sea tenure reforms to enable small-scale producers to have direct and equitable access to land, sea, water, credit and other productive resources. This set of demands articulates a ‘food sovereignty’ agenda (Sowman & Cardoso, 2010 – see glossary for definition). If trade is to benefit the poor, some accommodation with this food sovereignty agenda will be required. The basis for this accommodation is already present in the FAO Code of Conduct for Responsible Fisheries (FAO, 1995), and the evolving codes for responsible aquaculture and fish trade.

3.3 Commercial versus small-farms and fish for health or wealth. debates in aquaculture

The case for publically-funded aquaculture development in the context of food security and poverty reduction has been made both with reference to its direct impacts on small-scale producers living with poverty and nutritional insecurity, or investment in small and medium enterprises where fewer people are engaged in production but where the impact at national and regional levels is potentially much greater (Beveridge et al., 2010; Belton et al., in press). There are thriving and developing aquaculture sectors in the Americas, the Pacific and Europe as well, but much of this debate relevant to food security and poverty can be addressed with reference to the areas where these issues are of greatest global concern: Asia and Africa.

Aquaculture is a major food production sector in Asia (over 50 million tonnes a year), while in Africa, production has not yet reached 1 million tonnes. The poor performance of aquaculture in Africa has resulted in little investment in the sector in recent years but this is beginning to change in response to the growing gap between fish demand and supply and signs that historical constraints to aquaculture development on the continent are being overcome (Beveridge et al., 2010).

3.3.1. Aquaculture in Africa

With respect to smallholder systems, a focus in Africa has been on the farm pond as an integral part of the farming system, supporting the production not only of fish but also offering flexibility to farmers in the use of water for irrigation and household needs to reduce vulnerability to rainfall variability, particularly in the context of climate change. *Ex-post* analysis of the development of small-scale integrated aquaculture in Malawi, which has led to an increase in the number of fish ponds from 300 to 7 000 over the past 25 years, has quantified the following mean benefits accruing to farms incorporating fish ponds into their farming systems (Dey et al., 2007):

- 10 percent improvement in total farm productivity;
- 134 percent increase in per hectare farm income;
- 61 percent increase in total farm income;
- 40 percent increase in technical efficiency (financial input-output ratio), and
- 208 percent increase in household consumption of fresh fish and 21 percent increase consumption of dried fish.

The benefits to food security - both through increases in income and direct consumption of fish – are clear, but they accrue to relatively small numbers of people. Total production of farmed fish is still only a small fraction of total supply in Malawi, and in all other African countries apart from Egypt. And the numbers of farmers with ponds is a minute fraction of the number of smallholder farmers in Africa. Growth of the sector continues to be limited by the water and other resource constraints of small-scale farmers and by weak input and output markets and limited access to technologies and knowledge.

Analysis of performance success in Egypt, Cameroon, Ghana, Nigeria and Uganda shows that fish production begins to significantly contribute to fish supply and trade where conditions support the emergence of small and medium-scale aquaculture enterprises with a more commercial orientation. Where links to output markets

are strong – such as near urban centers and where the technologies and expertise have been available, entrepreneurs have seized opportunities to specialize in fish production (Beveridge et al., 2010). The impact of such development in Africa on food security, employment creation and revenue generation has not yet been evaluated, and studies such as those conducted by Stanley (2003) on the economic impacts of shrimp aquaculture in Honduras are recommended. However, as the majority of aquaculture in Africa to date has been orientated towards domestic and regional markets, rather than developed-country ones, the controversies around food security and export of fish that exist with respect to aquaculture in Asia and capture fisheries in LDCs and LIFDCs have not yet arisen in Africa.

3.3.2. Aquaculture in Asia

Asia has long traditions in aquaculture of carps, but the rapid growth and diversification of the industry has largely taken place within the last 40 years, when growth has often exceeded 10 percent annually and now contributes more than 90 percent of global production. This growth has been driven by rising demand from growing and urbanizing populations, stagnating supplies from capture fisheries, investment in education and technology research, a dynamic private sector and high levels of public investment in infrastructure to support agricultural development. The past fifteen years has seen the emergence of a vibrant SME sector, particularly in China, Vietnam, Thailand, Indonesia and the Philippines, which targets both domestic and international markets (Beveridge et al., 2010).

The aggregate data on Asian aquaculture all show increases in the volume and value of trade, increased contribution of production to agricultural GDP, and, in some cases, increased availability of fish in domestic supply as well (e.g. Figure 8, section 3.2). That this translates into improved food security and reduced incidence or prevalence of poverty is then often simply assumed, although this is not necessarily the case if revenues accrue largely to a small number of wealthy people, or the growing middle classes in Asian cities increase their fish consumption, but nothing changes for the poor and hungry. Once again, deeper analysis is needed before causal linkages can be inferred and poverty and food security benefits for aquaculture can be claimed.

Given that this is the aquatic equivalent of the ‘green revolution’, one would expect a selection of quantitative studies assessing the impact of this growth on poverty and food security. Unfortunately, this is not the case. While there is a voluminous literature on the negative environmental and social impacts of export-orientated shrimp aquaculture (e.g. reviewed by Bene, 2005) and well documented aggregate production and value statistics, in the FAO ‘State of World Fisheries and Aquaculture’ reports, it is once again difficult to find assessments of impact on poverty and food security that both articulate the pathways of impact and quantify them (several studies do one or the other, but this is less useful for evidence-based policy making). A recent review of the literature (Stevensen & Irz, 2009) found only one study robustly measuring poverty indicators to allow comparison with a counterfactual built from convincing data to establish causality and attribution, and indicating rural aquaculture’s contribution to household income. That one study, conducted in the Philippines, was their own (Irz et al., 2007). WorldFish Center scientists and their partners have since also developed analysis relating to aquaculture development in Bangladesh.

In Bangladesh, aquaculture now accounts for around 40 percent of total fish production, with a similar fraction from inland capture fisheries, and the remaining 20 percent from marine capture (Jahan et al., 2010). Enormous growth potential for aquaculture still exists, with huge areas of unutilized ponds (24 percent of total pond area, nationally) and current dominance of low-productivity extensive systems over more intensive production. Jahan et al. (2010) demonstrated positive income, employment and consumption effects for poor households adopting improved aquaculture practices, as measured against a control group of farmers not benefiting from improved aquaculture extension. Interestingly, consumption effects extended beyond fish, to improved consumption of other foods, indicating that income from fish sales and improved farm productivity were used to strengthen household food security.

Concerns over the extent to which small-farm aquaculture can be scaled out has led to recent reappraisal of development efforts to engage the poorest farmers in aquaculture production. Emphasis has shifted to meeting supply-demand gaps and ensuring a supply of fish to lower-income consumers, and an evolving policy narrative is suggesting that larger-scale enterprises, which don’t face the constraints to investment that small, resource-poor farmers do, are a better target for aquaculture investment in the service of wider food security (Belton et al., in press). This shift is now evident in evolving policies for aquaculture development in Bangladesh.

Table 6: Origin and average price of farmed and wild fish species from 15 markets across Bangladesh (adapted from Little et al., 2009)

Main source	Species	Average price (\$/kg)
Capture fisheries	Walking catfish	3.76
Capture fisheries	Stinging catfish	3.24
Capture fisheries	Climbing perch	2.85
Capture fisheries	Spotted snakehead	1.77
Aquaculture	Rohu	1.73
Capture fisheries	Mystus tengara	1.65
Aquaculture	Catla	1.58
Capture fisheries	Indigenous barbs	1.19
Capture fisheries	Striped snakehead	1.19
Aquaculture	Mrigal	1.18
Aquaculture	Tilapia	1.01
Aquaculture	Silver carp	0.92
Aquaculture	Pangasius	0.85

Evidence that the development of commercial aquaculture is making fish more available to lower-income consumers in Bangladesh comes from recent market surveys. The lowest cost fish found across a range of urban and rural trading-center markets in Bangladesh are non-native farmed fish species (Table 6), with the cheapest being the Mekong striped catfish (*Pangasius* species), which is also exported in large quantities to Europe from its native Vietnam. These species are largely grown in commercial farms – not the smallholder ponds that were the original target for development assistance in aquaculture, in the service of food security.

3.3.3 Aquaculture, the fishmeal industry and export of small-pelagics: do they reduce the supply of fish to the poor?

Larger-scale, commercial aquaculture has traditionally relied on feeds high in fish oil and fish meal, and, as the sector has grown, it has usurped poultry and livestock production as the main consumer of fish-based animal feeds. These are derived mostly from the capture and processing of small oil-rich pelagic marine fish such as herring, sardines, anchovies, sand eels, and mackerels. These fish are mostly caught in industrial fisheries, but are also a major part of the catch of semi-industrial or artisanal fleets using purse-seines and other ring-netting techniques in near shore and inland waters. Trash fish (essentially by-catch from trawl fisheries) is also sometimes used for aquaculture feed, although it is not preferred, as it is more difficult to control quality as its composition is variable. These small and ‘trash’ fish are also important in domestic and regional markets for low-cost fish, and they are also among the most nutritionally valuable, particularly with respect to Omega-3 fatty acids (see section 2.3).

The big question, therefore, is whether there is competition between direct human consumption and reduction for animal (aquaculture) feed for these species, which comprise the largest landed species group in capture fisheries (27 million tonnes, or 29.7 percent of capture fisheries landings in 2006).

Direct human consumption of small pelagic fish is particularly important in Africa, and of the 36 countries where pelagic fish contribute over 50 percent of total fish supply, 14 are in Africa (Tacon & Metian, 2009). These fish are widely traded in the region; for example, in 2003, about 70 percent of Namibia’s horse mackerel landings were exported to the Democratic republic of Congo (one of the countries in Africa with the highest relative

dependence on fish in diets), with the rest destined for West, Central and Southern African countries, while pilchards are canned and anchovies reduced to fish oil and fish meal, exported largely to Japan and South Africa at that time (Franz et al., 2004). Many small pelagic fisheries, including those from Africa's productive inland fisheries, are sun-dried or smoked and widely distributed throughout the continent, often in trade that goes unrecorded in official statistics.

As in Africa, small pelagic fish are widely traded and consumed by the poor in Asia, but, according to Tacon & Metian (2009) here they face more direct competition as a food source for the larger Asian aquaculture industry (although Latin American and African fish also enter the globalized value chains for fish oils and feeds).

Tacon and Metian's analysis marshals an impressive array of national statistics, and shows that small pelagic fish are exported from countries where there is malnutrition, but causal links between the two are assumed, rather than tested, and no direct evidence of a trade-off in availability of fish (or other protein and micronutrient sources) to the poor versus exports is presented. The authors' concede that the data to test these links is not generally available, but still they recommend that markets be regulated to ensure that fish suitable for direct human consumption are not reduced to animal feeds, but are instead directed towards food insecure people. This conclusion should be tempered with the observations that not all small pelagic fish are suitable for direct human consumption, there are technical barriers to handling and processing catches from large-scale fisheries to maintain quality, and there are economic constraints to investing in the quality control systems to land a greater proportion of industrial catches as human food. Some of these can be overcome, but it seems more likely that some small pelagic fish – whether caught in the waters of Europe or Africa – will always be most effectively utilized to support aquaculture production, rather than being sold directly for human food and this may not be wasteful or amoral if it provides economic benefits through more indirect pathways.

It should also be noted that since the mid-1990s, the proportion of fish used for direct human consumption has grown as more fish is used as food and less for producing fishmeal and fish oil (FAO, 2011). Innovation in the aquaculture feed industry, driven mostly by the need to reduce costs (feed costs are invariably the largest share of aquaculture inputs) is bringing down the proportion of fish meal in aquaculture feeds (Naylor et al. 2009). The ratio of wild fish feed to aquaculture output globally is less than one (0.63) but remains as high as 4.0 for Atlantic salmon. Terrestrial plant-based feeds (e.g. soya) and single-cell algae are among the promising fishmeal and fish oil substitutes under development, as are some seafood processing byproducts.

Overall, it seems likely that a combination of improved catch regulations to sustain stocks of pelagic fish, coupled with feed innovation, will send price signals to aquaculture producers that will encourage innovation to reduce dependence on pelagic fish catches as a source of aquaculture feeds. It is unlikely these sources will be eliminated, but they may be reduced, giving space for innovation in ways to supply these fish directly to low income consumers in developing countries.

3.3.4 Aquaculture: pathways to poverty, food security and environmental sustainability

Aquaculture for poverty reduction and food security is developing fast, but not always in ways promoted by many development agencies. Rather than being a means to secure nutritional gains and income directly for the poorest smallholder farmers, it is increasingly a means to increase domestic fish supply to low-income consumers, develop opportunities for employment, support local economic multipliers and to generate revenue from trade (Belton et al., in press). This mix of small-scale and larger-scale aquaculture parallels developments in agriculture, where calls for support to smallholders co-exist with support for commercialization of agriculture to accelerate its role in promoting macroeconomic growth (Wiggins et al., 2010).

Table 7: Summary of observed links between poverty and aquaculture development in developing countries, derived from Stevenson & Irz, (2009) and literature cited therein, supplemented by more recent work at the WorldFish Center.

Poverty impact pathway	Evidence/Examples	Conclusions
Entry into aquaculture by the poor	None given in Stevenson & Irz (2009) Pond aquaculture taken up by the rural poor in Bangladesh (Jahan et al., 2010) Cage aquaculture taken up by landless poor with access to seasonal or permanent inland water, e.g. Adivasi minority people, with a focus on women, NW Bangladesh. (WorldFish Center, unpublished reports).	Major impediments to entry by the poor exist in the form of lack of access to water, land, credit technical support and inputs, as well as high uninsured risks of loss of fish stocks and investment. Innovations in aquaculture for the landless are possible (e.g. small cages, coastal shellfish and seaweed culture) given the right institutional environment (e.g. sea tenure and contract farming).
Employment of the poor on fish farms	Shrimp farming employs more than 2 million people, and generates more labour demand than alternative land uses (e.g. irrigated fruit production, sugar and coconut plantations). Lowest grade wage labour in shrimp farming earns 1.22 times the average annual income in Mexico, but reports of wages around the poverty line in Bangladesh and other Asian countries. Labour intensity varies across different aquaculture technologies	Aquaculture does create wage labour, but it is not clear whether these are new jobs, or replacement sources of income for those displaced from land. It is also clear that labour standards and wages may not be sufficient to reduce vulnerability and lift people out of poverty. Pressure from importers for fair trade and labour standards are improving this situation.
Employment of the poor in upstream and downstream industries	Each job on a shrimp farm generated 1.86 off-farm jobs in Brazil, but only 0.25 jobs in Honduras, and about 0.21 jobs in the Philippines Processing employment provides opportunities for women, who dominate that labour force e.g. in Philippines and Bangladesh. Earnings from shrimp feed and processing industry in Bangladesh are only 1 – 1.5 USD per day for manual workers, just around the national poverty line, and are even lower for women (Islam, 2008).	In coastal areas (e.g. mangroves) development of aquaculture may simply replace fisher-gatherer poverty for agricultural wage-labourer poverty, with benefits accruing mainly to more skilled labour, farm owners and managers, and larger-scale traders. There are trade-offs between employment generation, supply of fish and foreign exchange earnings in aquaculture development strategies. Each represents a potential pathway to poverty reduction and food security benefits.
Increased supply of fish for consumption by the poor	Expected effect of increasing supply is to drive down the price of fish (and, potentially, other sources of protein, e.g. beans, small wild-caught fish, poultry), making it more affordable to the poor. This has disproportionate benefits for low-income consumers as they spend a greater proportion of their income on food. Strong evidence of this effect comes from studies in Asia, e.g. in Bangladesh, where Pangasius and carp are now the cheapest fish on the market. Consumption surveys also show increased consumption by the poor, although the nutritional benefits of these fish may not be as high as some of the ones previously consumed by the poor (S. Thilsted).	This is often the main rationale for public-sector support to aquaculture development in developing countries. Potentially reduces the value of and income from wild fisheries, although fish markets are highly segmented and support a range of products with different price elasticities. Long-term health benefits (food security and poverty reduction outcomes) are difficult to attribute to aquaculture production increase.

AQUACULTURE, FISHERIES, POVERTY AND FOOD SECURITY

Poverty impact pathway	Evidence/Examples	Conclusions
Integration of aquaculture into smallholder aquaculture by the poor	Tangible benefits to integration of fish on farms from studies in Ghana, Malawi and the Philippines, e.g. doubling of protein intake (from below to above recommended levels) in Ghana, range of benefits from Malawi (see section 3.3.1), and increase in net incomes and resource-use efficiency in the Philippines	It is not usually the poorest farmers that are able to integrate aquaculture, so it makes already more successful or asset-endowed farmers wealthier, but may not have impact on the poorest. Has not always scaled out beyond project sites.
Poverty impact pathway – negative outcomes	Evidence/Examples	Conclusions
Conversion or privatization of land for aquaculture	Aquaculture development in coastal and floodplain areas can exclude the poor and lead to loss of customary or informal access rights to harvestable resources (e.g. mangroves, wild fisheries). The evidence for these effects is mixed and context-specific.	Ecosystem services costing frameworks developed by ecological economists, together with cost-benefit analysis that makes potential development pathways explicit are required to inform decisions regarding land-use change for the benefit of poverty reduction and food security.
Environmental burdens falling disproportionately on the poor	Loss of natural habitats, salinization of effluent discharges, depletion of wild populations to stock aquaculture ponds, overexploitation of small pelagics for fish oil and fish meal and introduction of non-indigenous animals and plants which may impact natural environments are all documented to occur, and these will tend to impact the poor disproportionately, as they have a greater level of dependence on common pool or open access natural resources.	There is a lack of documentation of poverty impacts, but displacement, erosion of system resilience, and civic unrest are all outcomes of poorly regulated aquaculture development, particularly in asian coastal wetlands. Use of polluter-pays principles and establishing better environmental standards and land-use planning frameworks is essential if aquaculture is to be sustainable and make net contributions to poverty reduction and food security.
Reduced market price for fish leads to reduced income for poor fishers	Important where capture fisheries are a major source of employment for the poor, but may not be a factor where wild and farmed fish are sold in different markets, or produce very different products with different values and price elasticities (low cross-elasticities).	Few negative impacts on wild fish prices at first sale observed. The food supply benefits are likely to outweigh any price reduction to fishermen, and increased supply may have positive benefits for overall development of markets, cold chains and retail outlets.

A sector that combines different forms of aquaculture production provides multiple potential pathways for poverty reduction, and the policy challenge is to determine and support the most effective ones. At the moment, the evidence-base for which these should be is somewhat scanty (Table 7 above), but nevertheless suggests that overall, the sector is providing substantial positive benefits for poverty reduction and food security, and will continue to do so providing environmental sustainability concerns can be addressed.

The sustainability of major increases in fish production from aquaculture has in particular been called into question by the experience of aquaculture in Southeast Asia where many intensive farms have been abandoned due to self pollution, disease and loss of supporting services from nearby mangroves. Aquaculture of carnivorous species can also increase the demand for wild caught-fish for feed (or for stocking, where nursery-grown juveniles are not available) and enhance pressure on wild fisheries as well as compete with poorer communities for access to cheap fish protein. For aquaculture and other new production technologies to contribute to sustainable food provision, continued research is needed on forms that do not lead to over-harvest of wild ecosystems for food, seed or broodstock, and how to draw on these ecosystem services without causing severe or irreversible loss of other ecosystem services.

4. Improving the contribution of fisheries and aquaculture to poverty reduction and food security: policy recommendations

In many countries, explicit policy goals for fisheries and aquaculture development are still framed in terms of production targets, even if the implicit goals – increasing trade and government revenue, bolstering local or national food security, maintaining employment in a diverse coastal economy, or maintaining social stability – are more varied. When viewed from the perspective of participants in the sector such as fishers, farmers, processors and traders, or that of competing users of water, land and marine resources, the diversity of possible goals is broader still. There is no right answer to the appropriate balance of goals for fisheries and aquaculture development. There is, therefore, no single recipe for governance reforms that affect or target the fisheries and aquaculture sectors. Critical, instead, is the process of arriving at goals considered politically legitimate by relevant stakeholders. Also important is that the process of development and policy reform is informed by the best available scientific, economic, and social analysis of the issues at stake and explicit consideration of the likely outcomes of alternate courses of action (Andrew et al. 2007). With these principles in mind, the following five points are proposed to be considered when engaging with reform processes in fisheries and aquaculture in a development context.

4.1. Strive for policy coherence

Policy incoherence can undermine prospects for growth, poverty reduction and food security. For example, government subsidies for fuel or vessel modernization, in the absence of property rights regimes, can lead to fleet capacity being higher than the resources can sustain (OECD, 2008). Policy reform within the sector is also often hampered by separate discussion of fisheries and aquaculture, and neglect of inland capture fisheries due to the marine focus of most influential global policy studies. Policy on freshwater resources tends to focus on the water and ignore what swims in it. Agricultural and rural development policy frequently omits fisheries and aquaculture. Despite the fact that over 90% of the world's fish and aquaculture workers are from developing countries, there has been limited consideration of fisheries and aquaculture in a development context. These sectoral divisions are narrowing, however, and the inclusion of fisheries in recent 'food futures' studies are an encouraging sign that the sector's role in nutrition is being recognized and valued (section 1).

Three simple steps to improve coherence are:

- i. Work more in partnership with development economists, planners and practitioners to avoid a narrowly sectoral perspective and to ensure the sector's development goals fit with wider national economic development policy priorities.
- ii. Make poverty and food security goals and strategies explicit in fisheries and aquaculture sector policy. FAO CCRF guidelines are available to guide this process (FAO, 2006).
- iii. Ensure coherence between major cross-sectoral development policies and programs and sectoral policy. Table 8, overleaf, provides some examples, drawing on the OECD's (2008) policy coherence in fisheries framework.

AQUACULTURE, FISHERIES, POVERTY AND FOOD SECURITY

Table 8: Cross-sectoral issues to consider in developing coherent fishery and aquaculture policies that support poverty reduction and food security

Policy Domain	Issue	Key national policy process, document or instrument
Environment	Climate change adaptation	National plans of adaptation (NAPA); UNFCCC global adaptation fund
	Environmental flows to sustain inland fisheries; water allocation to aquaculture	National and trans-boundary river and lake basin management plans; development of irrigated agriculture
	Coastal zone management, biodiversity conservation	Integrated coastal zone management plans, protected areas and zonation plans
	Vulnerability of coastal and wetland-based communities to extreme weather events and other natural disasters (e.g. tsunamis)	National disaster preparedness and response plans
	Biosafety – movement of fis. for aquaculture, disease and genetic strain management	Convention on Biodiversity; biosafety protocols; guidelines on use of non-native species in aquaculture; broodstock management good practices
Technology	Reducing post harvest losses	Inward investment schemes, value-chain upgrading
	Reducing greenhouse gas emissions from the fishery sector; producing low-carbon	REDD+ for mangroves; Blue carbon funds; National mitigation plans (NAMA); Green technology grants (e.g. for improving vessel or processing plant energy efficiency)
Economy	Trade and export promotion	WTO Negotiations on subsidies, tariffs and technical barriers to trade; joint venture and public-private partnership arrangements, quality assurance processes; food safety standards; ecolabels; fair trade
	Poverty reduction and food security	Poverty Reduction Strategy Plan (PRSPs); Social protection schemes; Food security policy; Famine early warning systems; micro-finance initiatives; diversification and enterprise development schemes; representation in rural poverty surveys
Social	Addressing social exclusion and upholding rights to decent work, right to food, gender equity, children's work, migrants rights etc.	National legislation upholding the Universal Declaration of Human Rights; improved access to judicial services
	Social service provision in fishing communities (health, education, judicial services)	Malaria and water-borne disease reduction initiatives; National AIDS response programs, fair allocation of health and education budgets to remote fishing communities and rural fish farming ones; participation in nutrition surveys
Governance	Decentralization	Local Government Act; District Development Plans, community-based natural resource management
	Land and sea/water tenure reform	Land Act; water privatization schemes; Territorial Use Rights in Fisheries, Marine Protected Areas, fishery licensing schemes, ITQ programs
	Fisheries and aquaculture management and development; reduction of IUU Fishing	National fisheries policy and Fisheries Act; Aquaculture Sector Development Plan; FAO Code of Conduct for Responsible Fisheries (and Aquaculture); EEZ, Regional Seas and LME governance; Port-State measures; High Seas and trans-boundary fish stock management etc.

The list in Table 8 may seem long and daunting but not all of these issues will be important everywhere. Some may be surprising: for example, what has fisheries governance got to do with AIDS. The connection is made because many fishing communities around the world have high HIV prevalence and AIDS incidence, often an order of magnitude higher than national average rates (Kissling et al., 2005). Very high incidence of AIDS in fishing communities undermines incentives for long-term community stewardship or investment in fisheries and aquaculture, and also negates development gains as affected households often have to sell productive assets to pay for medical care, and consequently lose their income sources and become food insecure (Allison & Seeley, 2004). Recognizing these linkages, some governments, such as that of Uganda, have articulated an AIDS response strategy specific to the fishery sector, to ensure that the sector's ability to contribute to Uganda's economic development is not undermined by the high human and economic costs of the HIV epidemic.

Every process and policy linkage listed in Table 8 has been explored to some degree. OECD has, for example, contributed to a multi-agency policy briefing linking fisheries, aquaculture and climate change adaptation (PaCFA, 2009), while the degree of inclusion of fisheries and aquaculture in poverty reduction strategy plans has been assessed by Thorpe et al (2005). The FAO/DFID Sustainable Fisheries Livelihoods Programme developed a series of policy briefings ('New Directions in Fisheries', 2005-2007) that linked the sector to issues and policies in: poverty reduction and vulnerability; national accounting and economic planning; global governance reform; trade; climate change; HIV/AIDS response; gender mainstreaming; microfinance; literacy; and information and communication technology development (ICT4D).

While the above examples provide evidence of increasing integration among policies addressing fisheries, aquaculture, poverty reduction and food security, this integration is currently at the stage of identifying policy gaps, building conceptual frameworks, assembling data or writing policy documents. Implementation of coherent policy following careful analysis of costs, benefits, trade-offs, political feasibility, social impacts, and environmental consequences are still an aspiration. Frameworks such as those in Table 8 could be used to develop checklists and measures of policy cohesion, or to identify important contradictory policies or neglected linkages, as part of programs to ensure policy is implemented in coherent ways, and not just thought about coherently.

In the context of the current global attention to food security issues, one important entry point for building coherence is to focus on the links between fisheries and aquaculture development and human nutrition. Section 1 of this report highlighted policy coherence as critical to the success of food security initiatives, as the production, distribution and consumption of food occupies almost every policy arena. The fishery system is simply a sub-set of the food and natural-resource production sectors, so the same arguments apply. Section 2.3 of this report further elaborated the important nutritional role played by some fish species in the diets of the poor, particularly as providers of PUFAs, vitamins and minerals essential for healthy growth and mental development. Three of the key questions for policy analysis are:

- i. Is aquaculture increasing the quantity of fish available to the poor, but decreasing their nutritional quality?
- ii. Is it technically and financially viable to divert small, oily fish away from animal feed production and towards direct human consumption?
- iii. What are the trade balances, in nutritional terms. i.e. does a country that exports high-cost fish and imports low-cost fish lead to a net nutritional benefit or deficit?

A final recommendation on coherence; there is a need to be explicit about impact pathways. How will a transition to wealth-based fisheries or the development of commercial aquaculture result in a positive impact on, say, maternal health and reduction in child mortality in the least developed countries? At the moment, such linkages are usually made in the vaguest of terms. The influential recent work on 'wealth-based fisheries', for example, has not yet been explicit in how the proposed reforms will benefit the undernourished. It simply asks us to trust that the combined workings of governments and markets will somehow convert wealth into nutritional welfare for those who need it most, through a series of income-consumption linkages. I would contend that a political economy analysis of the processes by which this may or may not happen is required before we can be confident that radical sectoral restructuring of any given fishery or aquaculture enterprise will bring benefits to the poor and hungry. This involves combining an impact pathway analysis with a risk assessment, and framing both with a study of the political economy of the country where reform is being considered. Methodologically, this could build on OECD guidelines for ex-ante impact assessment for development planning (OECD, 2007).

4.2 Avoid blueprints: fit reforms to context and sequence them appropriately

Aquaculture and fisheries are heterogeneous industries that exist in a diversity of political, economic, social and cultural contexts. Guiding principles, frameworks and typologies are useful in addressing some of this complexity. Blueprint solutions are not. Development economists and planners have largely abandoned recipe-book approaches to macro-economic planning and recognize the importance of a process that identifies the most promising pathways for positive impact through a cross-sectoral 'diagnosis' (e.g. Rodrik, 2006; Collier, 2007). This diagnostic approach has also been recommended and applied to fisheries governance systems (Andrew et al., 2007) and common pool resource governance more generally (Ostrom, 2007).

4.2.1 Matching reform goals to existing sector role and economic potential

Depending on the production and fishery characteristics and national and local economic context, poverty reduction and food security aims in capture fisheries may be best served by:

- a policy that seeks to maximize resource rents and export revenues;
- a policy, management and development package that supports local and regional market development and local multiplier effects through management of small-scale fisheries. Some potential rent is traded off against improved likelihood of that benefits will be captured locally and be more widely distributed;
- a policy that supports quasi-open access or flexible access regimes to enable the poor to gain a seasonal, temporary or supplementary livelihood from aquatic resource exploitation.

The choice of overall strategy will depend on the size of the potential payoff (related to the size and productive potential of the resource, and on linkages to markets), the costs of transforming the current governance system to one capable of delivering greater benefits, and the political and administrative feasibility of doing so, and, perhaps most importantly, the risks involved in shifting benefits upstream and relying on efficient markets and effective economic governance mechanisms to redistribute them in the service of poverty reduction and food security.

Picture a coastal prawn fishery where hundreds of inefficient small trawlers (originally financed by a development assistance programme) race to catch as many prawns as they can in the season, with no effective regulation. The stocks are depleted, profitability is marginal and labour in the fishery mostly comprises illegal migrants and children. Because of declining profits, no one is investing in vessel upgrades to improve efficiency and safety, or to improve quality of the landed product. The low quality prawns are sold at below the average global market price, to buyers seeking the cheapest product, for bulk markets in processed products. The catches are often unreported (and therefore untaxed). A license is available to anyone who applies, for a small administrative fee. Hardly anyone is benefitting from this resource; its rents are being squandered and it is only profitable to vessel owners because they squeeze down labour costs and gain access to subsidized fuel, some of which they sell on the black market. This is much more profitable than using it to go fishing. This fishery, which is probably a net drain on the economy, is a perfect candidate for a transformation towards ITQ or other rights-based scheme, to maximize wealth generating potential.

Now picture a small fishery supporting tens of thousands of farmers by supplementing their seasonal agricultural income with some hook and line and trap-fishing in local wetlands, in a country with a preponderance of rent-seeking officials who are unaccountable to the citizenry and who form a government incapable of delivering decent health and education services to its rural population. The economy is stagnating so no new jobs are being created, population is rising, farm size is shrinking, and the number of landless poor is increasing. There is no comparative advantage in trade due to the fishing areas being located in a remote corner of a land-locked country with few paved roads. Most of the fish are anyway of no interest to developed-country or even domestic urban consumers, but these small fish are rich in micronutrients and much appreciated in the region. Traditionally, they are eaten by expectant mothers. Any investment in maximizing rent from such a fishery by investing in channeling its benefits through a smaller number of rights-holders is likely to be both futile and damaging to its current beneficiaries.

These are obviously caricatures (although some will recognize their basis in a number of real fisheries in developing countries). The overall point, summarized in Table 9, is that fishery sector policy has to be matched to context. Aiming to maximize resource rents doesn't make sense everywhere, all the time. Optimizing the most needed and most easily distributed benefits (e.g. jobs, or cheap nutritious fish in local markets) may sometimes be better than risking the loss of those benefits for doubtful or marginal gain.

Table 9: Matching pro-poor and pro-food security fisheries policies to resource characteristics and national political-economic context

Resource characteristic. and national context	Examples	Policy orientation for optimizing contribution to poverty and food security (and indicative impact pathways)	Risks and trade-offs
Large biomass of high unit-value resources Low local demand, relative to resource production capacity, Resources mostly not accessed by artisanal fisheries	Tuna in SIDS EEZs Mauritania, Namibia Uganda (Nile perch)	Maximizing the rents from the resource through limited access or quota-based management and generating income from trade and from fishing agreements with third countries. (Rents contribute to growth, which creates economic opportunities for the poor. Revenues to government. can also be spent on social service provision)	Loss of value added components if rent comes mainly from fishing agreements; large investment in fisheries assessment and enforcement needed to maintain values
Large biomass, productive, low unit- cost resources; high local demand; resources support extensive small-scale fisheries	Ghana, Senegal (small pelagics), Cambodia (inland fisheries. Mekong), Uganda (omema – small fish sold dried)	Managing the fishery for its contributions to employment, local multipliers and domestic demand for fish by the poor. (Those with access to fish as producers and consumers are the beneficiaries. Some growth-linkage effects locally. Fishery income can be used for other investments e.g. agricultural inputs)	Low sector economic efficiency (high labour input costs relative to financial output), total rents generated remain low
Limited resources of low potential value in global trade and limited potential as contributor to GDP growth; high domestic demand for fish; limited alternative employment, particularly for rural poor many of whom fish seasonally or occasionally	Inland fisheries throughout. sub-Saharan Africa, particularly wetlands and small water bodies (e.g. Malawi, Zambia), coastal fisheries in SIDS	Fishery can act as a safety net, to provide supplementary seasonal or emergency incomes to the poor, e.g. through diverse livelihoods, labour buffer, subsistence consumption. (Direct income and nutritional benefits to those who are seasonally hungry, or displaced or vulnerable due to climate or economic shocks. Reduces need for government/aid expenditure on social protection and safety nets.)	The fishery provides little net contribution to poverty reduction beyond sustaining the livelihoods and nutritional needs of those who access the resources; Generates negligible resource rents

Similar arguments apply to aquaculture development, although here, the picture is somewhat reversed. There are indications from both African and Asian countries that specialized commercial enterprises, rather than household or small mixed farm production, bring greater returns on investment and deliver larger benefits. This does not imply giving up on small-farm production, but rather it allows for a wider choice in how to invest in aquaculture for poverty reduction and food security. The concept of 'pro-poor' policy doesn't mean working only with the poor – it means working for poverty reduction more broadly.

One key recommendation could be not to pursue policy options that are likely to widen inequality in countries with weak governance and poor track-records in their use of NR wealth for poverty reduction ('resource curse' countries...). In these countries, it may be better that aquaculture benefits or fisheries rent is 'dissipated' locally than if revenues are increased but not effectively spent on national economic development and poverty reduction (Wilson & Boncoeur, 2008).

4.2.2 Sequencing development interventions

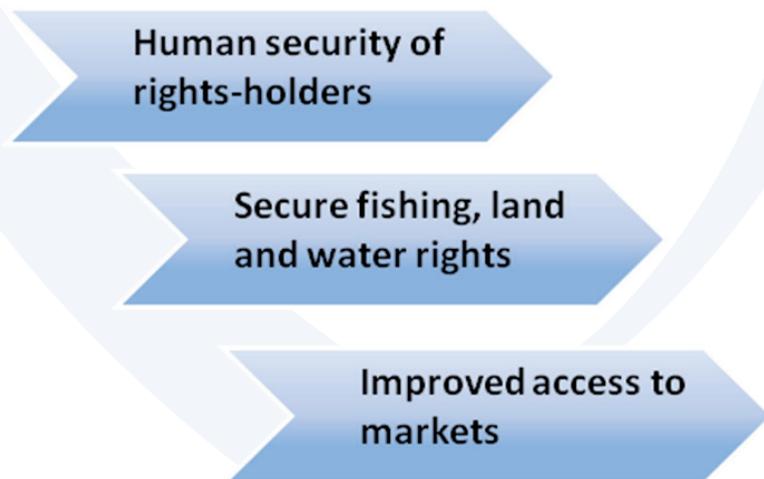
To maximize the development impact of a reform programme, its actions should operate synergistically. This is partly a matter of getting the sequencing right. For example, in many developing-country contexts, reform processes often exclude people who are already vulnerable. These may include those marginalized from development processes on the basis of factors such as gender, caste, or ethnicity. Reforms that exclude these people can deepen inequality, increase conflicts and escalate the costs of addressing social problems, including crime – all of which impact negatively on growth and undermine the goals of growth-focused policy (Tzannatos, 1999; Fajnzylber et al., 2002; Edward, 2006). Therefore if you want the benefits of reform to be equitably distributed, then, prior to reforming fishing rights, you may first need to address processes that generate inequality and human insecurity. This entails helping people realize their fundamental social, economic and cultural rights, which can be achieved through adoption of human rights frameworks as part of an expanded conception of 'rights-based fisheries' (Allison et al., 2011a; 2011b). Examples are ensuring the human rights of migrants are not violated or addressing gendered inequalities.

Where human security is not a concern (as in most developed and middle-income countries) these considerations may not apply and reform can proceed straight to reforming rights of access, without fear that people's basic human rights will be violated by a transition to more exclusionary forms of management.

Similarly, investing in strengthening links to global markets, to encourage growth, may simply accelerate resource degradation if effective resource management systems are not already in place. This has been seen with sea-urchin fisheries, where markets arrived in previously remote areas before governing systems were put in place to regulate the harvests. The result was a world-wide depletion of sea-urchin fisheries by 'roving bandits' of the globalized fishing industry (Berkes et al., 2006). Simulation analysis has also indicated that the welfare effect of fish trade liberalization in an exporter country is negative under open access, but positive under most conditions of regulated restricted access (Neilsen, 2009). Furthermore, where there are inequalities in society, engaging with global markets can sometimes magnify them. This is seen in the case of gender discrimination in global value chains for shrimp in Bangladesh (see Section 3.3). This argues for also addressing human insecurity before or while promoting greater global market integration, as well as addressing governance.

Thus, I propose a simple generalized model for sequencing policy reform or development investment in the fishery and aquaculture sectors of developing countries (Figure 10). If a sector-study ('diagnosis') indicates that there are likely to be problems of social exclusion and violations of rights associated with governance transitions, then these have to be dealt with first. Next, the investment in strengthening governance will ensure that the resource's productive capacity is protected and enhanced. In the aquaculture case, this is likely to relate to wider environmental governance. Strengthening links with global markets will generate greater and more sustained development benefits when both human rights and property rights have first been secured.

Figure 10: Generalized sequencing of development activities to improve fisheries and aquaculture



In practice, these investments and processes are likely to overlap, but investing out of sequence risks the rapid depletion of the resource (with the resulting loss of benefits to those dependent on it) and the exploitation or marginalization of a country's most vulnerable citizens. These are in fact the two often-seen negative impacts of globalization, and are what fuels its critics. These impacts can be avoided or reduced by well sequenced investments and effective, coherent policy implementation.

Finally, reforms that envision a transfer of resource rents from poor users to larger corporate actors, or that aim to consolidate and reduce the number of participants in small-scale fisheries or small-farm aquaculture, need to demonstrate a prior commitment to investing in livelihood diversification and redressing any gaps in basic rights among the groups most directly affected (Béné et al. 2010a; Allison et al. 2011b). Examples include efforts to secure rights for landless groups and ethnic minorities in Bangladesh (Jentoft et al. 2010) and investments in livelihood diversification in Vietnam as a component of the government's policy objective to reduce excess capacity in its small-scale coastal fisheries (Pomeroy et al. 2009). Fisheries reforms in post-Apartheid South Africa have explicitly aimed to redress past violations of human rights as a key principle in allocating new resource rights in small-scale fisheries (Allison et al. 2011b). Linking improvements in fisheries governance with enhancement of rights and social development among fishing communities has recently emerged as a priority of the FAO as well (FAO 2010).

4.3 Invest in evidence-based political economy analysis

This paper has argued that there are serious inadequacies in the knowledge-base available at global level to inform investments for poverty reduction and food security from fisheries and aquaculture. Examples of such weaknesses include:

- the paucity of rigorous ex-post impact assessments of completed fishery sector investment programs;
- the limited utility of national level indicator data in assessing causal relationships between changes in fish production, trade and development outcomes;
- fragmented case-study research on poverty and food security that cannot address questions on the scale of benefits derived from the sector at more aggregate levels;
- biases in fishery statistical systems (e.g. the underrepresentation of small-scale and inland fisheries);
- limited research on linkages between fisheries and other sectors, and therefore on the potential benefits of improved policy coherence across sectors, and
- weak (and untested) specification of impact pathways in proposed policy reforms.

This suggests a need to invest in a stronger research base. The WorldFish Center and its partners are focused on research that aims to improve the contributions that fisheries and aquaculture make to poverty reduction

and food security. Its research agenda (Figure 11) reflects many of the subject areas and research questions required, and is supported by most bilateral donor agencies, but it needs to expand to have significant impacts.

Some specific questions and topics for policy-relevant research that could provide improved guidance in understanding the linkages between fisheries and aquaculture, and poverty and food security, include:

- i. Analysis of whether conversion of low-cost fish into animal feeds (particularly for aquaculture) is reducing its availability to humans and having negative consequence on nutrition and health. Existing work alludes to this relationship and suggests wide-ranging reform to the sector to maximize the use of fish for direct human consumption, but is unable to provide the evidence to support it.
- ii. The development benefits of privatizing common pool resources, such as fisheries. An ongoing DFID-funded systematic review of the poverty and food-security outcomes of privatization programs in the common pool resources of developing countries (fisheries, forests, rangelands, wildlife) started with 1356 studies in the peer-reviewed literature, but only 110 studies were sufficiently rigorous and well documented to make an initial screening for impact assessment purposes (D. Hildebrandt, 15/11/10, personal communication).
- iii. The role of inland fisheries in poverty alleviation and food security needs to be better reflected in development and fisheries policies and strategies. The tendency to undervalue inland fisheries has resulted in inadequate coverage in national and international agendas (Dugan et al, 2010).
- iv. Risk assessment and cost-benefit analysis are required before investing in reform (i.e. ex-ante impact assessment). Where the fishery and aquaculture sector provide important food security and welfare functions, but are perhaps underperforming in sectoral economic terms, there is a need to consider carefully the risks to existing benefits in a process of wealth-based fisheries reform to maximise sectoral efficiency.
- v. We also need to assess carefully the likelihood that rents and revenues from aquaculture will in fact be spent productively to reduce poverty and food insecurity. Are the policies and institutions for effective public expenditure in place? Are accountability mechanisms functioning?
- vi. Much more emphasis is needed on distributional issues in policy formulation and implementation – promoting inclusion of the poor where possible – e.g. in global value chains for aquaculture and in rights-based management of fisheries.

Figure 11: A policy-relevant research agenda to support the improved contribution of fisheries and aquaculture to poverty reduction and food security (WorldFish Center, 2011)

Focal Area	Key research question
Climate Change Vulnerability and Adaptation	How will climate change affect fisheries and aquaculture in developing countries and how can adaptive capacity be built?
Improved value chains	How can we improve input and output value chain. to increase the development impact of aquaculture and fisheries?
Nutrition and health	How can investments in fisheries and aquaculture best improved human nutrition and health?
Gender and equity	How can strengthening the rights of marginalized fish dependent people reduce inequality and poverty?
Sustainable aquaculture technologies	How do we increase productivity, ecological resilience and development impact of aquaculture?
Policies and practice for resilience	What policy and management investments will increase the resilience of small-scale fisheries and increase their contribution to reducing poverty and hunger?

Policy research should also recognize that economic optimality may not be politically achievable or desirable. Acceptance of 'good enough governance' (Grindle, 2007), 'clumsy solutions' to complex or 'wicked' problems (Verweij et al., 2006), or observations of the irrelevance of official policy to the practice and outcome of much development work (Mosse, 2004) all point to an acceptance that economic policy has to make accommodations with human institutions that may deviate from perfect rationality, or which may reflect (sometimes rational) overt or covert political and personal agendas. This is the domain of political economy analysis, and this is likely to be a key frame for future useful work in this area.

As well as its subject and theoretical framings, there is a need for changes in research process, to reflect the negotiated and contested nature of the policy process. Engaging stakeholders in evidence-based analysis of the likely implications of competing reform options would help to bring both political and technical legitimacy to the reform process. The role of research is to bring the best scientific and socio-economic analysis to the table regarding the implications of different reform options as measured against a range of locally-defined development goals. Clarity on the current distribution of economic gains derived from fisheries and aquaculture and the likely future distribution under various reform options is key, as is being explicit about the assumptions that underlie this analysis. Simplistic solutions, while intellectually appealing, have been shown to fail when implemented without due regard for the broader social-ecological context and actors' incentives (Pitcher and Lam 2010). Moreover, when centralized fisheries management agencies draw on a narrow base of information, neglecting local ecological knowledge, they miss opportunities to transform stakeholder interactions and behaviors (Evans 2010).

4.4 Engage stakeholders in dialogue over reform goals

A process to reform policy should begin by building inclusive, multi-stakeholder dialogue over reform goals. Particularly where changes in government policy and law or support to reform efforts through official development assistance are concerned, explicit recognition of multiple goals and values of main stakeholder groups is key. Often goals will be in competition, and there is no technical solution to reconcile these. Only meaningful engagement with and deliberation among stakeholders can yield goals that will be seen as legitimate. Fisheries reform efforts are also most likely to yield improvements in equity when they are the result of democratic processes that include all key stakeholders (Robinson 2010). Typically this will extend to and include stakeholders outside of the small-scale fisheries sector, because these compete for use of the same environmental resources, or they have a stake in benefit streams, or because they influence decision-making. Special attention may be required to ensure that non-economic values are considered. While sound goal-setting may seem obvious, it often fails to get adequate attention: one recent global review of countries' efforts to implement the Code of Conduct for Responsible Fisheries found that over half of the world's major fisheries lack clearly defined management goals (Pitcher et al. 2009).

In the context of the achievement of poverty reduction and food security goals, there is an additional requirement to link fishery sector actors and agencies with those shaping the wider development agenda. This would help ensure that the sector's development does not take place in isolation or opposition to national economic and social policy, and global food security imperatives.

4.5 Build on what already works

The fisheries and aquaculture sectors are sometimes portrayed as ecological catastrophes that are squandering our natural resources, aided and abetted by the governments that subsidise the whole process with tens of billions of dollars a year. Trade in fish, in access to fishery resources and aquaculture sites by developed country fleets and firms, along with illegal fishing, is plundering the food stores of the poor in order to feed the rich.

From a more optimistic perspective, aquaculture is growing spectacularly in many parts of the world, and there are numerous examples of success in fisheries management, using a whole range of management strategies, including protected areas, community-based management institutions, and ITQs. Half the world's fish stocks are NOT overexploited – at least biologically. Fish are among the most traded of commodities, so the sector is more successfully integrated into global markets than most. The revenues this trade generates are substantial; fish is one of the most valuable exports from the least developed countries. With high value fish being exported and low value fish being imported, there is net positive trade balance for developing countries that export fish. Per capita global availability of fish is at an all-time high. Fish are easy to sell: projections are for continued rise in demand for seafood products. Efficient production from aquaculture is making fish more affordable to the poor, without damaging the profits from capture fisheries, which supply different markets. There is continued technological innovation in aquaculture, in areas like improved breeds, feeds that use less fish meal and culture systems that are less environmentally damaging, less disease-prone, and more suitable for use by those with limited access to inputs. The sector produces something everybody wants – healthy, nutritious food. Moreover, it does so with generally lower energy inputs and greenhouse gas emissions than other animal production systems (Bunting & Pretty, 2007). There is much that is good, to support and build on.

What seems to work best in fisheries and aquaculture, in the context of poverty reduction and food security in developing countries, are small-scale fisheries and small and medium-scale aquaculture enterprises. Proposals for greater investment in the small-scale sector are emerging from organizations like FAO not because of a romantic attachment to 'artisanal' and 'traditional' forms of production, but on the basis of observed necessity and economic rationality: most of the world's fisheries comprise small-scale units of production, and these have persisted into the 21st century—despite fifty years of policy and development support for their replacement by industrialized fishing. In aquaculture, by contrast, development assistance has focused on integrating aquaculture with small-holder farming, with success that remains rather localized and limited. It has not been transformative (Belton et al., in press). Private-sector led development of small, medium and large-scale enterprises has, by contrast, been a spectacular success and has had a positive global impact on fish supplies. Drawing on the analysis in this document, on guidelines for SSF in the FAO CCRF, and on recent research (summarized in Bene et al., 2007; Thorpe et al., 2007; Allison et al., 2011b), the following general policy directions to support the fisheries sectors' continued contributions to poverty reduction and food security are suggested:

- i. Support the continued operation and development of small-scale fisheries where this is possible. Unless there is compelling evidence that small-scale fisheries cannot operate efficiently (e.g., in offshore marine fisheries), development benefits are more likely to be maintained and widely distributed if the fishery is based on small-scale production units and decentralized marketing networks.
- ii. Promote the adoption of rights-based fishing. Build on customary tenure systems where these exist and have wide legitimacy. Developed rights regimes based on an understanding of the need for flexible, adaptive access rights that have good 'institutional fit' with livelihood strategies. Investment is required in areas such as strengthening government-community partnerships, building capacity of fishery organizations in the context of multi-stakeholder negotiations in coastal and water resource governance, supporting governments and communities to end illegal fishing, and developing business models to help sustain financially the community-level organizations required for management.
- iii. Ensure that compensation schemes or livelihood alternatives are included in programs supporting a transition to rights-based fishing. Without such planning, excluded fishers may have no alternative livelihoods and require social security provision. It is also important that reduction in numbers of fishers is combined with management measures that ensure that this does indeed lead to a reduction in fishing pressure. The reduction in fishers should not be replaced by capital investments that sustain or even increase fishing pressure. ITQ systems, where they are workable, should help prevent overcapitalization.

- iv. Support livelihood diversification. Diversified livelihoods are already a feature of many fishing communities, particularly inland ones. Development in rural areas where fishing is important may be served best by interventions that support complementary household activities. Encouraging alternative livelihood sources raises the opportunity income of fishing, with potential conservation and economic benefits. Mobility is also an element of a diversification strategy, and where it does not threaten resource degradation it brings economic benefits and should be supported through recognition and strengthening of reciprocal or conditional access arrangements.
- v. Build on existing strengths and strategies of small-scale fisherfolk to increase their adaptive capacity and build resilience of the fishery system. Fisheries sector development analyses have tended to focus on what small-scale fisherfolk do not have — access to infrastructure, finance and technology— rather than what they do have—adaptable and flexible income-generating strategies, resilient resource management institutions, knowledge, skill and social capital. The key to sustainable fisheries management and development is to facilitate small-scale fisherfolk to find their own routes out of poverty by building on their existing capital and capabilities.

For aquaculture, again drawing on the analysis from this document, supplemented by reference to OECD (2010a), Beveridge et al (2010) and Belton et al (in press) the following areas of existing dynamism and innovation can be strengthened and directed towards support for poverty reduction and food security:

- i. Support the development of innovation systems in countries with nascent aquaculture sectors. Concentrating on only one part of the aquaculture system (e.g. production technologies, or output markets) undermines the development of the sector; many promising aquaculture ventures have stalled due to input market failures (seed and feed). A functioning innovation system can develop or adapt new technologies in response to evolving circumstances, rather than rely on external technical support. This requires coordinated support across a range of policy arenas - environment, trade, food safety, land use policy and so on.
- ii. Support the growth of the SME aquaculture sector. Public investment in the SME aquaculture sector in Cameroon generates more income and food development per dollar invested than smallholder pond culture does (Brummett et al., 2008). When projects end SMEs are better able to continue to grow, proliferate and generate jobs and food throughout the value chain, ultimately stabilizing fish prices for the benefit of lower income consumers.
- iii. Address the nutritional implications of aquaculture. Making a larger quantity of less nutritious fish available more cheaply to low income consumers may not realize net gains in nutrition and health outcomes. Growing nutrient-dense small indigenous fish alongside larger, more profitable and productive fish for cash sale may be one way of farming for both income and nutrition gains (Roos et al 2007).
- iv. Address equity and environment issues to ensure the sustainability and poverty-reduction benefits of aquaculture development. Improved regulation of value chains – partly driven by consumer demands – is leading to reduction in some of the environmental and social problems that have tarnished aquaculture's reputation in the past. Regulations on moving fish and shellfish around and improved quality control and safety monitoring systems, tied to access to external markets, have helped reduce the incidence of disease in the sector. Human rights abuses (e.g. the use of child labour, exploitative working conditions for women) have been highlighted by NGOs and used to bring pressure for improved labour standards on governments and producers. These investments in the systems governing global trade have benefitted the sustainable development of the sector and provide an important means through which multilateral agencies can contribute to supporting green and fair economic growth.

With carefully targeted and appropriate policy support and public investment, the economic and technological dynamism of fisheries and aquaculture will ensure it continues to play its part in delivering important benefits to global efforts to secure adequate food and a decent life for all.

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For further details contact:

The WorldFish Center
Jalan Batu Maung, Batu Maung,
11960 Bayan Lepas, Penang, Malaysia

Mail: PO Box 500, GPO 10670 Penang, Malaysia
Tel: +(60-4) 626 1606
Fax: +(60-4) 626 5530
Email: worldfishcenter@cgiar.org

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