
Fisheries and aquaculture and their potential roles in development: an assessment of the current evidence



Prepared by



UNIVERSITY OF
STIRLING

June 2013

This report was written by Robert Arthur (MRAG), Chris Béné (IDS), William Leschen and David Little (UoS) [alphabetical order], with research support from Hannah Norbury (MRAG). An earlier version benefited from the comments of Ben Cattermoul and Alan Tollervey (DFID); John Barrett, Tim Bostock, Cassandra de Young, Stephen Hall, Neil MacPherson, Cristina Rumbaitis del Rio, Meryl Williams (members of the Steering Committee) and Edward H. Allison, Rashid Sumaila and Shakuntala Thilsted as well as an anonymous reviewer. This work was funded by the UK-Department for International Development, Research and Evidence Division. The conclusions remain however those of the authors only.

Project no: GB1690
Issue ref: Final
Date of issue: 15/06/2013
Prepared by: RA/CB/DL/WL /HN
Checked/Approved by: CM/RA

Contents

Executive Summary	1
1 Introduction.....	9
1.1 Background	9
1.2 General objective	9
1.3 Scope of the assessment.....	9
1.4 Recent trends in aquaculture and fisheries.....	10
1.5 Approach	11
2 Methodology.....	11
3 Findings.....	13
3.1 Outcomes	13
3.1.1 Food security, nutrition and health	13
3.1.2 Fisheries and economic growth	18
3.1.3 Aquaculture and economic growth.....	24
3.2 Mediating factors	27
3.2.1 Governance reforms in fisheries	27
3.2.2 Gender	29
4 Mapping of other relevant initiatives	30
4.1 Overview of recent and relevant research activities and programmes	30
4.2 Messages from stakeholders	31
4.3 Food Security	32
4.4 Economic growth.....	33
5 Conclusions.....	34
5.1 Knowledge gaps.....	36
Appendix 1: Terms of Reference	39
Appendix 2: Methodology.....	41
Appendix 3: Papers Assessed by Section	45
Appendix 4: Initiatives reviewed.....	61
Appendix 5: Search Log.....	85

Executive Summary

Background

In November 2012, the UK Department for International Development (DFID) set the terms of reference for a commissioned assessment of fisheries and aquaculture science. The task was to complete a 'scoping review', consisting of an in-depth assessment of the existing evidence related to fisheries and aquaculture activities in developing countries and their contribution to economic growth, food security and nutrition. For this the assessment was expected to identify the existing evidence and 'evidence in the pipeline' (i.e. to be published imminently) from the existing literature, compile it, and provide an assessment of the strength (in the sense, scientific rigor) of that evidence, and identify knowledge or evidence gaps. In addition the assessment was to be complemented by a mapping of existing relevant interventions in fisheries and aquaculture.

Findings

In order to conduct this assessment, the team of consultants adopted a six step methodological protocol that allowed them to assess in a consistent manner the scientific quality of the documents included in the assessment, based on quality, size and consistency of the evidence. After scanning, 202 documents were retained. The main evidences from these 202 documents were organised under two main threads: (i) Developmental outcomes, including food security; nutrition; health; economic growth and (ii) Mediating factors focusing on governance; and gender.

Development Outcomes

Fish and nutritional security

Quality	Size	Consistency
High	Large	Consistent

Fish contributes to nutritional security. The findings on this question is consistent and relies on a large and well-established body of evidence that confirms the high nutritional value of fish and the potential effective contribution that fish can offer in principle to address multiple micronutrient deficiencies in developing countries. Some caveats are worth mentioning, however. In particular, while it is clear that fish consumption can increase animal protein intake and perhaps also essential micronutrient and fats content, this does not necessarily mean that the nutritional status will improve or can be measured. Also problems continue to persist with regard to 'demonstrating' the impact on micronutrient status or other functional outcomes (e.g. cognition, infections, growth and development). These problems apply to all food-based approaches, however, not only to fish-related ones.

Fish consumption and nutritional links to health

Quality	Size	Consistency
High	Large	Consistent

Fish consumption is generally good for health. The literature indicates a large and consistent body of evidence demonstrating that indeed fish consumption does provide protective effects on a wide range of health issues, including incidence of stroke, high blood pressure, coronary heart disease, and possibly cancer – but the mechanisms through which these different effects function are still poorly understood. On the other hand, the risks of contaminants are still persistent in some part of the world. When considered together, however, experts agree that the positive effects of high fish consumption largely overcome the potential negative effects associated with intoxication risks

Fishers and health risks associated with fishing activities

Quality	Size	Consistency
High	Large	Consistent

Fishing communities face many health hazards. The key findings under this theme are consistent and stress the very high exposure and vulnerability of fishing communities to a whole combination of reinforcing risks. Fishing is certainly amongst the most dangerous occupations in the world. Evidence has been established largely from developed countries fisheries, but one can expect developing countries' situation to be even worse. In addition, for various social, cultural and possibly economic

reasons, fishing communities are also particularly exposed to risks related to diseases including malaria, water-borne diseases, STDs and HIV/AIDS. Prevalence of these diseases is often higher in fishing communities than in the rest of the population.

Fish consumption and poverty

Quality	Size	Consistency
High	Large	Inconsistent

Do poor consume (more) fish? The literature exploring the relation between fish consumption and poverty is relatively large and of relatively high quality. But the main findings are inconsistent and ambiguous. While the majority of the articles stress the importance of fish as a critical source of animal protein for the poor, this role is somewhat overstated as the share of protein intake derived from plants (e.g. beans, peas, nuts) far exceeds that of fish-protein in developing countries. Furthermore, the contribution of fish to food security is too often narrowly measured through their share in animal protein intake (thus, overlooking the nutrient contribution). At the same time there is strong evidence that fish consumption is the highest in tropical Asian and sub-Saharan African countries, suggesting that the adage ‘fish as a rich food for the poor’ reflects the reality. At the household level, evidence is strong that both fishing households and fish-farmers consume a higher proportion of fish than other households, but there is no robust evidence that this higher consumption results in higher nutritional status.

International fish trade and food security

Quality	Size	Consistency
Moderate	Medium	Inconsistent

Does (international) trade reduce food insecurity? The findings that emerge from this heterogeneous body of literature are relatively inconsistent, reflecting essentially the lack of tangible evidence and the subsequent unsettled debate that characterises current discussions: while some studies claim that international fish trade contributes to improve food security of developing countries through fish export revenues, none of these studies demonstrate any tangible correlation between fish export revenues and import of food or improvement in food security at national or local levels. At the other end of the spectrum, other studies claim that international fish export threatens food security at the local level but here again fail to provide rigorous evidence to support this statement. Some recent papers refute this polarised vision and stress the local-specificity of the cases and the need for new approaches to capture both the local and national level dimensions of the problem.

Impact of fisheries and aquaculture interactions on food security

Quality	Size	Consistency
Moderate	Small	Inconsistent

Is the interaction between fisheries and aquaculture positive from a food security perspective? The findings on this are unclear. While studies at the global level confirm the increasingly critical role of aquaculture to fill the gap between fish demand and supply, this growing importance is not without raising questions, in particular in relation to the current need of the aquaculture sector for fish meal/oil production and the potential effects that this could have on direct human food security. No demonstrated evidence has been found, however. On the other hand, local case studies suggest that large farmed fish are usually of lower nutritional content than wild indigenous small fish. Overall, there is no clear evidence that larger supply of farmed-fish (or conversely availability of wild fish) have a direct effect on micronutrient status of the producing households and/or consumers.

Fish, food security and the major drivers of changes

Quality	Size	Consistency
Low	Medium	Inconsistent

Can fisheries and aquaculture play any role in the future in terms food security when accounting for population growth, fisheries current crisis, and climate change? No clear message emerges from the literature yet. Overall, most of the analyses recognise the severity of the wild fisheries situation at the global level, but tools and methods to estimate the impacts of global drivers on food security at local level are still missing. Equally, the ‘big picture’ is not necessary easier to draw. The uncertainty

induced by the climate change on the dynamics of the stock is complicated by the lack of reliable data about small-scale fisheries. Consequently most of the attempts to estimate the effect of these global drivers are still highly hypothetical and rely on questionable assumptions and/or methods.

Fisheries and national economies

Quality	Size	Consistency
Low	Large	Inconsistent

Can fisheries contribute to national economic growth in developing countries? Although the number of articles and documents discussing the subject is large and the (neo-classical) theory assertive, statements are rarely rigorously substantiated and empirical evidence is weak, essentially due to lack of appropriate national statistics and data on multiplier effects. Evidence regarding the actual practice of rent extraction and its reinvestment in the fisheries sector or in effective poverty alleviation interventions is also lacking. It is also unclear from the literature how changes to increase efficiency and increase rents, including national certification schemes, actually benefit the poor. In contrary, within a developing country context, there is evidence to suggest that fisheries, in particular more labour-intensive fisheries, can provide important additional seasonal employment, support agricultural livelihoods and may also provide a 'labour buffer' function. While a global analysis is still missing, it is suggested that fisheries can potentially provide employment opportunities for the poor, in particular in conditions where capital and investment are lacking and in post-conflict conditions.

Fish trade and poverty alleviation

Quality	Size	Consistency
Moderate	Large	Inconsistent

Does fish trade effectively contribute to alleviate poverty? The literature supporting this hypothesis tends to rely heavily on global data sets that are essentially the compilations of foreign exchange earnings and/or revenues derived from fish trade, but not real evidence of the effects of these revenues on the national economy of the countries or the livelihoods of their populations. In addition, the focus so far has mainly been on international trade. Yet the contribution of local trade to national economies is also often expected to be important. However, issues of local trade and multiplier effects have received much less attention and there is currently little evidence of the size of income and/or employment multipliers from fisheries and aquaculture. The nature of trade therefore appears important but information on local trade arrangements and value chains is limited, inconsistent and fragmented. One area where there is more evidence is in the area of fisheries access agreements. Access to developing country resources by foreign fishers has been able to generate significant incomes for national governments in a number of cases. However, there is no evidence to date to show how this income is redistributed and whether it is having a specific impact on poverty. Furthermore, there is also evidence suggesting that unless specific effort is made, developing countries gain less from fishing agreements than the foreign fishing companies involved.

Post harvest loss and value chains

Quality	Size	Consistency
High	Large	Consistent

How much food is lost from fisheries? Fish is a highly perishable commodity and hence susceptible to high post-harvest losses. There is consistent evidence that these losses occur throughout the food/value chain and can be both quantitative and/or qualitative (i.e. economic and nutritional). However, in developing countries, processed fish –dried, smoked and fermented- typically outweighs fresh fish by volume and number of traders. Furthermore, these types of processing typically produce little waste when compared to fillet processing. Fish from small-scale producers can be supplied to both local and distant markets and there are often a diverse range of actors involved before the fish reaches the consumer, such that fish feature in a wide range of livelihoods. There is strong evidence that power asymmetries are an important characteristic of value chains. Relative to other actors in the value chain, small-scale producers are often receiving the least benefit.

Fishing and household economies

Quality	Size	Consistency
Moderate	Large	Consistent

What benefits do fisheries provide at the household level? Fisheries provide a wide range of benefits, beyond income. The assessment found recurrent evidence that fishers are not always among the “the poorest of the poor” and when poverty is present it can be both a consequence as well as a cause of resource degradation. Fishers tend to be poor for reasons that extend beyond the fisheries sector and a growing body of evidence shows that narratives based on the Tragedy of the common are far too simplistic to capture the multi-dimensional nature of the poverty/vulnerability affecting fishing communities. There is also ample evidence of the important social and cultural functions that fisheries offer and the contributions that they make to local communities. Beyond material benefits (through food – produced or purchased, income and employment) and the support of wider household livelihood strategies such as seasonal contributions and safety nets, fisheries also have a role in supporting relationships and well-being within communities, often through reciprocal arrangements and collective action. Even larger, although less tangible, benefits arise from the nature of the activity and from the sense of personal or collective identities and job satisfaction that can be derived from engaging in fishing activities. A general weakness with this literature is that there are, as yet, no comprehensive models to capture and integrate this empirical evidence so the nature of these evidences remains series of individual local examples.

Aquaculture and national economies

Quality	Size	Consistency
Moderate	Medium	Inconsistent

Does aquaculture contribute to economic development? The debate is not necessarily new but still very much unsettled. There is now little doubt that the model of small-scale subsistence aquaculture which had been promoted by international development agencies as a direct entry point for poverty alleviation has not delivered its promise. Evidence also confirms that the different forms of medium to larger, commercial systems which have successfully expanded and have been at the origin of the blue revolution in Asia and to a lesser extent in the rest of the developing world have generated large revenues and foreign exchange. However, no tangible evidence/data is found in the literature to substantiate the expected trickle-down effects of tax revenues and foreign exchange earnings derived from these commercial systems on the welfare of lower income households, suggesting that these forms of aquaculture have not translated into demonstrable and inclusive benefits for the poorest.

Aquaculture and household livelihoods

Quality	Size	Consistency
Moderate	Large	Mixed

Does aquaculture help the poorest? Few isolated case studies evoke the possibility that income and employment created by aquaculture can benefit low-income households participating in specific, often rural, aquaculture activities in both Asia and Africa. However, the overall evidence from the literature indicates that it is usually the better-off farmers and households who tend to not just benefit the most from aquaculture development but also to be able to take up the new technology and connect to the extension services when the latter are available. The reasons for this include income and access to credit and information but also more structural issues, such as ownership or rental of land and water resources - which is still a considerable constraint for the poorest households in most developing countries. Overall it also seems that peri-urban fish-farmers are more likely to generate higher incomes, net returns and longer-term financial viability, than similar producers in more remote rural areas due to access to both inputs and higher value markets. This illustrates the importance, for the sustainability of aquaculture, of access to urban markets for both sales of fish as well as access to key inputs such as feed and fingerlings. Too few rigorous analyses are available to make these findings generic.

Issues of scale and types of aquaculture system

Quality	Size	Consistency
Moderate	Large	Inconsistent

Does scale and types of aquaculture system matter for poverty reduction? The debate is not settled. On one hand some documents claim that the trend towards increasingly intensive production systems does not necessarily represent a threat to efforts to alleviate poverty. No systematic evidence was found however to show the opposite, that is that intensive systems benefit the poor. Instead (as mentioned in the previous paragraph), evidence tends to suggest that the poorest are generally excluded from these types of systems although there may be employment opportunities within the value chain. Second, intensification seems to come at the cost of increased risk of stock diseases (aquatic animal health), environmental degradation - related to intensifying any agricultural food production system – which again may affect more severely the poor. Emerging discussions raise the question of the species selected for culture and how this can positively or negatively affect poverty-reduction. Species such as pangasius (*Pangasius hypophthalmus*) and tilapia (e.g. *Oreochromis niloticus*) have been introduced in many countries and have proved to be extremely successful in becoming important food fish. Whilst there are strong views about the use of exotic species in aquaculture and culture-based systems the evidence of the risk of the culture of some important exotic species has not been clearly established compared to the risks of using domesticated native species. In the context of countries stringent national policies to prevent introductions of non-indigenous live fish species (in order to protect natural biodiversity), there is a need to generate more robust evidence of the relative costs, benefits and risks of aquaculture.

Mediating factors

Governance reforms in fisheries

Quality	Size	Consistency
Moderate	Medium	Inconsistent

Do fisheries governance reforms really benefit the poorest? Overall, there is a general agreement within the rigorous part of the literature that there is no single type of arrangements or role for state and non-state actors (including the private sector) that will deliver outcomes that benefit the poor in all cases. While the consensus on these points is strong, the evidence for how institutional aspects can be addressed to support poverty alleviation outcomes is more mixed and unclear, reflecting the divergent positions that currently characterise debates on this issue. On one hand a large body of work suggests that the observed outcomes are the result of poor policy and practice, highlighting a need to introduce new institutional arrangements (e.g. individual and collective rights) or to undertake institutional reform (e.g. the development of co-management arrangements). The evidence of the effectiveness of these measures in the developing countries context remains weak however and where it has been presented, often relates to environmental indicators. Evidence of poverty alleviation is more ambiguous and more rarely (rigorously) documented. Where it is, there is reasonable evidence that reforms are often instrumentalised by different types of actors for the opportunity they provide to capture/access resources and power. Yet the literature remains weak in its ability to extrapolate beyond the individual case without ‘cherry-picking’. There is also currently no single consistent framework proposed to assess how well fisheries governance systems are performing (including for the poor) or to identify how these systems can be improved. Overall issues of knowledge and power and how these have become established are highlighted although there is little systematic evidence in the current fisheries literature of how these affect poverty outcomes.

Gender

Quality	Size	Consistency
Moderate	Large	Mixed

How does gender affect participation in fisheries and access to benefits? Women’s roles in fisheries are not well recognised. A number of narratives relating to the issue of gender in fisheries emerge from the literature, essentially centred on gendered division of fisheries and household labour, household income and household security. Evidence to support these narratives is weak or too

location-specific however to be generalised, partially due to a lack of disaggregated data and relevant information. At the same time a larger number of papers focussing more specifically on women (as opposed to gender) are found in the literature. Whilst some of these papers highlight differences between men and women, there is little research as to why these differences occur and what the gender issues are. In fact the evidence is strongest with regards to the role of women in economic and/or socio-cultural spheres, rather than on the gender dynamics (i.e. the drivers for these gender divisions). Nevertheless, all these papers demonstrate convincingly that women's roles and their contribution in fisheries are not wholly recognised, unrecorded and undervalued, and mainly invisible in national statistics.

Findings: other initiatives

Around 80 organisations, and their associated activities, were initially identified as having some relevance to fisheries and aquaculture with regards to economic growth, food security and nutrition. The majority of initiatives reviewed take place in South East Asia, and Sub Saharan Africa, although projects do occur in Latin America, India and the Pacific Islands. Fisheries and aquaculture are addressed in research activities and programmes as either directly, or as part of broader themes including: agricultural development, biodiversity, climate change, ecosystem services, rural development, livelihoods, coastal development and management, and natural resource management.

There was a general consensus that fisheries and aquaculture are important and that programmes and interventions in these areas could result in enhanced contribution to economic growth, food security and nutrition although impact pathways were not clearly identified or generalised at best. Fisheries and aquaculture are not always addressed as a separate issue and in a number of cases is combined with agriculture, and where this is the case they have a lower profile. The importance of addressing governance issues and developing political will to address fisheries challenges was highlighted by a number of stakeholders.

Initiatives operate at a number of levels: local pilot projects and case studies (in a country or region) implemented with a view to scaling up. National and regional capacity building, institutional strengthening programmes sought to engage with national and regional institutions, influence policy and increase cooperation. Few initiatives were operating at an international level. A large majority of the collaboration is with government departments and ministries. Other partners include international and local NGOs, inter-governmental agencies, private sector and universities.

Food security

Food security has been a high profile issue especially following the spike in food prices in 2008. It appears to be the general consensus that fisheries and aquaculture are important in this respect and can contribute to food security in the future. A number of global initiatives on food security have been created recently and high level conferences have been held to discuss global food security issues. However, within these wider initiatives the intended role and contribution of fisheries is less obvious or clear.

Economic growth

There are some differences in the way that fisheries and aquaculture are viewed with respect to economic growth. Within many programmes the contribution that aquaculture can make is more clearly identified and defined. However there is increased interest in wealth-based approaches to management and there are a number of models being developed to indicate what the potential economic gains from generating economic rents might be. Perhaps as a result there is an emphasis in a number of programmes on 'securing rights' for fishers. Across Africa there are also a number of initiatives to improve the environmental sustainability of fisheries through ecosystem based approaches to fisheries and to develop Fisheries Improvement Plans (FIPs) as a move towards Marine Stewardship Council (MSC) certification. In aquaculture and capture fisheries more widely

there is increasing attention being given to value chains and, in particular, on the effect of changes in value chains.

Gap analysis and research implications

Cluster	Evaluation			Gap
	Quality	Size	Consistency	
Fish and nutritional security	High	Large	Consistent	Lack of data assessing the impact of fish-intake on micronutrient status.
Fish consumption and nutritional links to health	High	Large	Consistent	
Fisheries and health risks	High	Large	Consistent	
Fish consumption and poverty	High	Large	Inconsistent	Lack of systematic and global data and methods to quantify current and future direct and indirect contributions of fisheries and aquaculture to food security at household, local and national levels.
International fish trade and food security	Moderate	Medium	Inconsistent	
Impact of fisheries and aquaculture interactions on food security	Moderate	Small	Inconsistent	
Fish, food security and the major drivers of changes	Low	Medium	Inconsistent	
Fisheries and national economies	Low	Large	Inconsistent	
Fish trade and poverty alleviation	Moderate	Large	Inconsistent	Lack of systematic and global data to quantify the different ways fisheries and aquaculture contribute to poverty reduction and economic growth at both local and national levels.
Fisheries value chains	High	Large	Consistent	
Post harvest loss	High	Large	Consistent	
Fishing and household economies	Moderate	Large	Consistent	
Aquaculture and national economies	Moderate	Medium	Inconsistent	
Aquaculture and household livelihoods	Moderate	Large	Mixed	
Issues of scale and types of aquaculture system	Moderate	Large	Inconsistent	
Governance reforms in fisheries	Moderate	Medium	Inconsistent	Lack of methods and baseline to assess governance reform.
Gender	Moderate	Large	Mixed	Complete absence of gender-disaggregated data.

The assessment of the evidence has identified a number of evidence gaps and challenges facing researchers and practitioners. Currently, there are important aspects of fisheries and aquaculture that are not considered in national statistics and where they are the figures may be inaccurate. This assessment has identified the relationship between men and women and establishing their roles and contribution through gender analysis; and, health and safety within the fisheries sector as two such

aspects that require attention. A general concern across the evidence assessed in this report is that it is not always clear how poverty is being conceptualised, articulated or measured. Addressing fisheries issues in a developing country context does not necessarily mean addressing poverty, and fisheries research could benefit from the wider literature on the nature of poverty.

A major weakness that has been identified is in the evidence of the ways in which fish production, wealth and changes in the availability of fish translate into developmental benefits, especially for the poor. In other words, how they reduce poverty. Poverty reduction is recognised as not being about aggregate production of fish, yet these metrics still dominate some of the analysis of the contribution that fisheries can make to poverty alleviation. More evidence is needed in particular on the distributional aspects of benefits, recognising differentiated access and entitlement to fish resources, even within households, and how this could be improved. Even in the well-studied area of nutrition there are still limitations to the evidence and persistent problems in demonstrating the impact of fish availability on micronutrient status or other functional outcomes (e.g. cognition, infections, growth and development).

This assessment has revealed a wealth of evidence of the benefits from fisheries and aquaculture at the local level and of the effect of different aspects of change. This scale aspect is a critical consideration as analysis at different scales has led to different conclusions in some instances. The understanding of the possible pathways and alternative arrangements that could benefit the poor could be enriched through further analysis of this evidence through a global study that could capture and quantify more rigorously and in a more systematic manner the contribution of fisheries to poverty alleviation and food and nutritional security spanning both national and household levels.

The value chain literature is increasing and developing. The analysis provides an opportunity to move beyond the analysis of trade statistics and is beginning to explore the power relations within value chains and the effects of change on value chains and the actors associated with them (e.g. Tran et al. 2013). This is a promising area given the rapid pace of change and global nature of trade in fish. Certification has been seen as a way of addressing the power asymmetries within value chains but the evidence suggests that the introduction of certification schemes plays out within a particular political and economic setting and may have unintended social consequences. This merits further research.

There is a pressing need to assess how different types of aquaculture systems and value chains contribute to poverty alleviation, and the mechanisms through which this is achieved. There is also scope for more analysis of regional trade and of the value chains associated with aquaculture inputs as this is currently limited. Finally, fish represents a source of nutrition as well as income. Including this aspect in value chain analysis to examine changes in nutritional value and who benefits from this in different value chains and resulting from changes in value chains could also be useful. With evidence that aquaculture may produce different fish products compared to capture fisheries, and that there are important interactions and interdependencies (e.g. through competition for water, use of fish seed and fish for feed and pollution), there arise many questions needing answers concerning who benefits, and at what and whose cost.

Finally, more tools and methods are urgently required to estimate the impacts of global drivers on food security at local level. Equally, the 'big picture' is not necessarily easier to draw. For example, the uncertainty induced by climate change on the dynamics of fish stocks is complicated by the lack of reliable data about small-scale fisheries. As a result most of the attempts to estimate the effect of these global drivers are still highly hypothetical and rely on questionable assumptions and/or methods. Similarly, there are gaps in understanding the effects of different value chains (including the increasingly extended chains to urban markets) and of multipliers on local trade, and how these affect the poor.

1 Introduction

1.1 Background

In November 2012, the UK Department for International Development (DFID) set the terms of reference for a commissioned assessment of fisheries and aquaculture science. The work to be completed was to be a 'scoping review', the main objective of which was to provide DFID with a robust assessment and analysis of evidence in the field of fisheries and aquaculture research. The findings of the assessment are expected to be used by DFID to guide its involvement in this field of research. Determining the contribution of fisheries and aquaculture to economic growth, food security and nutrition is pertinent at a time when the post 2015 development agenda¹ is being established to continue the work and progress of the Millennium Development Goals² in eradicating global poverty.

1.2 General objective

The terms of reference (ToR) stipulated a desk-based assessment and consist of an in-depth assessment of evidence related to fisheries and aquaculture in developing countries and their impact/relationship with economic growth, food security and nutrition (details of the Terms of Reference are provided in Appendix 1). Subsequent meetings and correspondence with DFID confirm that the consultants completing the assessment were not expected to elaborate, converse or take position on some of the current open discussions found in the literature, but simply to identify the existing evidence and 'evidence in the pipeline' (i.e. to be published imminently) from the existing literature, compile it, and provide an assessment of the strength (in the sense, scientific rigor) of that evidence, and identify knowledge or evidence gaps.

To complete this desk-based assessment, the team of consultants was therefore expected to conduct a literature review of peer-reviewed articles and other relevant evidence arising from applied field research and technical assistance programmes in the field of fisheries and aquaculture development; complemented by a comprehensive mapping of other relevant interventions in these areas (both on-going and/or recently completed). The aim of this complementary mapping exercise was to provide a detailed overview of all other recent and relevant research activities and programmes in this area.

1.3 Scope of the assessment

The ToR provided for a desk-based assessment and stressed that the focus of the assessment should be on the contribution of fisheries and aquaculture to **economic growth, food security**³ and **nutrition**. Consequently, no specific reference to environmental issues related to the over-capitalisation of the world fisheries (such as over-exploitation of the resources) or to the impact of the rapid expansion of aquaculture activities on the environment (e.g. pollution) in certain parts of the world will be made in this report, beyond these related to possible implications of these environmental degradations for economic growth, food security or nutrition.

¹ UN, 2013, A New Global Partnership: Eradicate Poverty and Transform Economies Through Sustainable Development, The Report of the High-Level Panel of Eminent Persons on the Post-2015 Development Agenda

² <http://www.un.org/millenniumgoals/>

³ Food security is defined as 'a situation that exists 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' FAO. 2002. The State of Food Insecurity in the World 2001. Rome

1.4 Recent trends in aquaculture and fisheries

In 2010 global capture fisheries and aquaculture from both marine and inland waters produced 148 million tonnes of fish, which was valued at US\$217.5 billion (FAO 2012). Developing countries account for over 60% of global fish catch (FAO 2009). Whilst global marine capture fisheries production has stabilised at about 90 million tonnes, global aquaculture production has continued to expand at an average annual rate of 8.8% between 1980 and 2010 (FAO 2012). In 2010 aquaculture production was 60 million tonnes, with an estimated value of US\$119 billion. This production is recognised to be of particular importance to developing countries, as a potential driver of local and national economic development and for the critical role that fish can play in the food and nutrition security of people, including the poorest⁴.

Fish and fishery products are the most traded food commodities in the world (FAO 2012). In value terms, they account for 10% of total agricultural exports and 1% of world merchandise trade. World trade in these products is valued at US\$102 billion dollars with world imports of fish and fish products setting a new record in 2010 at US\$111.8 billion. The value of the global fish trade exceeds the value of international trade in all other animal proteins combined⁵. Developing countries play a major role in the global trade of fish and fish products; 50% of all fishery exports in value terms and more than 60% in quantity terms are supplied by developing countries (World Bank 2011). The context in which this production takes place is one in which an estimated 1.4 billion people are in poverty (2008 figure), 868 million people are estimated to be chronically hungry and an estimated one third of children in the developing world under five years of age are stunted (Conway 2012). At the same time, demand for fish products are likely to rise as a result of rising populations that are expected to reach 9.3 billion by 2050. Furthermore, developing countries now display a positive trade balance due to their increasing involvement in global fisheries trade. It is estimated that fish production generally contributes 0.5 – 2.5 % of GDP globally but detailed analysis of countries such as Mauritania and Vietnam show contributions of 10% or more (Allison 2011).

Despite the important contributions that fisheries can make, global debates and discussions on fisheries issues and fisheries policies appear dominated by concerns over environmental sustainability, overfishing and overcapacity. These debates tend to be characterised by crisis narrative (e.g. Worm et al. 2006) within which the potential of fisheries is limited and management of fisheries can, at best, only hope to minimise the impacts of development within fisheries and that impacts upon fisheries. Capture fisheries become a subject for conservation while aquaculture assumes greater importance as a means to replace lost capture fisheries production.

Recent work on fisheries in developing countries has sought to challenge this view of fisheries based on evidence of huge productivity and of the importance of fisheries and aquaculture across scales. This work has sought to emphasise a capture fisheries and aquaculture systems as locally complex, diverse and dynamic, central to livelihoods and providing food, income and employment as well as a range of social and cultural values and benefits. The benefits become particularly important when placed in the context of current food production challenges, social change and growing climate change uncertainties. The report is intended to assess the available evidence to identify where fish, and the aquaculture and fisheries systems that provide this fish, might contribute to development objectives and drive development.

⁴ Final Communiqué of The Think Tank Validation Meeting on The Formulation of Pan African Fisheries Policy Douala Cameroon 26-28th November 2012 http://www.au-ibar.org/index.php?option=com_flexicontent&view=items&cid=69&id=535&Itemid=48

⁵ World Bank, 2011, The Global Program on Fisheries Strategic Vision for Fisheries and Aquaculture, <http://siteresources.worldbank.org/EXTARD/Resources/336681-1224775570533/2011StrategicVision.pdf>

1.5 Approach

The contribution of fisheries to developmental outcomes is most often presented in terms of income, employment and food. However, the literature suggests that the actual benefits and the technical and social processes through which they are derived are complex and often dynamic. To avoid oversimplification and to contribute to theory of change approaches we will explore not only the evidence related to the developmental outcomes but also use the literature to highlight some of the social mediating factors that can influence the nature of the benefits derived from fisheries and aquaculture and, crucially, their distribution. This approach will be used to structure the assessment, providing a means to explore the outcomes from fisheries systems and their relation to food security and nutrition and economic growth, as well as to examine the issues associated with the process of generating these.

2 Methodology

In order to conduct this assessment, the team of consultants adopted a six-step methodological protocol that allowed them to assess rigorously and in a consistent way the scientific quality of the documents included in the assessment (the full detailed description of each of these steps is presented in Appendix 2):

1. **Sourcing of the literature:** academic research documents, including journal articles, books and book chapters, government and international institution studies, reports, working papers and forthcoming papers, and other grey literature sources were searched, using Science Direct and Google Scholars
2. **Screening and selection:** five inclusion/exclusion criteria were applied: language; year of publication; academic quality; geographic areas; and topical relevance. Based on these criteria 202 documents were retained.
3. **Characterisation of the studies:** each of the 202 retained documents were then characterised regarding the nature (primary/secondary – case study-review) and scale of the data (small/large data bases)
4. **Assessment of the quality of the documents:** for each document, the academic quality of the methodology was assessed through a three-criterion evaluation system: rigour, validity and reliability (adapted from ESRC, 2003, Petticrew & Roberts, 2006 and Gough, 2007) shown in Table 1.
5. **Evaluation of the quality of the body of evidence:** The body of evidence was then evaluated by aggregating the quality of research scores obtained through step 2 to 4 above. The results were then summarised using three criteria: Technical quality of the body of evidence based on the descriptors in Table 2; size of the body of evidence (large: more than 10 documents; medium: between 10 and 6, small: 5 or fewer documents); and consistency of the body of evidence
6. **Synthesis:** a clear, accessible and concise synthesis of the main findings was produced. Where appropriate, links to other key-documents which had not been included in the assessment (either because their focus was outside the direct scope of this assessment or their methodology (or lack thereof) had led to their non-inclusion in this assessment) but are widely quoted in the fisheries or aquaculture literature), are made in the final part of this document.

Table 1: Criteria used to assess the quality of the research at the article level

Indicators	Criteria	Yes	Partial	No
Validity	<ul style="list-style-type: none"> Are the findings substantiated by the data and has consideration been given to limitations of the methods that may have affected the results? Are there problems in applying the method to some research question(s)? 			
Rigorousness	<ul style="list-style-type: none"> Is the context or setting adequately described? Is (are) the research question(s) clear? Is the method used appropriate to answer the research question(s)? Is the method applied correctly? Is there evidence that the data collection was rigorously conducted to ensure confidence in the findings? 			
Reliability	<ul style="list-style-type: none"> Is the data analysis rigorously conducted to ensure confidence in the findings? Is the methodology adequately described to ensure confidence in the findings? 			

Table 2: Criteria for the quality of the body of evidence

Quality of the body of evidence	Definition
High	Many/the large majority of single studies are assessed as being of a high quality, demonstrating adherence to the principles of rigour, validity and reliability.
Moderate	Of the single studies, approximately equal numbers are of a high, moderate and low quality, as assessed according to the principles of rigour, validity and reliability.
Low	Many/the large majority of single studies are assessed as being of low quality, showing significant deficiencies in adherence to the principles of rigour, validity and reliability.

3 Findings

The following sections are constructed around key-developmental outcomes, including DFIDs current priority areas, and each section provides a summary of the evidence that were identified from the assessment.

3.1 Outcomes

3.1.1 Food security, nutrition and health

Two 'meta-threads' emerge from the literature around the theme of 'fish, health and food security': one group of documents relating to the issue of 'fish, nutritional security, and health' and a second group relating to the question of 'fish and food security'. These two meta-threads can be further disaggregated into seven clusters as follows -see also Figure 1.

Fish, nutritional security and health

- Fish and nutritional security
- Fish consumption and nutritional links to health
- Fishers and health risks associated to fishing activities
 - Fisheries and related diseases (HIV/STDs etc)
 - Fisheries, health and safety risks

Fish and food security

- Fish consumption and poverty
- International fish trade and food security
- Fisheries and aquaculture and the impact of their interactions on food security
- Fish, food security and the major drivers of changes

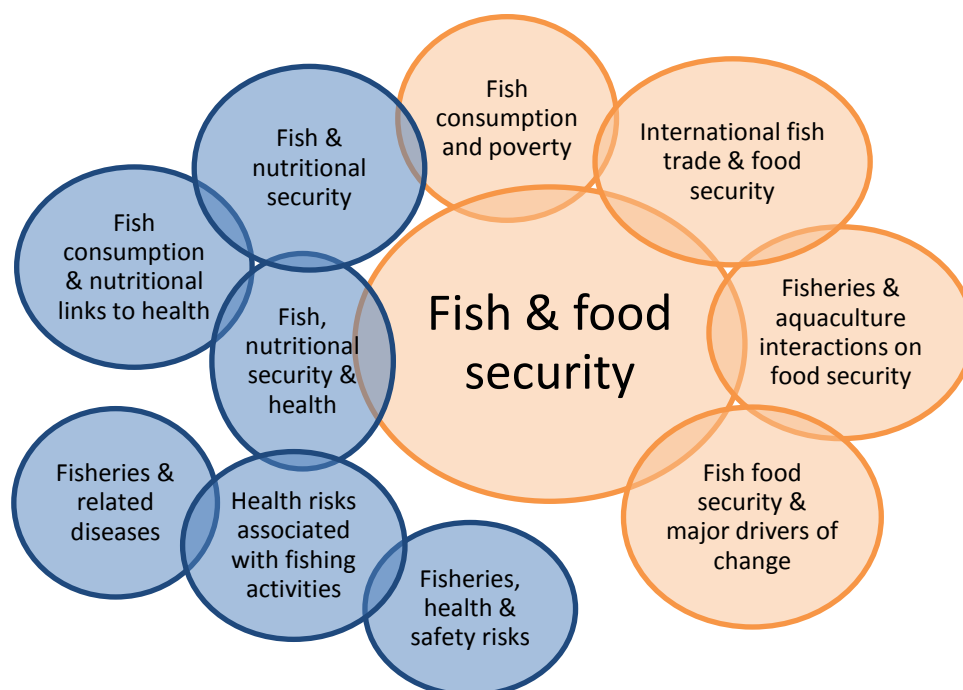


Figure 1 Main clusters emerging from the papers assessed within the theme of food security, nutrition and health

3.1.1.1 *Fish, nutritional security and health*

Fish and nutritional security: a growing literature is now being published, which aims to document the contribution of fish (through fisheries and aquaculture) to nutritional security. This cluster of literature is relatively large and homogenous, made of articles published essentially in nutrition journals (e.g. Journal of Nutrition, Public Health Nutrition). Out of the 11 articles that were retained for this assessment (all published after 2003) -see Appendix 3- five are literature reviews, one is a systematic review, while the remaining five are primary data-based research. Table 3 presents the quality of the body of evidence: it is remarkably high: the large majority of the studies have been assessed as being of a high quality, demonstrating adherence to the principles of rigour, validity and reliability.

Table 3: Quality of the body of evidence for the cluster: *Fish contribution to nutrition and health*

Criteria	Score
Validity	22/22 = 1
Rigour	53/56 = 0.96
Reliability	22/22 = 1

The overall message that emerges from this part of the literature is consistent and supports the well-established evidence of the high nutritional value of fish (in particular small fish) in terms of micronutrients (bioavailable calcium, vitamin A, iron and zinc), and the potential effective contribution that fish can offer in principle to address multiple micronutrient deficiencies in developing countries. Some caveats are worth adding, however. Firstly, the majority of the studies that propose to quantify fish micronutrient content have been conducted in Asia (essentially Bangladesh and Cambodia). Far less is known about species in other parts of the developing world, and especially in Africa. It is also the case that different fish have different nutritional qualities (e.g. 'white fish' and 'oily fish') and these may also be different for culture fish cultured differently. There may be nutritional outcomes if people switch from small wild fish to larger cultured fish in terms of micronutrient density and availability. Secondly, while fish intake will increase animal protein intake and perhaps also essential micronutrient and fats content of a person's diet, this does not necessarily mean that the nutritional status of that person will improve or can be measured (Kongsbak et al. 2008). There is presently a lot of focus on animal-source foods, including fish, in the first 1,000 days of life – not only as a source of vitamins and minerals, but also of animal protein, and more so, as a source of essential fats for brain development and cognition. However problems continue to persist with regard to 'demonstrating' the impact on micronutrient status or other functional outcomes (e.g. cognition, infections, growth and development). These problems apply to all food-based approaches, however, not only to fish-related ones.

Fish consumption and nutritional links to health

Complementing the research highlighted above on the contribution of fish to nutritional security, a second cluster of articles was found, which looks more specifically at the effect of fish consumption on human health, considering issues such health benefits (e.g. reduction of stroke risk), versus health risks (ciguatera, mercury and other toxins) –see Appendix 3. Here again the cluster is medium sized and remarkably homogeneous in terms of type of research undertaken. Most of the documents are articles published in medical or food/health journals. Amongst the nine articles retained, six are literature review and two are systematic reviews/meta-analyses. The last one is a modelling exercise. The quality of the body of evidence is relatively high as shown in Table 4 although it is not scoring as high as the previous cluster, essentially due to the difficulty to evaluate simultaneously two opposite types of risks: positive effect of fish consumption versus negative risks of consumption.

Table 4: Quality of the body of evidence for the cluster: *Fish consumption and nutritional links to health*

Criteria	Score
Validity	17/20 = 0.85
Rigour	39/50 = 0.78
Reliability	18/20 = 0.90

The key message that emerges from this part of the literature is an overall positive and consistent conclusion: on one hand, there is a large and well-established body of evidence that fish consumption does provide protective effects on a wide range of health issues, including incidence of stroke, high blood pressure, coronary heart disease, and possibly cancer – but the mechanisms through which these different effects function are still poorly understood. On the other hand, the risks of intoxication/poisoning are still persistent at least in some part of the world (e.g. Pacific region). When considered together, however, experts tend to agree (e.g. FAO/WHO 2010) that the positive effects of high fish consumption largely overcome the potential negative effects associated with contamination risks.

Fishers and health risks associated with fishing activities

The third cluster consists of articles which aim at documenting and assessing the potential health risks associated with fishing and fish processing activities. These fall essentially into two categories. The first one relates to risks related to diseases that are likely to be highly prevalent among fisherfolk (men and/or women involved in fishing or fish trading and processing). These include HIV/AIDS and STDs, but also water-borne diseases such as schistosomiasis and malaria. The second group of articles focus on the safety risks affecting fisherfolk (at sea but also in the wider fishery sector, including fish processing factories). Because of the nature of the issues considered, a substantial number of these articles have been published in medical (or similar types of) journals (see Appendix 3). As far as the studies on fishing-related diseases are concerned, the cluster is medium to large sized with eleven articles retained, four of which are literature reviews while the other seven are primary-data analyses. Seven articles were retained for the safety risks sub-cluster, five of which are primary-data analyses. Although none of these 18 articles included in this cluster are systematic reviews or meta-analyses, the quality of the body of evidence is relatively high –see Table 5 and Table 6, essentially due to the rigour that usually characterises this type of (medical) research.

Table 5: Quality of the body of evidence for the cluster: *Fisheries and related diseases*

Criteria	Score
Validity	18/22 = 0.81
Rigour	53/55 = 0.96
Reliability	20/22 = 0.90

Table 6: Quality of the body of evidence for the cluster: *Fisheries, health and safety risks*

Criteria	Score
Validity	10/14 = 0.71
Rigour	30/35 = 0.86
Reliability	12/14 = 0.86

The key findings under this health risks cluster are consistent and stress the very high exposure and vulnerability of fishing communities to a whole combination of (sometimes reinforcing) risks. Fishing is certainly amongst the most dangerous occupations in the world with accidents involving numerical loss of fingers or limbs, back injuries, permanent disabilities and loss at sea. Evidence has been established largely from statistics from developed countries fisheries, and it is recognised that

developing countries' statistics (which are often non-existent) are probably even more daunting. In addition, for various social, cultural and possibly economic reasons, fishing communities are also particularly exposed to risks related to diseases including malaria, water-borne diseases, STDs and HIV/AIDS. Prevalence of these diseases is often higher in fishing communities than in the rest of the population.

3.1.1.2 Fish and food security

Fish consumption and poverty

The first cluster under this 'fish and food security' meta-thread includes articles that explore the question of the relation between fish consumption and poverty: do poor people consume more (or less) fish than better-off households, and if so which fish? Does aquaculture improve availability of fish and to whom? Are fishing communities consuming more fish than non-fishing communities? The large cluster of 10 articles and reports that was retained for this part of the assessment (Appendix 3) is somewhat more heterogeneous than the clusters on nutrition and health discussed above. It includes three literature reviews (but no systematic review), and seven individual analyses, four of which are combinations of local case-studies and global data. The quality of the body of evidence presented in Table 7 is also slightly lower than the clusters on nutrition but still remains relatively high.

Table 7: Quality of the body of evidence for the cluster: *Fish consumption and poverty*

Criteria	Score
Validity	16/20 = 0.80
Rigour	40/50 = 0.80
Reliability	16/20 = 0.80

The main findings that emerge from this part of the literature are inconsistent and somewhat ambiguous. On one hand the majority of the articles reviewed (along with many others founded in the literature) stress the importance of fish as a critical source of animal protein for the poor; this importance is however somewhat overstated (and misleading) as the share of protein intake derived from plants (e.g. beans, peas, nuts) far exceeds that of fish-protein. Too often the contribution of fish to food security is also deceptively measured through their share in animal protein intake (thus, overlooking the nutrient contribution). At the same time there is strong evidence that fish consumption is the highest in SIDSs and LIFDCs from tropical Asian and sub-Saharan Africa, suggesting that the adage 'fish as a rich food for the poor' is reflecting reality. At the household level, evidence is strong that both fishing households and fish-farmers consume a higher proportion of fish than other households, but there is no robust evidence that this higher consumption results in higher nutritional status. In fact the only study that rigorously demonstrates higher nutritional status in fish-farming households also suggests that this higher nutritional status does not result from direct fish consumption but from the additional cash generated by the selling of the fish, which allows household to purchase nutrient-rich food (Aiga et al. 2009).

International fish trade and food security:

The second main cluster in this thread on fish and food security relates to fish trade and discusses in particular the contribution that international fish trade can make to food security in developing countries. Amongst the nine articles and reports that have been retained (see Appendix 3), eight are relying on existing data (with a mix of local case studies and global data sets), suggesting that a lot of the debate on this issue is based on 'recycling' data. None of these articles offers a methodology and a combination of data that allows apprehending the issue comprehensively and rigorously. A lot of the articles rely on 'visual' (loose) observation of trends between data sets. As a consequence the quality of evidence is only moderate as shown in Table 8. In particular the validity and reliability scores are relatively low due to problems in the methods applied to answer these questions.

Table 8: Quality of the body of evidence for the cluster: *International fish trade and food security*

Criteria	Score
Validity	7/18 = 0.39
Rigour	27/45 = 0.60
Reliability	8/18 = 0.44

The main messages that emerge from this heterogeneous literature are also relatively inconsistent, reflecting essentially the lack of tangible evidence and the subsequent unsettled debate that characterises current discussions on this issue: on one hand some authors claim that international fish trade contributes to improve food security of developing countries through fish export revenues, although none of these studies demonstrate any tangible correlation between fish export revenues and import of food or improvement in food security at national or local levels. On the other hand, other authors claim that international fish export does threaten food security at the local level. Here again none of the studies provide rigorous evidence to support this statement. A more recent series of papers refute this polarised vision and stress the local-specificity of the cases and the need for the methods to capture both the local and national level dimensions of the problem (e.g. Béné et al. 2010).

Fisheries and aquaculture and the impact of their interactions on food security:

The third cluster found in this part of the literature relates to the question of the potential (positive and negative) interactions and synergies between wild fisheries and aquaculture and the outcomes of these interactions in relation to food security⁶. Only four papers have been retained (see Appendix 3). Two of them are based on global databases, the third one includes both case-studies and global data sets, while the last one is a literature review relying essentially on case studies. Despite this relatively small pool, the overall quality of the body of evidence is moderate to high as shown in Table 9.

Table 9: Quality of the body of evidence for the cluster: *Fisheries and aquaculture and the impact of their interactions on food security*

Criteria	Score
Validity	5/8 = 0.62
Rigour	13/16 = 0.81
Reliability	9/12 = 0.75

The findings are mixed. At the global level, the studies emphasise the increasingly critical importance of aquaculture to fill the gap between fish demand and supply, recognising that wild fisheries are likely to have reached their maximum capacities. However, the growing importance of aquaculture is not without raising questions about the potential negative impact that the use of wild fish for fish meal/oil production could have on human food security. In particular it is often stated that there is competition between direct human consumption and reduction for animal (including aquaculture) feed of small pelagic fish. No demonstrated evidence of this impact has been found, however. At local/household level, case studies in Bangladesh highlight that large farmed fish are usually of lower nutritional content than wild indigenous small fish. Yet, there is no clear evidence that larger supply of farmed-fish (or conversely availability of wild fish) have a direct effect on micronutrient status of the producing households and/or consumers.

⁶ Note that another related part of the literature (note reviewed here) discusses the ecological implications of these interactions –in particular through the impact of aquaculture on mangrove.

Fish, food security and the major drivers of changes

The fourth and last cluster includes a moderate sized mixed group of articles that attempt to address the general question of the link between fisheries or aquaculture and food security within the wider context of global drivers such as population growth, fisheries governance reform, or climate change. The eight articles identified constitute a rather heterogeneous pool of analyses. Four of them are general literature reviews of various nature and quality, three others propose some form of scenario/projection analyses, and the last one is a case study exploring the potential effect of MPAs on local population's food security. While the quality of the body of evidence for some of these analyses is high, the overall scoring of the whole pool is relatively low as shown in Table 10, reflecting the poor level of adherence to the principles of rigour, validity or reliability of some of these analyses.

Table 10: Quality of the body of evidence for the cluster: *Fish, food security and the major drivers of changes*

Criteria	Score
Validity	7/16 = 0.44
Rigour	17/40 = 0.42
Reliability	4/16 = 0.25

Due to the heterogeneity of the analyses assessed under this cluster, no clear message emerges from this pool of articles. Overall, most of the analyses recognise the severity of the wild fisheries situation at the global level, but tools and methods to estimate the impacts of global drivers on food security at local level are still missing. Equally, the 'big picture' is not necessary easier to draw. The uncertainty induced by the climate change on the dynamics of the stock is complicated by the lack of reliable data about small-scale fisheries. As a result most of the attempts to estimate the effect of these global drivers are still highly hypothetical and rely on questionable assumptions and/or methods.

3.1.2 Fisheries and economic growth

Within the literature there have been a number of attempts to derive estimates of the direct value of the outputs from marine capture fisheries using national statistics in order to highlight the economic importance and potential of the sector. Recent estimates have suggested an aggregate global value of US \$80–85 billion annually (e.g. World Bank and FAO, 2009) and, by including processing and ancillary activities, a total contribution to global economic output of between US \$225 and \$240 billion per year (Dyck and Sumaila 2010). Whether this wealth can be generated sustainably and how it can be used to alleviate poverty, are critical concerns. Within the literature there are two important strands that address this issue. The first considers how fisheries can be made more efficient and the rents generated from this captured and redistributed. The second major strand is based on institutional economics and examples of collective management of local resources that suggest that fisheries can be successfully managed as common property resources and that this management may not be as inefficient as assumed. For this reason we have concentrated in this section on contributions of fisheries to economic growth at the national and local level as well as the issue of trade in fish, value chains and post harvest losses that span the two. This is presented below in Figure 2.

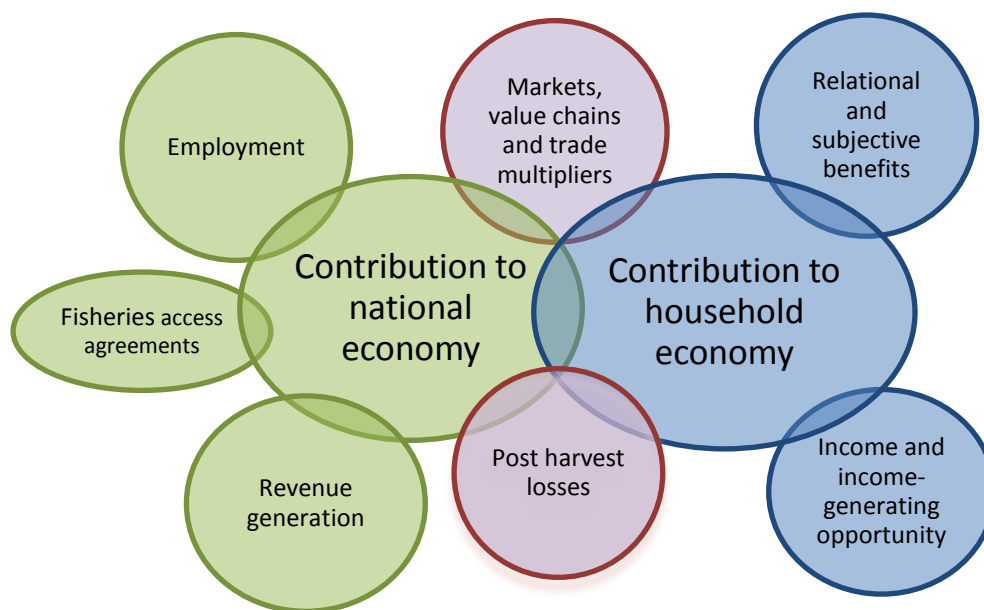


Figure 2: Main clusters emerging from the papers assessed within the theme of economic growth

3.1.2.1 Fisheries and national economies

The first cluster of articles examines the contribution of fisheries to national economies through three main pathways: (1) generation of revenues to national accounts from access payments, exports, taxation and license fees; (2) wages and income received by those employed in the sector; and (3) effect of multipliers and economic linkages within the regional/national economy (Appendix 3). The cluster is quite homogeneous in terms of the type of research undertaken, dominated by bio-economic modelling and the use of national and global data sets. Most of the documents are articles published in fisheries and economics journals. Amongst the 19 articles retained, four include modelling exercises and six contain literature reviews. The quality of the body of evidence is relatively low (Table 11), essentially due to the difficulty to provide any evidence of how positive contributions at the national level can be linked to pro-poor outcomes at the local and household level.

Table 11: Quality of the body of evidence for the cluster: Fisheries and national economies

Criteria	Score
Validity	17/38 = 0.45
Rigour	63/95 = 0.66
Reliability	18/38 = 0.47

At the national level, the evidence generated from studies using global and national data sets is used to highlight the opportunities for governments to maximise wealth in the fisheries sector. Fisheries can in theory be a means to generate rents that can be extracted and used to address poverty. While a consistent message is often advocated, the evidence is weak due to problems inherent to national and global data sets. While opportunities for poverty reduction through utilisation of rents, job and income opportunities are often discussed in the literature, these elements are rarely rigorously

substantiated. Evidence for the actual practice of rent extraction and its reinvestment in the fisheries sector or in poverty alleviation and resultant impacts is currently lacking.

In addition to the financial value of fisheries production, a number of authors have considered the employment contribution of fisheries to national economies. Employment is a useful metric as it provides a measure that relates to wealth distribution. However, a number of authors have demonstrated that, at least within the catching part of the fisheries, it is not possible to maximise both the value of fisheries production and employment. Within a developing country context, there is evidence to suggest that in conditions of chronic unemployment or where there are limited alternatives to fishing, the level of employment in the fishery that maximises the national revenue in the rest of the economy, and which will contribute most to the balance of trade, is larger than the employment that maximises resource rent (e.g. Wilson and Boncoeur 2008). The evidence is that fisheries, in particular more labour-intensive fisheries, can also provide important additional seasonal employment, support agricultural livelihoods and may also provide a ‘labour buffer’ function as people can move in and out of fishing activity depending upon other opportunities (e.g. Jul Larsen et al. 2003). While the evidence is still weak, it is suggested that fisheries can potentially provide employment opportunities for the poor, in particular in conditions where capital and investment are lacking and in post-conflict conditions.

Much of the evidence on the wealth that fisheries can generate is based on first sale price of fish and, as such, falls short of capturing the full social costs and benefits associated with fisheries. This partly reflects the lack of data on multiplier effects within national economies. Within the literature on fisheries and national economic development, the importance of multipliers and the role of fisheries as a driver of development has been argued but with little in the way of quantitative evidence of fisheries growth potential. Instead much of the literature focus remains on high value products for export, increasing economic efficiency and export markets. It is not clear from the literature how changes to increase efficiency and increase rents, including national certification schemes, actually benefit the poor. As with the wider literature on economic growth and poverty it is not the aggregate wealth that matters as much as the distribution of this wealth. As with all of this section, the lack of evidence suggests that it may be misleading to rely only on global figures to infer conclusions about impacts on poverty at the local level.

3.1.2.2 Fish trade and poverty alleviation

The second cluster of articles examines the contribution of the trade in fish to national and local economies (Appendix 3). The cluster is smaller but more diverse than the first cluster in terms of the research undertaken. The articles, which are mainly published in fisheries journals, make use of both existing national and global data sets and primary data. Amongst the 12 articles retained five are full or partial literature reviews and six are case studies or draw on case study material. The quality of the body of evidence is moderate as it is affected by the mix of global and local studies (Table 12) and some inconsistencies in the conclusions drawn from the studies within the cluster. As with the first cluster, the challenge remains to demonstrate the link between trade and pro-poor outcomes at the local and household level.

Table 12: Quality of the body of evidence for the cluster: Fish trade

Criteria	Score
Validity	12/24 = 0.50
Rigour	47/60 = 0.74
Reliability	15/24 = 0.63

As the section above highlighted, the development of fish trade, in particular for export, is often presented as a means for countries to generate wealth from fisheries and to take advantage of rising demand for fish products. The literature supporting this tends to rely heavily on global data sets that are, as Béné et al (2010) argue, essentially the compilations of foreign exchange earnings and/or

revenues derived from fish trade, not real evidence of the effects of these revenues on the national economy of the countries or the livelihoods of their populations. Using FAO data, Béné et al (2010) also found no demonstrable correlations between fish trade and economic and/or human development in sub-Saharan Africa. This may be partly because of the nature of the data. A number of studies have also highlighted, however, that fish trade is affecting the nature and distribution of benefits from fisheries at the local level. These papers draw on local examples to argue that the wealth generated through trade is not necessarily invested back into the fisheries sector or to the regions from which the fish resources are being extracted. Furthermore, the concern is raised that while increased supply may benefit the poor, declines in production might result in reduced quantities and qualities of fish and higher prices. However, relying only local examples makes it difficult to establish how consistent the evidence is.

Access to developing country resources by foreign fishers is another form of trade that has been able to generate significant incomes for national governments in a number of cases. However, there is no evidence to date to show how this income is redistributed and whether it is having a specific impact on poverty or that this is what it is intended for (e.g. Arthur et al. 2010). Furthermore, there is a risk that developing countries gain less from fishing agreements than the fishing companies involved and that these agreements can negatively affect local fishers. Evidence to date suggests that fisheries agreements based on comparative advantage arguments are most likely to be successful where there are few conflicts or contests over resource allocation (e.g. Namibia).

Within the literature, the focus has mainly been on the effect of globalisation and international trade on the local situation. Yet the contribution of local trade to national economies is also often presented as important, given that contribution of the capture fisheries sector to national GDP for many developing nations ranges between 0.5 and 2.5%. This suggests that the sector may support much greater output through multiplier effects and 'trickle-up' linkages in the economy. However, issues of local trade and multiplier effects have received much less attention. There is currently little evidence of the size of income and/or employment multipliers from fisheries and aquaculture although some studies report that there is strong qualitative evidence that fisheries can boost the amount of cash in circulation in rural areas, providing important opportunities for local market-driven development. The nature of trade therefore appears important but for local trade arrangements and value chains information is limited, inconsistent and fragmented. In addition, it is not clear how many people, and who, are employed in processing and ancillary activities (e.g. Allison et al. 2011). Finally, it is recognised that relations between actors are complex, with evidence that local traders and agents can develop reciprocal arrangements including loans and purchasing agreements but that these can, at times, be exploitative. While there is little known about the nature of local economies, it is clear that the local impacts of market innovations, such as the introduction of mobile phones and certification schemes are not straightforward and are highly context specific.

3.1.2.3 Fisheries value chains

The third cluster relates to the growing literature on value chains. This literature is extending the analysis beyond the technical assessment of efficiencies aimed at maximising net revenue to examine structure, function and wealth distribution associated with value chains. Such analysis is able to draw attention to the roles of different actors including fishers and farmers; the state; NGOs and certification schemes. The articles retained for this assessment examine aquaculture and capture fisheries value chains in Southeast Asia and Africa. Out of the ten articles that were retained -see Appendix 3- all are based on primary data and the quality of the evidence was consistently high (Table 13).

Table 13 Quality of the body of evidence for the cluster: *Fisheries value chains*

Criteria	Score
Validity	19/20 = 0.95
Rigour	45/50 = 0.90
Reliability	16/20 = 0.89

There are a number of consistent messages that emerge from the literature. Fish from small-scale producers can be supplied to both local and distant markets and there are often a diverse range of actors involved before the fish reaches the consumer, such that fish feature in a wide range of livelihoods. Power asymmetries are an important feature of value chains. The evidence suggests that, relative to other actors in the value chain, small-scale producers are often receiving the least benefit. The evidence also points to ambiguous relationships between producer and buyers (often traders and/or processors). These can involve various credit relationships that restrict bargaining power and can be exploitative. Informal credit and financial support play a strong role within the value chain. Demand for fish and the studies identify that the need of buyers to secure supplies of fish can also be exploited by producers at times when fish is scarce, with fishers able to demand sexual favours as well as money. The studies provide evidence of vertical integration, especially in export oriented trade for both capture fisheries and aquaculture, as a means to secure supplies. There is evidence from a limited number of studies that the role of the state can be diminished in global value chains as private sector actors, such as processing companies and aquaculture input suppliers become important sources of information, materials and credit. These studies also highlight the increasing role setting and enforcing standards associated with the emergence of fisheries and aquaculture standards that are beginning to shape markets.

Post harvest losses

The literature assessed in this cluster seeks on the one hand to provide some forms of evaluation of overall post-harvest losses, and on the other, to identify the ways in which these post harvest losses can be reduced. This cluster is relatively large but diverse, including articles published in both food and nutrition and fisheries journals. Out of the nine articles that were retained for this assessment - see Appendix 3- three are literature reviews, while the remaining six are based on primary data. Table 14 presents the quality of the body of evidence: while the research questions are fairly straightforward, assessing losses is more challenging in practice and a number of studies focused on very limited examples. Quantitative assessments are also limited.

Table 14 Quality of the body of evidence for the cluster: *Post harvest losses*

Criteria	Score
Validity	11/18 = 0.61
Rigour	37/45 = 0.82
Reliability	12/18 = 0.67

The overall message is consistent. Fish is a very perishable commodity and hence susceptible to high post-harvest losses. These losses occur throughout the food/value chain and can be either quantitative or qualitative (including both economic and nutritional). Quantitative losses are more serious and include fish discarded at sea and lost from the food chain through spoilage caused by insect infestation (often around 20%), poor handling and contamination. An FAO study (Kelleher 2005) suggested global discards of around 7.3 million tonnes, but with variations between fishing methods and regions (discards in shrimp fisheries may represent up to 90% of the catch). The literature suggests that discarding is low in artisanal fisheries where post harvest methods have usually been developed locally to utilise a wide range of species including low quality fish. Physical losses in these fisheries, suggested to be around 5%, typically depend on the time between catching

and processing/consumption but seasonality and larger volumes landed during peak season can increase loss and/or down-grading. Processing methods are often able to use downgraded fish and secondary processing chains have also emerged that make use of by-products and effectively reduce overall loss, also improving availability of nutrients to poorer consumers. Qualitative losses from downgrading may affect the fisher and/or processor but it can also mean that there are consumers that are able to access a nutritious food. There are very limited quantitative estimates of these forms of losses. Waste streams from aquaculture value chains, especially those that service export markets with processed product, are tending to decline rapidly as competitive pressures force innovation e.g. pangasius industry in Vietnam

3.1.2.4 Fishing and household economies

Articles within the final fisheries and economic growth cluster explore the question of the relationship between fishing and household economy: what sorts of benefits are derived from fish and fishing and are poor fishing people better-off than those who don't fish? How are these benefits realised? What is the evidence that these benefits can be enhanced? There is a large body of work associated with this theme and an extensive grey literature and the cluster of 15 papers retained (see Appendix 3) is relatively homogeneous. It includes three literature reviews, and eleven individual analyses, four of which are combinations of local case-studies and global data. The quality of the body of evidence can be considered relatively high (see Table 15).

Table 15: Quality of the body of evidence for the cluster: *Fishing and household economies*

Criteria	Score
Validity	20/30 = 0.67
Rigour	60/75 = 0.80
Reliability	19/30 = 0.63

Despite a relatively large number of studies, there remains a lack of precise information about the role of fisheries at the individual and household level and about how poverty relates to fisheries. What has been established is that fishers are not always among the “the poorest of the poor” and poverty can be both a consequence as well as a cause of resource degradation. People tend to be poor for reasons that extend beyond the fisheries sector and tackling poverty amongst fishers will require more than sectoral interventions. At the same time, both the retained literature and wider grey literature highlight the important roles that fisheries can play within household economies and the contributions that they can make to local livelihoods. Within the literature, the range of benefits that that inland and marine capture and culture-based fisheries can provide includes material benefits (through food – produced or purchased, income and employment) and the support of wider household livelihood strategies, for example, through seasonal contributions and safety nets. But benefits extend beyond these material/financial dimensions. Fisheries also have a role in supporting relationships and well-being within communities, often through reciprocal arrangements, access to fisheries and collective action. Even larger, although less tangible, benefits arise from the nature of the activity and from the sense of personal or collective identities and job satisfaction that can be derived from engaging in fishing activities. The literature highlights however the extent to which these fisheries contributions that are embedded within local cultural and social contexts are often downplayed in the wider debates on the role of fish and fisheries.

The literature also demonstrates that –contrary to what is often assumed- these fisheries are often locally regulated. The evidence goes some way to demonstrating that while fisheries are often referred to as ‘open access’, there are in fact often some institutional structures that regulate fishing activity at the local level that can serve to ensure that fisheries benefit poorer as well as wealthier households. Altering the nature of these institutions, or command over fisheries resources, can have significant effects on resource-poor, poorer groups, and indeed the wider community but less evidence is available to demonstrate whether development initiatives have been able to increase the

pro-poor nature of these arrangements. . A general weakness with this literature is that there are, as yet, no general models to explain the empirical evidence so the nature of these evidences remains series of individual local examples.

3.1.3 Aquaculture and economic growth

Aquaculture, as the fastest growing global food production sector, has now equalled and will surpass wild caught fisheries production. As a result, aquaculture will continue its increasing influence on global value chains and is likely to play a growing role in filling the gap between fish demand and supply for the world population. While production of high-value, primarily carnivorous species predominates in Europe, US and some other countries, it is in Asia that the production and supply of the majority of farmed fish and shrimp occurs. This includes the supply to both national and regional markets as well as to developed countries' markets, through increasingly commoditised global value chains.

This literature search and categorisation of papers led to the identification of three meta-threads:

1. Aquaculture contribution to the national economy
2. Aquaculture, households and livelihoods
3. Issues of scale and types of aquaculture

Within each thread a number of clusters have been identified as illustrated in Figure 6.

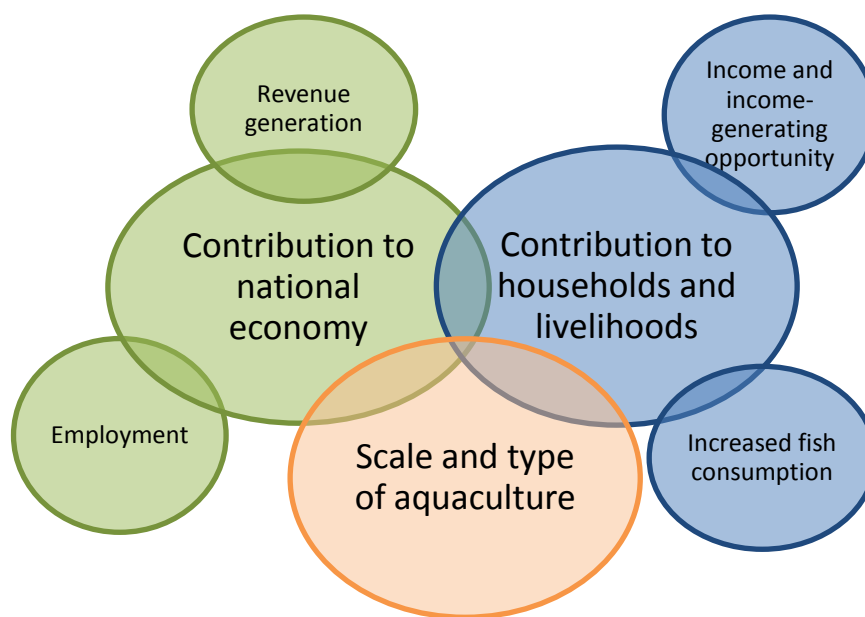


Figure 3: Categorisation of Meta and Sub clusters for Aquaculture: economic growth and poverty reduction

3.1.3.1 Aquaculture and national economies

From the literature search eight papers were retained, of which three were regional-based reviews, one was a model-based regional analysis, and four were national-based reviews. These eight papers were further divided into overall aquaculture development and species-specific reviews at both regional and national levels. Overall the quality of the papers was assessed as moderate (Table 16), with a noticeably stronger quality, choice and depth coming from Asian aquaculture compared to Africa or South and Central America.

Table 16: Quality of the body of evidence for the cluster: *Aquaculture and national economies*

Criteria	Score
Validity	10/16 = 0.62
Rigour	20/40 = 0.50
Reliability	5/16 = 0.31

There appears to be an increasing trend in the national and international literature for questioning the quality of primary and secondary data relating to causal links made between aquaculture development and poverty reduction. The literature also challenges the evidence for economic growth through aquaculture translating into demonstrable and inclusive benefits for poor people. The retained literature goes on to more critically present and analyse the impacts of two different categories of aquaculture systems: ‘immanent’ systems, that is, commercial, private and larger scale aquaculture projects which are vibrant and growing in Asia, and ‘interventionist’ systems, that is, systems (mainly small-scale subsistence aquaculture systems) that have been supported by bi- and multi-lateral development agencies (Belton and Little 2011). The literature points out that these two categories do not necessarily have the same effective contributions to economic growth and poverty alleviation. This discussion runs through a number of papers in this cluster under different guises. For example, as early as 1997, Lewis (1997), through an overview of the historical context of mainly donor-supported small-scale aquaculture in Bangladesh, questions the assumption that this category has, or will in the future, be able to generate beneficial outcomes for the lower income resource-poor farmers who engage in this type of aquaculture. On the other hand, data on aquaculture and economic growth at macro-level is available in countries such as Vietnam and Nigeria, where aquaculture now accounts for a significant share of national GDP. However, no tangible evidence/data was found in the literature to substantiate the expected trickle-down effects of tax revenues and foreign exchange earnings derived from these immanent systems on the welfare of lower income households, thus raising the question of whether they make an effective contribution to poverty alleviation.

3.1.3.2 *Aquaculture and households livelihoods*

Literature related to the household and livelihood theme is more common than for the previous cluster; 15 papers were retained for this cluster (see Appendix 3). These include 11 post-project reviews or evaluations (eight using primary data and two using secondary data), two PhD Theses, and one literature review. The availability of quality literature was noticeably prominent for Bangladesh. The overall standard of the papers was classed as moderate (Table 17). However, the retention rate of those with valid and robust empirical evidence bases was still relatively low compared to the overall number reviewed, of which the vast majority were lacking disaggregated data on household wealth, income status, and standardised controls. Also, they were often of (too) small sample size and of (too) small time duration to ensure a validity of findings.

Table 17: Quality of the body of evidence for the cluster: *Aquaculture and households livelihoods*

Criteria	Score
Validity	19/30 = 0.63
Rigour	44/75 = 0.59
Reliability	11/30 = 0.60

The overall evidence from the retained documents suggests that the benefits to household livelihoods through aquaculture development can occur in a number of ways. Income, employment generation and increased fish consumption have been observed for both producers and others in the value chain. Impacts on livelihoods can be seasonal and indirect. However, in the most rigorous analyses included in this assessment, it is recognised that despite targeted pre-project intentions, it is the slightly better-off farmers and households who tend to not just benefit the most but also to be able to

take up the technology and extension offered through the intervention/project. Some recent studies present however some new set of evidence that suggests that aquaculture can also benefit the poorer people in communities either as producers or through associated activities. This outcome is due to a number of factors. Undoubtedly social structures may impede the poor from benefitting but there is some evidence for aquaculture supporting social mobility. Access to ownership or rental of land and water resources is however still a considerable constraint for the poorest households in most developing countries. Some studies have looked at the importance of location in terms of sustainability of the production systems and direct and indirect consumption of lower income households, thus illustrating the key role of access to urban markets for both sales of fish as well as access to key inputs such as feed and fingerlings. Evidence from these studies suggests that, provided with the same project extension and resources, peri-urban small-scale fish farmers are more likely to generate higher incomes, net returns and longer-term financial viability, than (similar) small-scale fish-farmers in more remote rural areas. These rural producers however benefit more through direct consumption of fish. These findings are based however on limited samples and need to be confirmed through more systematic empirical research.

3.1.3.3 Issues of scale and types of aquaculture systems

Understanding the relationship between scale and other key characteristics of aquaculture systems is critical to assessing their impacts on poverty alleviation and economic development. If aquaculture is viewed as being a mechanism that can contribute to reducing poverty from a multi-dimensional perspective then clearly the trajectories through which poor peoples' lives are changed is critical to ascertain. A total of 16 papers were retained in this thread (Appendix 3). Of these ten were evaluations of a range of specific aquaculture production systems, including projects (representing interventionist aquaculture development) and commercial sectors (representing immanent forms of aquaculture development). Four papers were comparative reviews of different production systems, and the final two were reviews of cooperatives/ grouping of specific producers into associations. Ten of the retained papers used primary data and four secondary data, whilst two papers used both. The overall standard of the papers was classed as moderate, as shown in Table 18. The fact that the number of papers retained in this thread is the highest for the aquaculture clusters considered is due to the cross-cutting nature of these issues.

Table 18: Quality of the body of evidence for the cluster: *Issues of scale and types of aquaculture systems*

Criteria	Score
Validity	19/32 = 0.59
Rigour	38/80 = 0.48
Reliability	7/32 = 0.22

This thread is not about describing and defining the aquaculture production systems. Instead, it provides a means of presenting evidence related to the scale, complexities and, most importantly, evolution of aquaculture systems, globally. This is done with the aim of highlighting the evolving role of aquaculture in relation to poverty alleviation and the inclusion of poorer people within the process of aquaculture development. Alleviation of, reduction in, or escape from poverty have all been claimed from the adoption of aquaculture but evidence remains scant in terms of its geographical scale and temporal contexts. Whereas incremental changes have been validated for poverty alleviation and reduction, escape requires transformative change to households and communities, in general linked to the type of development seen in shrimp and pangasius industries across Asia. An important thread in the literature has been the critique, using empirical evidence, of the focus on interventionist approaches to small-scale rural aquaculture. There are two important issues related to this that were highlighted in the literature. The first is that the documented trend within aquaculture towards increasingly intensive production systems does not necessarily represent a threat to efforts to

alleviate poverty. The second is that while more intensive systems might be able to support poverty alleviation through increased production, employment and lower price fish to buy, intensification may come at the cost of increased risk of stock diseases (aquatic animal health), environmental degradation - related to intensifying any agricultural food production system. It may also lead to increased elite capture of resources ultimately negatively affecting access and entitlements of the poor. Another key issue identified in the retained literature is the impact of species selection in aquaculture on poverty-reduction. The introduction of non-indigenous species such as pangasius and tilapia (e.g. *Oreochromis niloticus*) has resulted in their rapid establishment as species affordable by poor consumers. Balancing the risks of such introductions with the alternative strategy of upgrading native species remains a challenge as both may have potential negative impacts on biodiversity. The impacts of aquaculture undermining fisheries on which the poor depend for food security through competing for resources or through such biodiversity loss is also an area requiring more robust evidence of costs and, benefits.

3.2 Mediating factors

The contribution of fisheries and aquaculture to food security, nutrition and economic growth and to poverty alleviation is not related simply to productivity and abundance of the natural system. These contributions are mediated through institutional arrangements and social norms. Formal and informal institutions, including property rights, markets and social networks all influence access and entitlement to resources. Similarly, age, gender, origin, caste, occupation and ethnicity can all contribute to determining the who, what, where and how much associated with fisheries and aquaculture and the benefits derived from them.

When considering the contribution that fisheries and aquaculture can make to alleviating poverty it is therefore important to understand the multiple and interacting aspects that create the constraints and opportunities to realising benefits from these two sectors and can make people vulnerable to change. In this section we will consider the issue of governance as it has been discussed in some of the fisheries and aquaculture literature and the specific issue of gender in relation to fisheries.

3.2.1 Governance reforms in fisheries

Articles within this cluster explore the question of the ways in which society organises to provide and recognise access and entitlement to fisheries and aquaculture and the benefits from them: what sort of institutions can support poor people? What role does the state and other actors play in determining this? What is the evidence that particular arrangements work? These are important questions and the literature is large and extensive with many papers identifying governance as critical in creating the right conditions for fisheries to contribute to poverty alleviation. The search identified a cluster of 16 articles (see Appendix 3). The cluster is heterogeneous and includes four literature reviews, six individual analyses and two studies that could be considered as systematic reviews. The quality of the body of evidence is moderate to high (see Table 19).

Table 19: Quality of the body of evidence for the cluster: *Governance reforms in fisheries*

Criteria	Score
Validity	21/32 = 0.66
Rigour	74/80 = 0.93
Reliability	27/32 = 0.84

Access to fisheries and the distribution of the benefits from fisheries and aquaculture are typically mediated through a range of institutions, both formal and informal, that emerge from the continuous interactions between individuals and groups within a social and cultural context. The combination of rules, institutions and contracts that exist across levels makes up the systems of governance. These

shape people's actions and decisions and, as a result, analysis has focused on the roles of institutions, of actors within them and of power relations in respect to institutions. Often the focus is on the role in relation to access to resources and conservation of fish stocks, rather than the distributional aspects.

Within a somewhat heterogeneous literature the role of the state and individual and collective action emerge as important but in different ways. There is a consensus in the literature that governments are not the only ones capable of addressing societal problems, needs and aspirations. People and communities, in a variety of ways and circumstances, have been, and are, actively engaging in managing fisheries, and influencing outcomes and governance has come to be seen as a matter for a range of public and private actors. Decentralisation, co-management and community-based management approaches have been, and are still, a strong focus within the fisheries literature. Yet the evidence indicates that the approach to implementing community-based and co-management has varied, with different levels and types of participation, institutional arrangements and different objectives. Furthermore, enforcement and outcomes have been highly variable, having some successes but remaining in many cases ineffective. Evidence of poverty alleviation is even more ambiguous and reviews of community-based and co-management initiatives highlight that, while there is evidence of tangible benefits in a number of individual cases, decentralisation can represent a means to extend political influence and control rather than to empower, or delegate authority to, local users. Reforms create spaces that can actually increase state, key local actors or private sector's influence in determining access and control over resources, undermining other local institutions, and possibly reinforce elite's control over resource policy, management, and allocation.

The evidence for how institutional aspects can be addressed to support poverty alleviation outcomes is mixed and unclear, reflecting the divergent positions that currently characterise debates on this issue. On one hand there is a large body of peer-reviewed and grey literature that suggest that the observed outcomes are the result of poor policy and practice, highlighting a need to introduce new institutional arrangements that focus on the role of property rights. This body of work draws on particular interpretations of the problems facing fisheries, emphasising the role of fisheries as commons in problems such as overfishing and overcapacity. In addition to the material that was retained and assessed through this review, some other high-profile documents found in the literature take a strong, position on this (e.g. Sutinen 2008). Evidence for reform reflects the interpretation of the governance challenge and is presented primarily in terms of the benefit to rights holders, environmental outcomes and efficiency. The evidence of the effectiveness of these measures in terms of poverty alleviation and reduction however remains weak.

Decentralisation is also identified as creating new challenges for agencies and institutional arrangements, with people required to work in new ways as they seek to respond to policy changes. Faced with these challenges, actors are able to act to mediate the influence of policy, variously supporting, neutral or even resisting policy objectives, often in ways that are not entirely predictable. This is identified as a key challenge within a second body of work that presents evidence suggesting that institutional reform may not be the most appropriate intervention and that even just because there are problems in open access situations, this does not necessarily mean that this particular institutional arrangement that is the main problem. Indeed, given issues of elite capture and rent seeking behaviours, introduced or reformed institutions are likely to generate unexpected outcomes that may disadvantage the poorest. These authors argue for an emphasis on understanding individuals' situations (including the poor), their constraints and capabilities – which may go beyond fisheries. In this respect, this second set of literature is able to provide a limited set of detailed evidence of how institutional change can affect people's human condition and the role of power and agency in realising particular outcomes in specific contexts. Yet it remains weak in its ability to extrapolate beyond the individual case without 'cherry-picking'.

Evidence indicates that it is possible to negotiate and develop decisions regarding the management and conservation of natural resources that benefit the poor. However, there is currently no single consistent framework to determine how well fisheries governance systems are performing (including for the poor) or to identify how these systems can be improved. What distinguishes the two positions in particular is how they interpret the governance challenge and the emphasis that they place on the role of property regimes in constraining economically rational individual behaviour. The challenges are essentially fisheries challenges, where the management problem lies in designing appropriate individual or collective access rights and institutions. The second position suggests that the governance challenge is a political challenge that extends beyond the fisheries sector. The emphasis is on the wider political, economic and historical context within which individual motivations are less clear cut and differentiated between actors. Individual agency results from individual context, capabilities and condition. Issues of knowledge and power and how these have become established are highlighted to a greater degree and become a much more important area for analysis. What characterises both positions is the lack of systematic evidence in the current fisheries literature of how these affect poverty outcomes (Béné et al. 2009).

3.2.2 Gender

Gender is a relational concept that considers the roles, responsibilities and relationships between men and women and their changing dynamics in social, economic, cultural and institutional contexts. Within the context of fisheries, gender should consider the interaction of men and women with the natural resource. Therefore the literature selected excludes papers whose title portrayed a focus on women, thereby assessing the extent to which gender issues, gender analysis and gender mainstreaming is addressed in fisheries research, and to assess the strength of the evidence from this research.

With 11 papers retained (see Appendix 3), the literature is relatively large. Out of the 11 papers, five are literature reviews, three are primary data based research and three use a combination of literature review and primary data based research. All 11 studies either use literature from case studies or data collected from case studies in developing countries. The papers were published in a range of journals which included fishery and development journals. Despite using the term gender in their titles and abstracts, 10 of the 11 papers had a predominant focus on women. The quality of the body of evidence is moderate; of the studies assessed, approximately equal numbers are of a high, moderate and low quality, as assessed according to the principles of rigour, validity and reliability. The overall quality assessment scores are show in Table 20. Furthermore, the comparatively small number of papers returned from the literature search as shown in Appendix 1 indicates a lack of research on gender issues in fisheries.

Table 20: Quality of the body of evidence for the cluster: Gender

Criteria	Score
Validity	11/22 = 0.5
Rigour	28/55 = 0.5
Reliability	7/22 = 0.3

The papers fall loosely into three categories, although each paper covers aspects of the other categories as well. These categories are: gendered labour divisions/role of men/women in fisheries; gender and livelihoods; and gendered participation in governance, management and decision making as shown in Figure 4.

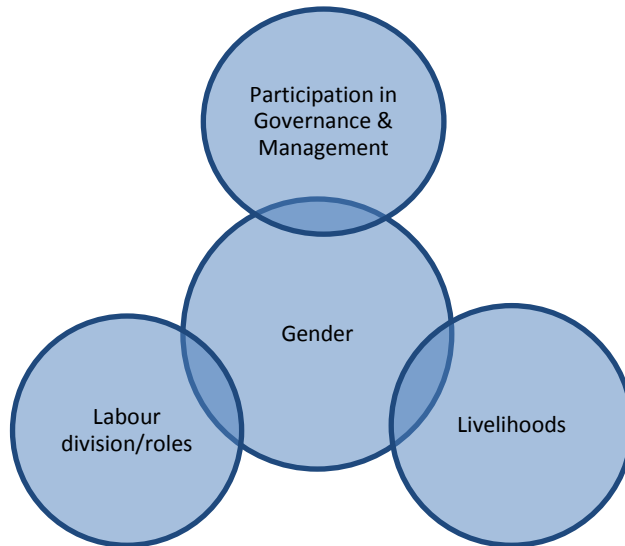


Figure 4: Main clusters emerging from the papers assessed within the theme of gender

Women's roles in fisheries are not well recognised. Indeed the assessment reveals a lack of disaggregated data collection and analysis which could enable comprehensive gender analysis. Instead most of the studies focus on women in fisheries; their roles, their lack of access to the natural resource, lack of credit and lack of participation in governance and management. A number of narratives relating to the issue of gender in fisheries emerge from the literature, essentially centred on gendered division of fisheries and household labour, household income and household security as well as HIV/Aids as a gender issue. Evidence to support these narratives is weak or too location-specific however to be generalised, partially due to the lack of disaggregated data and relevant information. At the same time a larger number of papers focussing more specifically on women (as opposed to gender) are found in the literature. Whilst some of these papers highlight differences between men and women, there is little research as to why these differences occur and what the gender issues are. In fact the evidence is strongest with regards to the role of women in economic and/or socio-cultural spheres, rather than on the gender dynamics (i.e. the drivers for these gender divisions). Nevertheless, all these papers demonstrate convincingly that women's roles and their contribution in fisheries are not wholly recognised, unrecorded and undervalued, and mainly invisible in national statistics.

4 Mapping of other relevant initiatives

The purpose of mapping other relevant interventions is to provide a detailed overview of recent and relevant research activities and programmes in this area. These were identified through professional networks, internet searches and email and telephone communication with key contacts. The main funding agencies and institutions, recipients and implementing partners and their level of interaction and collaboration were also identified.

4.1 Overview of recent and relevant research activities and programmes

Around 80 organisations, and their associated activities, were initially identified as having some relevance to fisheries and aquaculture with regards to economic growth, food security and nutrition. Fisheries and aquaculture focused initiatives were reviewed with respect to the degree to which they

incorporated economic growth, food security and nutrition in their programme or project design and/or their long term objectives.

Appendix 4 presents the initiatives that were reviewed, their geographical focus, topics of focus, key research questions or long term objectives, partners and collaborators, level of implementation or intervention and funding information (where available). A summary of the initiatives reviewed is given below.

The majority of initiatives reviewed take place in South East Asia, and Sub Saharan Africa, although projects do occur in Latin America, India and the Pacific Islands. Within South East Asia the countries of focus appear to be Cambodia, Vietnam, the Philippines, Sri Lanka, Timor Leste and Bangladesh. West Africa appears to receive marginally more attention with regards to programmes and activities than East and Central Africa.

Fisheries and aquaculture are addressed in research activities and programmes as either the thematic areas in themselves, or as part of broader themes. These broader themes include agricultural development, biodiversity, climate change, ecosystem services, rural development, livelihoods, coastal development and management, and natural resource management.

The long term objectives of the majority of initiatives included economic growth, food security and nutrition, to be achieved through changes to governance and natural resource management. There seemed to be a general consensus that fisheries and aquaculture are important and that programmes and interventions in these areas could result in enhanced contribution to economic growth, food security and nutrition although impact pathways were not clearly identified or generalised at best.

Food security appears to be most common focal area of the research activities and programmes, although broader issues such as poverty reduction, resource management, capacity building, governance, livelihoods, conservation, and climate change adaptation and resilience were frequent areas of focus. Some specific topics of focus included post harvest and value chain processes, microfinance, income, gender and increased productivity.

Initiatives operate at a number of levels; at a local level pilot projects and case studies (either in one country or a number of countries within the same region) were implemented with a view of scaling up. National and regional level activities and programmes sought to build capacity, strengthen institutions, influence policy and increase cooperation, coordination and engagement within government departments and among countries. Few initiatives were operating at an international level. A large majority of the programmes and research activities reviewed collaborate with Government departments and ministries in the countries in which they are working. Other partners include international and local NGOs, inter-governmental agencies and universities.

4.2 Messages from stakeholders

Fisheries and aquaculture are not always addressed as a separate issue and in a number of cases is combined with agriculture, and where this is the case they have a lower profile. The importance of addressing governance issues and developing political will to address fisheries challenges was highlighted by a number of stakeholders. It was suggested that the creation of a separate organisational or government body to specifically deal with fisheries and aquaculture can help raise their profile in policy debates, prevent them from being marginalised and help realise their benefits more explicitly. The example of the fisheries reform process which took place in Namibia was highlighted.

The beneficiaries of fisheries and aquaculture programmes are an issue of importance. Most fisheries programmes were either focusing on resource management or the poor as fish producers, with less emphasis on the poor as fish consumers. The dissemination of lessons learned, knowledge

sharing and the incorporation of this information into future programmes was highlighted as area of crucial importance by stakeholders. In addition, capacity building at the local and national level, in order for interventions and programmes to be long term and sustainable, was flagged.

4.3 Food Security

Food security has been a high profile issue especially following the spike in food prices in 2008. It appears to be the general consensus that fisheries and aquaculture are important in this respect and can contribute to food security in the future. A number of global initiatives on food security have been created recently and high level conferences have been held to discuss global food security issues. These include the following:

Initiatives:

- **New Alliance for Food Security and Nutrition** was launched under the US G8 leadership in 2012 and is a commitment by G8 nations, African partner countries and private sector partners aim to help lift 50 million people in sub-Saharan Africa out of poverty in the next 10 years by supporting agricultural development. At present nine African countries have signed up, these are: Benin, Burkina Faso, Côte d'Ivoire, Ethiopia, Ghana, Malawi, Mozambique, Nigeria and Tanzania. The New Alliance will:
 - help to reform the investment system to benefit the agricultural sector and stimulate investment in agriculture
 - help more farmers access markets by, for example, linking smallholder farmers to markets by improving rural roads
 - extend insurance services to smallholder farmers to help protect them from future droughts, crop failures or other catastrophes
 - increase access to innovative technology for smallholder farmers
- **UN Zero Hunger Challenge** was launched in April 2013 by UN Secretary General Ban Ki-moon and calls upon governments, farmers, scientists, business, civil society and consumers to ensure that 'every man, woman and child enjoy their Right to Adequate Food; women are empowered; priority is given to family farming; and food systems everywhere are sustainable and resilient' (UN, 2013). The challenge has five objectives:
 1. 100 per cent access to food for all, all year round;
 2. End to stunting among children under two because of a lack of nutrients during pregnancy and in the early days of life;
 3. Ensuring sustainable food systems;
 4. Doubling smallholder productivity and income; and
 5. Reduction in food loss, at the farmer level, through lack of suitable storage and reduction of waste of food by retailers and consumers.
- **UK Hunger Alliance** is a joint DFID-NGO consortium, which addresses food insecurity and under-nutrition and promotes predictable long term responses to food insecurity. Research is conducted to advocate key areas to overcome food insecurity
- **The Scaling Up Nutrition (SUN) Movement**, which was launched in 2010, unites people—from governments, civil society, the United Nations, donors, businesses and researchers—in a collective effort to improve nutrition. Within the SUN Movement, national leaders are prioritising efforts to address malnutrition. Countries are putting the right policies in place, collaborating with partners to implement programs with shared nutrition goals, and mobilising resources to effectively scale up nutrition, with a core focus on empowering women.

Conferences and summits:

- **Food Security Futures Conference**, 11th and 12th April 2013, CGIAR and FAO, focused on public-sector research relating to food security and nutrition, natural resources, and climate change.
- **Dublin Conference on Hunger · Nutrition · Climate Justice** – 15th and 16th April, 2013, Government of Ireland and the Mary Robinson Foundation – Climate Justice, focused on the linked challenges of addressing hunger, nutrition and climate justice
- **G8 Summit, Nutrition for Growth: Beating Hunger through Business and Science**, 8th June 2013, UK government, Brazil government and the Children's Investment Fund Foundation (CIFF), a global agreement was signed by world leaders. The Global Nutrition for Growth Compact commits countries and organisations by 2020 to:
 - improving the nutrition of 500 million pregnant women and young children
 - reducing the number of children under five who are stunted by an additional 20 million
 - saving the lives of at least 1.7 million children by preventing stunting, increasing breastfeeding and better treatment of severe and acute malnutrition.
 - **Global Oceans Action Summit for Food Security and Blue Growth**, 9th – 13th September 2013, focus will allow global leaders, ocean practitioners, scientists, representatives of civil society and the private sector to share experiences and demonstrate how combined action in partnerships for healthier and productive oceans can act as a driver of blue growth and shared prosperity

There have also been a number of high profile publications in recent years on food security. A selection of these was reviewed to evaluate the extent to which fisheries and/or aquaculture is incorporated. Whilst the UK Hunger Alliance report '*Small Scale, Big Impact - Smallholder agriculture's contribution to better nutrition*' (Wijeratna, 2013) and the All Party Parliamentary Group on Agriculture and Food for Development report '*Why No Thought for Food? A UK Parliamentary Inquiry into Global Food Security*' (Birch 2010) have little mention of the contribution that fisheries and aquaculture can make to food security and nutrition, the FORESIGHT review; '*The Future of Food and Farming: Challenges and choices for global sustainability*' (Foresight 2011) acknowledges that fisheries and aquaculture are important to nutrition and food security. The inclusion of fisheries and aquaculture is set within the contexts of sustainability, climate change, biodiversity and governance. Over-fishing is identified as a constraint of fisheries contribution to food security and one of the top 12 priority policy areas is ensuring sustainable fish stocks.

4.4 Economic growth

There are some differences in the way that fisheries and aquaculture are viewed with respect to economic growth. Within many programmes the contribution that aquaculture can make is more clearly identified and defined. However the influential '*Sunken Billions*' report from the World Bank (World Bank and FAO 2009) has generated interest in wealth-based approaches to management and there are a number of models being developed to indicate what the potential economic gains from generating economic rents might be. Perhaps as a result there is an emphasis in a number of programmes, including Conservation International and the NEPAD Partnership for African Fisheries on 'securing rights' for fishers. In West Africa the World Bank has a large fisheries project ongoing (the West African Regional Fisheries Programme) that is intended to develop local institutions and capacity to manage fisheries in order to generate rents that can be used to support national development. Across Africa there are also a number of initiatives to improve the environmental sustainability of fisheries through ecosystem based approaches to fisheries (with support from the FAO) and to develop Fisheries Improvement Plans (FIPs) as a move towards MSC certification. In aquaculture and capture fisheries more widely there is increasing attention being given to value chains and, in particular, on the effect of changes in value chains.

5 Conclusions

Data shows that fish consumption is high in small islands and low income fish-dependent states of tropical Asia and certain parts of sub-Saharan Africa. There is also a large body of evidence that demonstrates that fish producers (fisherfolk and fish-farmers) do consume a higher quantity of fish than the rest of the population. In relation to food and nutritional security, evidence from the literature assessed (essentially from developed countries) demonstrates that fish consumption can contribute to providing protective effects for a wide range of health issues, including incidence of stroke, high blood pressure, coronary heart disease, and possibly cancer. While the risks of intoxication/poisoning in some parts of the world are still prevalent, experts agree that, overall, the positive effects of high fish consumption largely overcome the negative effects associated with intoxication risks.

There is also strong evidence that fish is a valuable and highly-nutritious food. Fish, and in particular small fish, are important food in terms of micronutrients (bioavailable calcium, vitamin A, iron and zinc), oils and fats and they have the potential to make effective contributions to addressing critical nutrient deficiencies in developing countries. This is an important point, as the contribution of fish to food security is too often reduced to aggregate production and measured as a proportion of animal protein intake -thereby overlooking the important nutrient contribution.

Whilst there is strong evidence at the household level that both fishing households and fish-farmers consume higher proportions of fish than other households, there is no robust evidence that this higher intake results in improved nutritional status. There is some evidence that fish produced from aquaculture (and stocked fish from culture-based systems) can have an important role in terms of food intake but it is not clear how these roles complement (or otherwise) those of food intake of wild fish catch. Furthermore, it is recognised that even at the household level there may be important differences in access to the nutritional benefits of fish between men, women and children.

The indirect contribution of fish-related activities (fish capture, fish farming, fish trading, fish processing) to food security through income generation is unclear and not well documented. While a strong narrative exists in the literature, which states the potential role of these activities as a source of cash, very little robust data exist to quantify more rigorously this contribution. When data exist it does confirm the critical role of fisheries and aquaculture to the generation of income for those who can engage in these activities. Evidence on whether these revenues are actually used to improve household food or nutritional security is non-existing however.

Fish can provide other benefits to people at the local level; the evidence from the literature assessed suggests that an involvement in fishing can provide them with important material benefits (essentially income and employment) and support wider household livelihood strategies through specific contributions or as a safety net. Overall, the fisheries sector (including aquaculture) has grown faster than agriculture over the last 70 years, creating proportionally more employment than agriculture (in a large part for rural unskilled labour). While the average income for these workers may not be high, evidence suggests that in many instances the revenues of fishers are equal to or higher than for their neighbours. It seems therefore that the tension between the critical role that small-scale fisheries play in supporting employment and local economy in areas where other opportunities are non-existing and the pressure that this poverty prevention function imposes on the resource is growing. Yet no serious attempt to explore more rigorously the trade-off between these two processes has been proposed so far. In the absence of systematic analysis the debate remains essentially based on ideological/rhetorical arguments.

Fisheries also have a role in supporting relationships and well-being within communities, often through reciprocal arrangements and collective action. What has been established is that fishers are not always among the “the poorest of the poor”. Poverty can be both a consequence as well as a cause of resource degradation, and fishers and fishing communities tend to be poor for reasons that

extend beyond the fisheries sector itself. Tackling poverty amongst fishers will therefore require interventions that reach beyond the sectoral approach. These findings challenge some of the conclusions put forward by other widely quoted reports which insist that the only solution out of poverty is through reduction of fishing effort and better resource management (e.g. World Bank and FAO 2009).

While fisheries can make positive contributions to households, there is also well documented evidence of less positive impacts as a result of the vulnerability of fishing communities to a whole combination of sometimes reinforcing risks to health. These health issues include high exposure to water-borne disease, malaria, but also STDs and HIV/AIDS. Furthermore, fishing is identified as one of the most dangerous occupations in the world (including both developed and developing regions).

Women's roles and their contribution to fisheries are also not wholly recognised, and pass unrecorded and undervalued. These vulnerabilities and gaps in current knowledge have important practical implications for the types of safety nets that are developed for fishers and fisheries-dependent group. The way in which international commitments to gender equality can be achieved requires further attention.

The value of fish as a commodity makes them an important source of income at the household, community and in some cases national level. This is reflected in the statistics that present fish as one of the most traded commodities from developing countries. The economic (as opposed to food) value of fisheries highlights the potential role of fisheries in generating rents that can be used to address poverty. Analysis using national and global data sets has highlighted the potential returns and suggested opportunities for poverty reduction through rent utilisation, jobs and income. However, at this time, there is a lack of rigorous analysis and empirical evidence that rent extraction and its reinvestment in the fisheries sector or in poverty alleviation, results in actual poverty reduction. The debate seems also misinformed by the systematic use of few case studies chosen for their specific context - high value and well-managed fisheries and small population with limited dependence on fisheries and aquaculture for nutrition or employment (Namibia, Mauritania).

Fisheries access agreements are an example of how fisheries have been able to generate significant income for national governments in a number of cases but, again, there is currently little evidence that demonstrates that such income has been redistributed and is reducing poverty (should this pro-poor objective have been the original intention). There remain a number of critical assumptions about the redistribution of wealth but few concrete instances from which lessons can be learned or practices transferred. In fact experiences from other sectors (forestry, mining, oil) have shown high risk of rent seeking/elite capture in the situation of poor governance that characterises developing countries. The fundamental difference with these mining/oil sectors in the case of fisheries is the high dependence of a large number of resource-poor on the sector, raising the question of whether it is actually worth attempting to shift from the current labour-intensive condition that still characterises a large number of developing countries to a more capital-intensive sector (sine quo none condition for the creation of rent).

A further source of income from fisheries is the trade in fish and fish products. This is a complex area and the evidence from the literature suggests that fish trades can be important sources of wealth, but there is currently a lack of evidence on how this contributes to poverty alleviation. While a number of studies have used trade statistics to demonstrate the aggregate wealth that can be gained from fish export revenues and international trade, it has not been possible yet to demonstrate any tangible correlation with food security or human development at national or local levels. There is suggesting evidence that wealth generated through international trade is not necessarily invested back into the fisheries sector or in the regions from which fish resources are being extracted. Furthermore, the concern has been raised that while increased fish supply may benefit the poor, declines in production might result in reduced quantities and qualities of fish and higher prices. However, the strength and consistency of such evidence is not clear as it is based only on local examples. The literature on

fisheries and trade also highlights the potential of local trade in fish and access to fish and the important effect of multipliers as drivers of local development. Yet this is an area where it has been difficult to provide quantitative evidence. The uncertainty as to how fisheries can contribute to poverty alleviation is perhaps one of the reasons that fisheries have not featured strongly in national economic development policies and country Poverty Reduction Strategy Papers (PRSPs).

The literature on the benefits from fisheries repeatedly draws attention to issues of access to and control over fisheries resources, together with how their benefits of fisheries systems are distributed. While there are important differences in the literature with respect to where the emphases for intervention should lie, there is broad agreement that there is no single type of institutional arrangement or role for state and non-state actors (including the private sector) that will deliver beneficial outcomes for the poor in all cases. This points which emerged clearly from this review, was also highlighted few years ago by the Commission on Fisheries Resources (WHAT 2000). There is still a lack of consistent frameworks for use in determining how well fisheries governance systems are performing (including for the poor) and identifying how they can be improved.

There is an increasing diversity of aquaculture systems that have both direct and indirect effects on communities where the activities are concentrated. The potential for aquaculture to effectively reduce poverty through its contribution to food security and economic growth has only been established in a limited number of contexts. This is partly because of the way that poverty is treated in the aquaculture literature, with few studies disaggregating the effects by the wealth and/or income status of target farmers or considering the sustainability of outcomes over a realistic time frame. Similarly, while production of *Pangasius hypophthalmus* in Vietnam, shrimp in Thailand, China and Bangladesh has demonstrably made a contribution to economic growth, incomes, employment and foreign exchange at national economic levels, it is not clear in the peer reviewed literature whether, how and to what extent these have made any difference to local poverty issues.

5.1 Knowledge gaps

The assessment of the evidence has identified a number of gaps and challenges facing researchers. Currently, there are important components of fisheries and aquaculture that are not accounted in national statistics and where they are the figures are often inaccurate or grossly under-estimated. This assessment has identified the relationship between men and women and establishing their roles and contribution through gender analysis, and, health and safety within the fisheries sector as two such components that require attention. With regards to aquaculture the main knowledge gap is the lack of papers in the peer reviewed literature exploring the causal relationships –either positive or negative–between aquaculture development and food security, economic growth, and impacts on poor people. Similarly rigorous socioeconomic analyses of commercial aquaculture activities in developing countries and the impact of different production systems on lower income households are still lacking. More globally, a general concern across the evidence assessed in both fisheries and aquaculture is that it is not always clear how poverty is being conceptualised, articulated or measured. Addressing fisheries issues in a developing country context for instance does not necessarily mean addressing poverty, and fisheries research would in that sense benefit greatly from the wider literature on the nature of poverty found in the development literature.

There are many areas where evidence is currently weak and further research could reduce current uncertainties. A major weakness that has been identified is in the evidence of the ways in which fish production, wealth and changes in the availability of fish translate into developmental benefits, especially for the poor. In other words, how they reduce poverty. Even in the well-studied area of nutrition there are still limitations to the evidence and persistent problems in demonstrating the impact of fish availability on micronutrient status or other functional outcomes (e.g. cognition, infections, growth and development). More studies are needed on how fish contribute to the diets of the poor within their household food strategies.

Poverty reduction is recognised as not being about aggregate production of fish, yet these metrics still dominate some of the analysis of the contribution that fisheries can make to poverty alleviation. More evidence is needed in particular on the distributional aspects of benefits, recognising differentiated access and entitlement to fish resources, even within households, and how this could be improved. The assessment also revealed a wealth of evidence of the benefits from fisheries and aquaculture at the local level and of the effect of different aspects of change. This scale aspect is a critical consideration as analysis at different scales has led to different conclusions in some instances. The understanding of the possible pathways and alternative arrangements that could benefit the poor could be enriched through further analysis of this evidence through a global study that could capture and quantify more rigorously and in a more systematic manner the contribution of fisheries to poverty alleviation and food and nutritional security spanning both national and household levels.

The value chain literature is increasing and developing. The analysis provides an opportunity to move beyond the analysis of trade statistics and is beginning to explore the power relations within value chains and the effects of change on value chains and the actors associated with them (e.g. Tran et al. 2013). This is a promising area given the rapid pace of change and global nature of trade in fish. Certification has been seen as a way of addressing the power asymmetries within value chains but the evidence suggests that the introduction of certification schemes plays out within a particular political and economic setting and may have unintended social consequences. This merits further research.

There is a pressing need to assess how different types of aquaculture systems and value chains contribute to poverty alleviation, and the mechanisms through which this is achieved. There is also scope for more analysis of regional trade and of the value chains associated with aquaculture inputs as this is currently limited. Finally, fish represents a source of nutrition as well as income. Including this aspect in value chain analysis to examine changes in nutritional value and who benefits from this in different value chains and resulting from changes in value chains could also be useful. With evidence that aquaculture may produce different fish products compared to capture fisheries, and that there are important interactions and interdependencies (e.g. through competition for water, use of fish seed and fish for feed and pollution), there arise many questions needing answers concerning who benefits, and at what and whose cost.

Finally, more tools and methods are urgently required to estimate the impacts of global drivers on food security at local level. Equally, the 'big picture' is not necessarily easier to draw. For example, the uncertainty induced by climate change on the dynamics of fish stocks is complicated by the lack of reliable data about small-scale fisheries. As a result most of the attempts to estimate the effect of these global drivers are still highly hypothetical and rely on questionable assumptions and/or methods. Even the exact number of fish-dependent people in the world is still unclear. While none of the documents included in this assessment propose a rigorous way to estimate this number, one recent global initiative made a first valuable attempt in that direction (World Bank, FAO, WorldFish Center 2011).

While the question of environmental impact is outside the scope of this study it is important not to downplay the environmental impact of aquaculture. Critical uncertainties remain in relation to the use of exotic and/or domesticated native species in aquaculture that have not yet been addressed in a systematic manner. This is an area of considerable debate but with little evidence. In contrast the environmental impact of production systems becomes now far better understood and quantified. A recent review for instance (Hall et al. 2011), using a Life Cycle Analysis approach and secondary data available in the literature, managed to compare the environmental impact of 13 species groups in 18 countries, covering a vast range of production systems, habitats and feed types. The risk is that policies may be developed that constrain opportunities to develop aquaculture that can address important local poverty issues on the basis of assumptions about risk.

Appendix 1: Terms of Reference

Terms of Reference

Introduction

This document sets the terms of reference for a scoping review whose main aim will be to provide DFID with a robust review and analysis of evidence in the field of fisheries and aquaculture research. The findings of the review will then be used by DFID to evaluate its involvement in this field of research.

This exercise will consist of four main elements:

- In depth review of evidence related to fisheries and aquaculture in developing countries and their impact/relationship with economic growth, food security and nutrition;
- Exhaustive literature review of peer reviewed sources looking at this area of research;
- Comprehensive mapping of other relevant interventions in this area (both on-going and/or recently completed);
- Verification and peer-review of evidence presented through a discussion workshop (or similar event) to be carried out by a panel of renowned experts.

These activities are to be carried out over a period -to be agreed with DFID- of **maximum 8 weeks**. The scoping review team will constitute of 1 or more independent expert, **up to a maximum of 4**, who will liaise with two DFID technical advisers from Research and Evidence Division (RED). The maximum budget available is £50,000. Commercial issues will be key in the award of this contract so those able to deliver a saving on this will have an advantage.

This is a desk based piece of work and therefore the researchers will not be expected to travel overseas for the purpose of their investigation, however travel to London to visit DFID HQ should be expected on at least two occasions (at the beginning and the end of the exercise).

The information within this document should be considered in addition to any DFID guidance and procedures on conducting impact/mid-term reviews (do we have any guidance will we supply).

Objective of the proposed exercise and expected outputs

The main aim of this piece of the scoping review is to conduct a review and analysis of key research and evidence relating to the fisheries and aquaculture sector in developing countries and its relationship with economic growth and nutrition and food security. Other main outputs, as outlined above, will include a mapping of current and planned research in this area.

The analysis will be used to inform a DFID-wide discussion to review the evidence for and against DFID's involvement in this field of research and identify where it can add value in relation to other [on-going] research initiatives.

The three main outputs that will be expected from the consultant(s) are described below in more detail.

1. Review of evidence related to fisheries and aquaculture in developing countries and their impact/relationship with economic growth, food security and nutrition:

i) This should cover both:

a. Peer reviewed sources; and

b. Evidence arising from applied field research and technical assistance programmes implemented by international donor agencies and government ministries in the field of fisheries development.

c. The review of applied field research should also provide evidence of interventions that were successful in putting research into use, including -for instance- through design and implementation of an effective outreach and/or communication strategy.

ii) Evidence from this analysis will be presented in a comprehensive report in to be submitted to DFID by the agreed deadline.

3. Comprehensive mapping of other relevant interventions in this area (both on-going and/or recently completed).

i) The aim of this component is to provide DFID with a detailed overview of all other recent and relevant research activities and programmes in this area. This should include all relevant on-going interventions, as well as those that have been completed in the past three years and those that are currently planned and expected to be launched over the next year.

ii) This component should also involve a stakeholder analysis of the main funding agencies/institutions, recipients and implementing partners that will establish who these are and their level of interaction/collaboration.

4. Verification and peer-review of evidence presented through a discussion workshop (or similar event) to be carried out by a panel of renowned experts.

i) The findings and results that will be obtained from the activities described above will have to be verified through a peer review process to be conducted through a discussion workshop or similar process.

ii) The researchers will be responsible for and expected to organise and conduct this process and to liaise with the DFID technical advisers to agree the details, format, dates and logistic arrangements of any event.

Duration and timeline

The review is expected to take place between January and February 2013 with final outputs to be delivered by early March 2013 at the very latest (final deadline to be agreed with DFID staff). Inputs should be in the region of 30 days per researcher (also to be agreed with DFID staff). These should include preparation, reading, travelling time, interviews with stakeholders, review and analysis of relevant literature sources, writing of the final report, at least 1 day to be devoted to the running of the discussion/verification workshop and presentation of results, plus at least another day to respond and address any comments obtained as part of the latter.

Reporting

The review team will report to the DFID lead advisers in charge of this project.

The review team will report weekly to the DFID lead advisers sharing and communicating progress

The final report will consist of a main report structured as described in this document, supplemented by a 2 page executive summary setting out the review's main findings.

Appendix 2: Methodology

In order to conduct this assessment, the team of consultants adopted a six-step methodological protocol, as follow:

1) Sourcing of literature

First, academic research documents, i.e. journal articles, books and book chapters, government and international institution studies, reports, working papers and forthcoming papers, and other grey literature sources were searched⁷. For this, online electronic databases, specific websites, general search engines, citation tracking and personal contacts were utilised to ensure that both published and unpublished relevant studies were identified and scanned. In particular the following electronic search engines were used:

- Science Direct <http://www.sciencedirect.com/>
- Google Scholar <http://scholar.google.co.uk/>

Websites of institutions involved in programmes and research projects relating to fisheries and aquaculture in relation to economic growth, food security and nutrition were searched for existing information and were contacted with requests to provide information about new programmes and emerging evidence.

2) Screening and selection

Search terms

The search terms were initially kept broad to ensure the identification of as many eligible studies as possible. A tiered search term system based on keywords⁸ was then developed further through an iterative scoping process. A search database recording the date and means of each search was created to store records of the sources consulted, keywords used and the number of papers returned from the search; see Appendix 5.

Inclusion and exclusion criteria

To ensure that studies included in the assessment were accessible, relevant and of appropriate academic standard, five inclusion/exclusion criteria were applied:

- Language - documents included were primarily documents published in English and French. However where appropriate, key-documents in other languages were also considered and clearly labelled
- Year of publication - the focus was initially on documents published after 1990. However older documents which appeared seminal were also considered when more recent material was not available.
- Academic quality – peer-reviewed articles which satisfied the first two inclusion criteria above (language and year of publication) were retained. Non-peer reviewed materials (books and book chapters, government and international institution studies or reports, working papers, forthcoming papers, and other grey literature) satisfying these criteria were scrutinised further and their academic merit assessed before decision of final inclusion was made. Only non-

⁷ Non-scientific and/or advocating documents (e.g. blogs) were excluded.

⁸ The first tier used the primary keywords 'fisheries' and 'aquaculture' or equivalent (e.g. fish-farming), the second tier used the keywords and/or phrases 'economic development', 'poverty alleviation', 'food security' or 'nutrition', and the third tier focused on non-fisheries/aquaculture aspects such as 'gender', 'wellbeing' or 'human rights'.

peer reviewed material showing an academic quality of a level similar to peer-reviewed articles were retained.

- Geographic area: Studies relating to developing countries were selected whereas studies with a focus on developed countries were excluded.
- Topical relevance: Only studies which the content of which was recognised as relevant by the team member to the study were selected.

3) Characteristics of the studies

Two hundred and two papers were retained for assessment. For each of the studies that were retained, characteristics were recorded as follows:

- Data source of the study - primary data-based / secondary data-based / (systematic) literature review / meta-analysis
- Scale of the study –data generated through small-scale sampling (case studies) or through global data sets (or partial combination of both)

An ex-post analysis shows that the majority of studies retained used data derived wholly or partially from secondary sources as shown in Figure 1 including, national and global datasets and databases. The analysis also reveals that the majority of studies used data generated wholly or partially through small-scale sampling such as case studies (Figure 2).

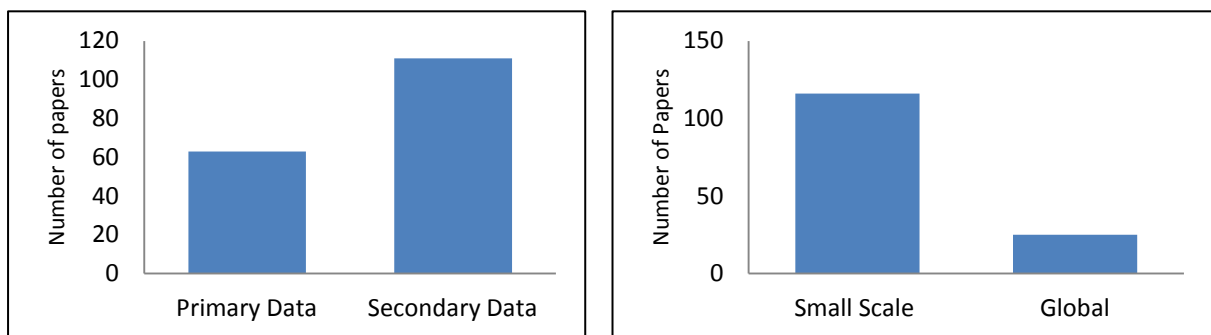


Figure 1: Data source across of the studies retained **Figure 2: Scale of studies retained**

4) Quality of the research

For each retained document, the academic quality of the research was assessed through a three-criterion evaluation system: rigour, validity and reliability. The degree of rigorousness of a study refers to the scientific rigour of the methodological protocols and methods adopted; the validity refers to whether the findings are substantiated and whether or not the study does what it says it will do; and the reliability relates to the repeatability of the study's methodology. A quality assessment checklist was produced to assist the quality appraisal process, and is presented in Table 1 (adapted from ESRC, 2003, Petticrew & Roberts, 2006 and Gough, 2007).

Table 1: Criteria used to assess the quality of the research at the article level

Criteria	Yes	Partial	No	N/A
Validity <ul style="list-style-type: none"> • Are the findings substantiated by the data and has consideration been given to limitations of the methods that may have affected the results? • Are there problems in applying the method to some research question(s)? 				
Rigorousness <ul style="list-style-type: none"> • Is the context or setting adequately described? • Is (are) the research question(s) clear? • Is the method used appropriate to answer the research question(s)? • Is the method applied correctly? • Is there evidence that the data collection was rigorously conducted to ensure confidence in the findings? 				
Reliability <ul style="list-style-type: none"> • Is the data analysis rigorously conducted to ensure confidence in the findings? • Is the methodology adequately described to ensure confidence in the findings? 				

Each of the articles were assessed using the nine questions listed in Table 2. A coding system was used to record the evaluations ('yes' = 1; 'partial' =2; 'no' = 3; N/A = 4) and to aggregate them by criterion (validity; rigorousness; reliability) for each cluster of articles, using an Excel spreadsheet. The frequency of occurrence of 'yes'-answers was then counted⁹ and the percentage scale maximum (PSM) technique used to score clusters in a way that makes them comparable¹⁰.

5) Evaluation of the quality of body of evidence

Based on their research questions and their findings, the selected documents were then grouped into thematic clusters of documents discussing specific issues. Where further thematic sub-categorisation appeared possible and relevant, the clusters were further divided into sub-clusters. The body of evidence was then evaluated by aggregating the quality of research scores obtained through step 2.4 above for each of the document in the cluster/sub-cluster. The results were then summarised using three following criteria:

- Technical quality of the body of evidence based on the descriptors in Table 4;
- Size of the body of evidence: large; medium; small (Table 5);
- Consistency of the body of evidence based on the descriptors presented in Table 6

⁹ Except for the second question of the validity criterion ("Are there problems in applying the method to some research question(s)?"), for which the number of occurrence of 'no'-answers was counted.

¹⁰ For illustration a score of 17/20 obtained from aggregating a cluster of 10 articles under the reliability criterion would signify that altogether the 10 articles have been evaluated with 'yes' 17 times (out of a maximum possible of 20 times), yielding an overall PSM score = 0.85 for the reliability criterion.

Table 4: Criteria for the quality of the body of evidence

Quality of the body of evidence	Definition
High	Many/the large majority of single studies are assessed as being of a high quality, demonstrating adherence to the principles of rigour, validity and reliability.
Moderate	Of the single studies, approximately equal numbers are of a high, moderate and low quality, as assessed according to the principles of rigour, validity and reliability.
Low	Many/the large majority of single studies are assessed as being of low quality, showing significant deficiencies in adherence to the principles of rigour, validity and reliability.

Table 5: Size criteria for body of evidence

Size of body of evidence
Large - more than 10 documents
Medium - between 6 and 10 documents
Small - 5 or fewer documents

6) Synthesis

Finally, a clear, accessible and concise synthesis of the main findings was presented for each of the cluster/sub-clusters within the themes shown in Table 7.

Table 7: Main themes considered in the assessment

Dimension	Themes
Outcomes	Food Security
	Nutrition
	Health
	Economic development
Mediating Factors	Governance
	Gender

Appendix 3: Papers Assessed by Section

Introduction, approach and methods

- Allison, E.A. 2011 Aquaculture fisheries poverty and food security. WorldFish Center, Penang
- Conway, G. 2012 One Billion Hungry: Can we feed the world? Comstock Publishing Associates, Ithaca and London
- ESRC UK Centre for Evidence Based Policy and Practice: Working Paper 11, 2003, 'Fit for purpose? Assessing research quality for evidence based policy and practice'
- FAO 2012 State of fisheries and aquaculture, FAO, Rome
- FAO 2009 State of fisheries and aquaculture. FAO, Rome
- Gough D (2007) Weight of evidence: a framework for the appraisal of the quality and relevance of evidence In J. Furlong, A. Oancea (Eds.) Applied and Practice-based Research. Special Edition of Research Papers in Education, 22, (2), 213-228
- Mark Petticrew & Helen Roberts, 2006, Systematic Reviews in the Social Sciences: A Practical Guide, Blackwell Publishing
- World Bank, 2011, The Global Program on Fisheries Strategic Vision for Fisheries and Aquaculture
- Worm, B., Barbier, E. B., Beaumont, N., Duffy, E., Folke, C., Halpern, B. S., Jackson, J. B., Lotze, H., Micheli, F., Palumbi, S., Sala, E., Selkoe, K., Stachowicz, J. & Watson, R. 2006. Impacts of Biodiversity Loss on Ocean Ecosystem Services. Science 314(5800): 787-790

Food security, nutrition and health

Fish, nutritional security and health

Fish and nutritional security

- Bonham, M. P., E. M. Duffy, P. J. Robson, J. M. Wallace, G. J. Myers, P. W. Davidson, T. W. Clarkson, C. F. Shamlaye, J. Strain & M. B. E. Livingstone. 2009. Contribution of fish to intakes of micronutrients important for foetal development: a dietary survey of pregnant women in the Republic of Seychelles. Public Health Nutrition 12(09):1312-1320
- Kawarazuka, N. & Béné. C. 2011. The potential role of small fish species in improving micronutrient deficiencies in developing countries: building evidence. Public Health Nutrition 14(11): 1927-1938
- Karapanagiotidis I.T., Yakupitiyage A., Little, D.C., Bell M.C., & Mente, E. 2010. The nutritional value of lipids in various tropical aquatic animals from rice–fish farming systems in northeast Thailand. Journal of Food Composition and Analysis 23: 1–8
- Kongsbak, K., Thilsted, S.H., & Wahed M.A. 2008. Effect of consumption of the nutrient-dense, freshwater small fish *Amblypharyngodon mola* on biochemical indicators of vitamin A status in Bangladeshi children: a randomised, controlled study of efficacy. British Journal of Nutrition 99, 581–597

Larsen, R., Eilertsen, K., & Elvevoll, E.O. 2011. Health benefits of marine foods and ingredients. *Biotechnology Advances* 29: 508–518

Lund, E.(in press). Health benefits of seafood; Is it just the fatty acids? *Food Chemistry*

Tacon, A. & Metian, M. 2013. Fish Matters: Importance of Aquatic Foods in Human Nutrition and Global Food Supply. *Reviews in Fisheries Science* 21(1): 22-38.

Roos, N., Islam, Md. M. & Thilsted, S. H. 2003. Small indigenous fish species in Bangladesh: contribution to vitamin A, calcium and iron intakes. *Journal of Nutrition* 133: 4021S-40126S

Roos, N., Chamnan, C., Loeung, D., Jakobsen, J. & Thilsted, S.H. 2007. Freshwater fish as a dietary source of vitamin A in Cambodia. *Food Chemistry* 103: 1104-1111

Roos, N., Wahab, M.A., Chamnan, C. & Thilsted, S. H. 2007. The role of fish in food-based strategies to combat vitamin A and mineral deficiencies in developing countries. *Journal of Nutrition* 137: 1106-1109

Thilsted, S.H. 2012. The potential of nutrient-rich small fish species in aquaculture to improve human nutrition and health. In R.P. Subasinghe, J.R. Arthur, D.M. Bartley, S.S. De Silva, M. Halwart, N. Hishamunda, C.V. Mohan & P. Sorgeloos, eds. *Farming the Waters for People and Food. Proceedings of the Global Conference on Aquaculture 2010, Phuket, Thailand. 22–25 September 2010.* pp. 57–73. FAO, Rome and NACA, Bangkok

Fish consumption and nutritional links to health

Allison, E.H., Delaporte, A., & Hellebrandt de Silva D. 2012. Integrating fisheries management and aquaculture development with food security and livelihoods for the poor. Report submitted to the Rockefeller Foundation, School of International Development, University of East Anglia Norwich, 124 p. (Note: assessed section 2.5 of the report)

Domingo, J. 2007. Omega-3 fatty acids and the benefits of fish consumption: Is all that glitters gold? *Environment International* 33: 993–998

Hoekstra, J., Andy Hart, A., Owen, H., Zeilmaker, M., Bokkers, B., Thorgilsson, B., & Gunnlaugsdottir, H. 2013. Fish, contaminants and human health: Quantifying and weighing benefits and risks. *Food and Chemical Toxicology* 54: 18–29

Lund, E. (in press) Health benefits of seafood; Is it just the fatty acids? *Food Chemistry*

Zatsick N. & Mayket P. 2007. Fish Oil: Getting to the Heart of It. *Journal for Nurse Practitioners* 3(2): 104-109

Molgó, J., Laurent, D., Pauillac, S., Chinain, M., & Yeeting B. 2010. Special issue on “Ciguatera and Related Biotoxins”. *Toxicon* 56: special issue

Sidh, K. 2003. Health benefits and potential risks related to consumption of fish or fish oil Regulatory. *Toxicology and Pharmacology* 38: 336–344

WHO-FAO 2010. Joint FAO/WHO expert consultation on the risks and benefits of fish consumption. *FAO Fisheries and Aquaculture Report No. 978*, 63 p.

Zheng, J., Huang, T., Yu, Y., Hu, X., Yang, B., & Li, D. 2012. Fish consumption and CHD mortality: an updated meta-analysis of seventeen cohort studies. *Public Health Nutrition* 15(4): 725-737

Fishers and health risks associated to fishing activities

Béné, C. & Merten, S. 2008. Women and Fish-for-Sex: Transactional Sex, HIV/AIDS and Gender in African Fisheries. *World Development* 36(5), 875-899.

Entz, A., Prachuabmoh V., van Griensven F. & Soskolne V. 2001. STD history, self treatment, and healthcare behaviours among fishermen in the Gulf of Thailand and the Andaman Sea. *Sexually Transmitted Infections* 77: 436–440

FAO. 2000. *The State of World Fisheries and Aquaculture. The State of World Fisheries and Aquaculture*. Rome: Food and Agriculture Organization of the United Nations.

Howard A.F.V., Zhou G., & F.X. Omlin 2007. Malaria mosquito control using edible fish in western Kenya: preliminary findings of a controlled study *BMC Public Health* 2007, 7:199 doi:10.1186/1471-2458-7-199

Jeebhay, M.F., Robins, T.G., Miller, M.E., Bateman, E., Smuts, M., Baatjies R. & Lopata A.L. 2008. Occupational Allergy and Asthma Among Salt Water Fish Processing Workers. *American Journal of Industrial Medicine* 51: 899–910

Kaplan, I.M., & Kite-Powell H.L. 2000. Safety at sea and fisheries management: fishermen's attitudes and the need for co-management. *Marine Policy* 24: 493-497

Kissling, E., Allison, E. H., Seeley, J.A., Russell, S., Bachmann, M., Musgrave, S. D. & Heck, S. 2005. Fisherfolk are among groups most at risk of HIV: cross-country analysis of prevalence and numbers infected. *AIDS* 19(17): 1939-46.

Lautze, J., McCartney, M., Kirshen, P., Olana, D., Jayasinghe, G., & Spielman, A. 2007. Effect of a large dam on malaria risk: the Koka reservoir in Ethiopia. *Tropical Medicine and International Health* 12(8): 982–989

McPherson, A. 2008. Health Service Delivery and Other HIV/AIDS Related Interventions in the Fisheries Sector in Sub-Saharan Africa - A literature review. "Fisheries and HIV/AIDS in Africa: Investing in Sustainable Solutions" WorldFish Center and the Food and Agriculture Organization of the United Nations (FAO), 33 p.

Matheson, C., Morrisson, S., Murphy, E., Lawrie, T., Ritchie, L., & Bond. C. 2001. The health of fishermen in the catching sector of the fishing industry: a gap analysis. *Occupational Medicine* 51(5): 305-311

Mojola, S. 2011. Fishing in dangerous waters: Ecology, gender and economy in HIV risk. *Social Science & Medicine* 72: 149-156

Nag, K.P. & Nag, A. 2007. Hazards and health complaints associated with fish processing activities in India—Evaluation of a low-cost intervention. *International Journal of Industrial Ergonomics* 37 : 125–132

Ngwenya, B.N., & Mosepele, K. 2007. HIV/AIDS, artisanal fishing and food security in the Okavango Delta, Botswana. Harry Hoppenheimer Okavango Research Center, University of Botswana, Maun, 11p.

Parker M., Allen T., Pearson G., Peach N., Flynn R. & Rees N. 2012 Border parasites: schistosomiasis control among Uganda's fisherfolk. *Journal of Eastern African Studies* 6(1): 98-123

Perez-Labajos, C.A., Blanco, B., Azofra, M., Achutegui J.J., & Eguía, E. 2009. Injury and loss concentration by sinking in fishing fleets. *Safety Science* 47: 277–284

Seeley, J. A. & Allison, E. H. 2005. HIV/AIDS in fishing communities: challenges to delivering antiretroviral therapy to vulnerable groups. *AIDS care* 17(6): 688-97

Windle, M.J., Neis, B., Bornstein, S., Binkley, M. & Navarro, P. 2008. Fishing occupational health and safety: A comparison of regulatory regimes and safety outcomes in six countries. *Marine Policy* 32: 701–710

Fish and food security

Fish consumption and poverty

Aiga, H., Sadatoshi Matsuoka, S., Kuroiwa, C. & Yamamoto, S. 2009. Malnutrition among children in rural Malawian fish-farming households. *Royal Society of Tropical Medicine and Hygiene* 103: 827—833

Béné, C., Steel, E., Kambala Luadia B. & Gordon, A. 2009. Fish as the “bank in the water” - Evidence from chronic-poor communities in Congo. *Food Policy* 34: 104-118

Bose, M. & Dey, M. M. 2007. Food and nutritional security in Bangladesh: going beyond carbohydrate counts. *Agriculture Economics Research Review* 20: 203-225

Garaway, C.J. 2005. Fish, fishing and the rural poor: a case study of the household importance of small scale fisheries in the Lao PDR. *Aquatic Resources, Culture and Development* , 1 (2): 131-144

Geheb, K., Kalloch, S., Medard, M., Nyapendi, A.-T., Lwenya, C. & Kyangwa, M. 2008. Nile perch and the hungry of Lake Victoria: Gender, status and food in an East African fishery. *Food Policy* 33(1): 85-98.

Gomna, A. & Rana, K. 2007. Inter-household and intra-household patterns of fish and meat consumption in fishing communities in two states in Nigeria. *British Journal of Nutrition* 97(1): 145-152.

Heck, S., Béné, C., & Reyes-Gaskin, R. 2007. ‘Investing in African fisheries: building links to the Millennium Development Goals. *Fish and Fisheries* 8: 211-226

Hortle, K.G. 2007. Consumption and the yield of fish and other aquatic animals from the Lower Mekong Basin. MRC Technical Paper No. 16, Mekong River Commission, Vientiane

Kawarazuka, N., & Béné, C., 2010. Linking small-scale fisheries and aquaculture to household nutritional security: an overview. *Food Security* 2: 343-357

Murshed-e-Jahan, K., Ahmed, M. & Belton, B. 2010. The impact of aquaculture development on food security: lessons from Bangladesh. *Aquaculture Research* 41(4): 481-495

International fish trade and food security

Alder, J., & Sumaila, U. R. 2004. Western Africa: A fish basket of Europe past and present. *Journal of Environment and Development*, 13(2), 156–178

Allison, E.H. 2011. Aquaculture, fisheries, poverty and food security. Working Paper 2011-65, Penang: WorldFish Center, 62 p.

Allison E., Delaporte, A., & Hellebrandt de Silva D.2012. Integrating fisheries management and aquaculture development with food security and livelihoods for the poor. Report submitted to the Rockefeller Foundation, School of International Development, University of East Anglia Norwich,124 p.

Béné, C., Lawton, R., & Allison, E.H. 2010. "Trade matters in the fight against poverty": narratives, perceptions, and (lack of) evidence in the case of fish trade in Africa. *World Development* 38(7): 933-954

FAO 2003. Expert Consultation on International Fish Trade and Food Security. Rome: Food and Agriculture Organization. Casablanca Morocco, 27–30 January 2003

Kent, G. 1997. Fisheries, food security and the poor. *Food Policy*, 22(5), 393–404

Kurien, J. 2004. Fish trade for the people: Toward Understanding the Relationship between International Fish Trade and Food Security. Report of the Study on the impact of international trade in fishery products on food security, Food and Agriculture Organization of the United Nations and the Royal Norwegian Ministry of Foreign Affairs

Rivera-Ferre M.G. 2009. Can Export-Oriented Aquaculture in Developing Countries be Sustainable and Promote Sustainable Development? The Shrimp Case. *Journal of Agriculture and Environment Ethics* 22:301–321

Smith, M.D., Roheim, C.A., Crowder, L.B. and 17 others 2010. Sustainability and Global Seafood. *Science* 327: 784-786.

Fisheries and aquaculture and the impact of their interactions on food security

Kawarazuka, N. & Béné, C. 2010. Linking small-scale fisheries and aquaculture to household nutritional security: an overview. *Food Security* 2: 343-357

Merino, G., Barange, M., Blanchard, J.L. Harle, J., Holmes, R., Allen, I., Allison, E.H., Badjeck, M-C., Dulvy, N.K., Holt, J., Jennings, S., Mullon C., & Rodwell, L.D. 2012. Can marine fisheries and aquaculture meet fish demand from a growing human population in a changing climate? *Global Environmental Change* 22(4): 795-806

Tacon, A.G.J. & Metian, M. 2009. Fishing for Feed or Fishing for Food: Increasing Global Competition for Small Pelagic Forage Fish. *Ambio* 38(6):294-302

Wijkstrom, U.N. 2009. The use of wild fish as aquaculture feed and its effects on income and food for the poor and the undernourished. In M.R Hasan and M. Halwart (eds). *Fish as feed inputs for aquaculture: practices, sustainability and implications*. Fisheries and aquaculture technical paper. No. 518. Rome, FAO. pp.371-407

Fish, food security and the major drivers of changes

Aswani, S. & Furusawa, T., 2007. Do marine protected areas affect human nutrition and health? A comparison between villages in Roviana, Solomon Islands. *Coastal Management* 35(5): 545-565

Bell, J. D., Kronen, M., Vunisea, A., Nash, W.J., Keeble, G., Demmke, A., Pontifex, S., & Andrefouet, S.. 2009. Planning the use of fish for food security in the Pacific. *Marine Policy* 33(1): 64-76

Béné, C., Macfadyen, G. & Allison, E.H. 2007. Increasing the contribution of small-scale fisheries to poverty alleviation and food security. *Fisheries and Aquaculture Technical Papers* 481. FAO, Rome. 141 pp

Beveridge, M.C.M., Thilsted, S.H., Phillips, M.J., Metian, M., Troell, M., & Hall, S.J. (in press). Meeting the food and nutrition needs of the poor: the role of fish and the opportunities and challenges emerging from the rise of aquaculture. The WorldFish Center

Garcia, S.M. & Rosenberg, A.A. 2010. Food Security and Marine Capture Fisheries: Characteristics, Trends, Drivers and Future Perspectives. *Philosophical Transactions of The Royal Society B-Biological Sciences* 365(1554): 2869-2880

Rice, J.C. & Garcia, S.M. 2011. Fisheries, Food Security, Climate Change, and Biodiversity; Characteristics of the Sector and Perspectives on Emerging Issues. *ICES Journal of Marine Science* 68: 1343-1353

Smith, M.D., Roheim, C.A., Crowder, L.B. and 17 others. 2010. Sustainability and Global Seafood. *Science* 327: 784-786.

Srinivasan U.T., Cheung W., Watson R. & Sumaila, U.R., 2010. Food security implications of global marine catch losses due to overfishing. *Journal of Bioeconomics* 12(3): 183-200

Fisheries and Economic Growth

Dyck, A.J. & Sumaila, U.R. 2010. Economic impact of ocean fish populations in the global fishery. *Journal of Bioeconomics* 12:227-243

World Bank & Food and Agriculture Organization (2009). *The Sunken Billions: the economic justification for fisheries reform*. Washington DC: World Bank, Agriculture and Rural Development Department - Sustainable Development Network, 86p

National economies

Bostock, T. & Walmsley, S. 2009. Enough to eat? Fisheries and food security. In: Bourne, R. and Collins, M. (eds.) *From Hook to Plate: The state of marine fisheries. A Commonwealth perspective*. Commonwealth Foundation, London

Carneiro, G. 2011. Marine management for human development: A review of two decades of scholarly evidence. *Marine Policy* 35: 351-362

Campbell, J., Whittingham, E. & Townsley, P. 2006. Responding to coastal poverty: should we be doing things differently or doing different things? In: (eds C.T. Hoanh, T.P. Tuong, J.W. Gowing and B. Hardy) *Environment and Livelihoods in Tropical Coastal Zones*

Cunningham, S., Neiland, A.E., Arbuckle, M. & Bostock, T. 2009. Wealth-based fisheries management: using fisheries wealth to orchestrate sound fisheries policy in practice. *Marine Resource Economics* 24: 271-287

Dyck, A.J. & Sumaila, U.R. 2010. Economic impact of ocean fish populations in the global fishery. *Journal of Bioeconomics* 12:227-243

Gillett, R. 2009. *Fisheries in the economies of the Pacific Island Countries and Territories*. ADB Pacific Studies Series

Hall, S. & Andrew, N.L. 2010. Recent developments in fisheries science and their prospects for improving fisheries contributions to food security. *Science Review SR9*. Foresight Programme

Heck, S., Béné, C., & Reyes-Gaskin, R. 2007. Investing in African fisheries: building links to the Millennium Development Goals. *Fish and Fisheries* 8(3): 211–226

Hersoug, P. (2011) Fishing rights to the right people? Management options in crowded small-scale fisheries. *MAST* 10(2): 15-39

Jul Larsen, E., Kolding, J., Overa, R., Nielsen, J. R. & van Zwieten, P. 2003 Management, Co-management or No Management? Major Dilemmas in Southern African Freshwater Fisheries. Fisheries Technical Paper 426/1 & 2. Rome: FAO

Kaczynski, V.M. & Fluharty, D.L. 2002. European policies in West Africa: who benefits from fisheries agreements? *Marine Policy* 26: 75-93

Teh, L.C.L. & Sumaila, U.R. 2013 Contribution of marine fisheries to worldwide employment *Fish and Fisheries* 14: 77-88

Thorpe, A., Whitmarsh, D.Ndomahina, E. Baio, A., Kemokai, M. & Lebbie, T. 2009. Fisheries and failing states: The case of Sierra Leone. *Marine Policy* 33: 393–400

Wilson, J.R. & Boncoeur, J. 2008. Microeconomic Efficiencies and Macroeconomic Inefficiencies: On Sustainable Fisheries Policies in Very Poor Countries , *Oxford Development Studies*, 36:4, 439-46

Fish Trade

Alder, J., & Sumaila, U. R. 2004. Western Africa: A fish basket of Europe past and present. *Journal of Environment and Development*, 13(2): 156–178

Allison, E 2011. Aquaculture, fisheries and poverty working paper. WorldFish Center

Arthur, R.I., Mees, C.C. & Halls, A.S. 2010. Assessing the impacts of fisheries management science: a review of DFID's Fisheries Management Science Programme. *Journal of Development Effectiveness* 2(1): 158-172

Béné, C., Lawton, R., & Allison, E.H. 2010. "Trade matters in the fight against poverty": narratives, perceptions, and (lack of) evidence in the case of fish trade in Africa. *World Development* 38(7): 933-954

Geheb, K., Kalloch, S., Modesta Medard, M., Anne-Therese Nyapendi, A.-T., Lwenya, C., & Kyangwa, M. 2008. Nile perch and the hungry of Lake Victoria: Gender, status and food in an East African fishery. *Food Policy* 33: 85-98

Kaczynski, V.M. & Fluharty, D.L. 2002. European policies in West Africa: who benefits from fisheries agreements? *Marine Policy* 26: 75-93

Kent, G. 1997. Fisheries, food security and the poor. *Food Policy* 22(5): 393-404

Kurien, J. 2004. Fish trade for the people: Toward Understanding the Relationship between International Fish Trade and Food Security. Report of the Study on the impact of international trade in fishery products on food security, Food and Agriculture Organization of the United Nations and the Royal Norwegian Ministry of Foreign Affairs

Mwika, S.M. 2006. Fisheries Access Agreements: Trade and Development Issues

Walker, B.L.E. 2002. Engendering Ghana's Seascape: Fanti Fishtraders and Marine Property in Colonial History. *Society and Natural Resources*, 15:389-407

Wierowski, F. & Hall, S. 2008. Public private partnerships for aquaculture and fisheries: getting started. *WorldFish Report*

Wilkins, A. 2012. Fisheries and Aquaculture Certification: Implications for Southeast Asia SSHRC Working Paper No. 2

Fisheries value chains

Ardjosoediro, I. & Neven, D. 2008. The Kenya Capture Fisheries Value Chain: An AMAP-FSKG Value Chain Finance Case Study. US AID microREPORT #122

Chiwaul, L., Jamu, D., Chawez, R., & Nagoli, J. (2012) The Structure and Margins of the Lake Chilwa Fisheries in Malawi: A Value Chain Analysis. WorldFish Project Report 2012/12

Gordon, A., Pulis, A., & Owusu-Adjei, E. 2011 Smoked marine fish from Western Region, Ghana: a value chain assessment. WorldFish Center. USAID Integrated Coastal and Fisheries Governance Initiative for the Western Region, Ghana. 46pp.

Hap, N., Un, S., Yagi, N., Nakajima, S., & Matsui, T. 2012. Value chain analysis of five key species: inland fisheries of Cambodia. IFREDI, Cambodia

Loc, V.T.T., Bush, S.R., & Sinh, L.X. 2009. Assessment of value chains for promoting sustainable fisheries development in the Mekong Basin: Cases of Pangasius in Vietnam and Cambodia. Vietnam Economic Management Review 26(5&6): 32-42.

Loc, V.T.T., Bush, S.R., Sinh, L.X. & Khiem, N.T. 2010. High and low value fish chains in the Mekong Delta: challenges for livelihoods and governance. Environment, Development and Sustainability 12: 889–908

Macfadyen, G. Mohamed Nasr-Alla, A., Al-Kenawy, D., Fathi, M., Hebicha, H., Mohammed Diab, A., Mohamed Hussein, S., Mohamed Abou-Zeid, R. & El-Naggar, G. 2012. Value-chain analysis — An assessment methodology to estimate Egyptian aquaculture sector performance. Aquaculture 362–363: 18–27

Ponte, S. 2008. Greener than Thou: The Political Economy of Fish Ecolabeling and Its Local Manifestations in South Africa. World Development 36(1): 159–175

Thyresson M., Crona, B., Nystrom M., de la Torre-Castro, M. & Jiddawi, N. 2013. Tracing value chains to understand effects of trade on coral reef fish in Zanzibar, Tanzania. Marine Policy 38: 246–256

Tran, N., Bailey, C., Wilson, N. & Phillips, M. 2013. Governance of Global Value Chains in Response to Food Safety and Certification Standards: The Case of Shrimp from Vietnam. World Development 45: 325–336

Post harvest loss

Ahmed, A.A. 2008. Post-Harvest Losses of Fish in Developing Countries. Nutrition and Health 19: 273-287

Akande, G. & Diei-Ouadi, Y. 2010. Post-harvest losses in small-scale fisheries: case studies in five sub-Saharan African countries. FAO Fisheries and aquaculture Technical Paper, Rome 550: 72p

Bolorunduro, P.I., Adesehinwa, A.O.K. & Ayanda, J.O. 2005. Adoption of Improved Fish Preservation Technologies in Northwestern Nigeria. Tropicultura 23(3): 117-123

Gordon, A., Pulis, A., & Owusu-Adjei, E. 2011. Smoked marine fish from Western Region, Ghana: a value chain assessment, WorldFish Center. USAID Integrated Fisheries Governance Initiative for the Western Region, Ghana. 46pp.

Gustavsson, J., Cederberg, C., Sonesson, U., van Otterdijk, R. & Meybeck, A 2011. Global food losses and food waste, extent, causes and prevention. Study conducted for the International Congress SAVE FOOD! Interpack 2011, Düsseldorf, Germany. FAO, Rome

Ibengwe, L. & Kristofferson, D.M. 2012. Reducing Post-Harvest Losses of the Artisanal Dagaa (*Rastrineobola Argentea*) Fishery in Lake Victoria Tanzania: A Cost and Benefit Analysis. Proceedings of the IIFET Conference, Dar es Salaam, Tanzania

Kabahenda, M.K., Omony, P. & Hüsken, S.M.C. 2009. Post-harvest handling of low-value fish products and threats to nutritional quality: a review of practices in the Lake Victoria region. Regional Programme Fisheries and HIV/AIDS in Africa: Investing in Sustainable Solutions. The WorldFish Center. Project Report 1975.

Kumolu-Johnson, C.A. & Ndimele, P.E. 2011. A review of post-harvest losses in artisanal fisheries in some African countries. *Journal of Fisheries and Aquatic Science* 6(4): 365-378

Nowsad Alam, A.K.M., 2010. Post-harvest Loss Reduction in Fisheries in Bangladesh: A Way Forward to Food Security, Report for the National Food Policy Capacity Strengthening Programme, Dhaka, Bangladesh

Purvis, J. 2002. Postharvest fisheries on the eastern floodplains, Caprivi. DEA Research Discussion Paper No. 51

Household economies

Allison, E.H. 2011. Aquaculture, fisheries and poverty working paper. WorldFish Center

Allison, E.H. & Ellis, F. 2001. The livelihoods approach and management of small-scale fisheries. *Marine Policy* 25: 377-388

Allison, E.H., Delaporte, A., & Hellebrandt de Silva D. 2012. Integrating fisheries management and aquaculture development with food security and livelihoods for the poor. Report submitted to the Rockefeller Foundation, School of International Development, University of East Anglia Norwich, 124 p.

Béné, C., Macfadyen, G. & Allison, E.H. 2007. Increasing the contribution of small-scale fisheries to poverty alleviation and food security. *Fisheries and Aquaculture Technical Papers* 481. FAO, Rome. 141 pp

Béné, C., Steel, E., Kambala Luadia, B., & Gordon, A.,. 2009. Fish as the 'bank in the water' - evidence from chronic-poor communities in Congo. *Food Policy* 34: 108-118

Garaway, C.J. 2005. Fish, fishing and the rural poor: a case study of the household importance of small scale fisheries in the Lao PDR. *Aquatic Resources, Culture and Development* 1(2), 131–144

Garaway, C.J., 2006. Enhancement and entitlement-the impact of stocking on rural households' command over living aquatic resources; a case study from the Lao PDR. *Human Ecology*.

Geheb, K., Kalloch, S., Medard, M., Nyapendi, A-T., Lwenya, C., & Kyangwa. 2008. Nile perch and the hungry of Lake Victoria: Gender, status and food in an East African fishery. *Food Policy* 33: 85–98

Jentoft, S., Onyango, P. & Islam, M.M. 2010. Freedom and poverty in the fishery commons. *International Journal of the Commons* 4(1): 344-366

Kawarazuka, N. & Béné, C. 2010. Linking small-scale fisheries and aquaculture to household nutritional security: an overview. *Food Security* 2(4): 343-357

Meusch, E., Yhoun-Are, J. Friend, R. & Funge-Smith, S. 2003. The role and nutritional value of aquatic resources in the livelihoods of rural people. A participatory assessment in Attapeu Province, Lao PDR. A contribution to the Dialogue on Water, Food and the Environment. RAP publication 11

Pollnac, R.B., Pomeroy, R.S. & Harkes, I.H.T., 2001. Fishery policy and job satisfaction in three southeast Asian fisheries. *Ocean and Coastal management* 44: 531-544

Salmi, P. 2005. Rural Pluriactivity as a Coping Strategy in Small-Scale Fisheries. *Sociologia Ruralis*, Vol 45(1/2)

Sarch, M.T. 2001. Fishing and farming at Lake Chad: Institutions for access to natural resources. *Journal of Environmental Management* 62: 185-199
Smith, L., Lorenzen, K. & Nguyen Khoa, S. 2005. Livelihood functions of inland fisheries: policy implications in developing countries. *Water Policy* 1-27

Tubtim, N. & Hirsch, P. 2005. Common Property as Enclosure: A Case Study of a Backswamp in Southern Laos. *Society and Natural Resources*, 18:41–60

Aquaculture and Economic Growth

Aquaculture and national economy

Ahmed, M., & Lorica, M. 2002. Improving developing country food security through aquaculture development—lessons from Asia. *Food Policy* 27 (2): 125–141

Allison, E.H. 2011. Aquaculture, fisheries, poverty and food security. The WorldFish Center, Penang, Malaysia 60pp. (Working Paper,2011-65)

Belton, B. & Little, D.C. 2011. Immanent and Interventionist Inland Asian Aquaculture Development and its outcomes. *Development Policy Review* 2011, 29 (4): 459-484

Bush S.R., Khiem, N.T., & Le Xuan Sinh, L.X. 2009. Governing the Environmental and Social Dimensions of Pangasius Production in Vietnam : A Review. *Aquaculture Economics & Management* 13 (4)

Chimatiro, S., Hummel, M., & Sholz, U. 1999. Still a long way to go - Aquaculture has an enormous impact on food security in Malawi. *Gate Technology and Development*, No. 1 - Small Scale Fisheries GTZ; 1999; 64 pages

Kaliba, A R., Ngugi, C., Mackambo, M., Osewe, K.O., Berno, E.S., Mnembuka, V., & Amisah, S. 2007. Potential effect of aquaculture promotion on poverty reduction in Sub-Saharan Africa. *Aquaculture International* 15:445–459.

Lewis, D. 2007. Rethinking aquaculture for resource-poor farmers: perspectives from Bangladesh. *Food Policy* 22 (6): 533–546

Rivera-Ferre, M. 2009. Can Export-Oriented Aquaculture in Developing Countries be Sustainable and Promote Sustainable Development? The Shrimp Case. *Journal of Agricultural and Environmental Ethics* 22 (4): 301-321

Aquaculture – Households and livelihoods

ACIAR. 2010. Extending low-cost fish farming in Thailand: An ACIAR–World Vision collaborative program ACIAR Impact assessment Series 66 72pp

- Balgah, A.R. & Buchenrieder, G. 2010. Targeting of and Outreach to the Poor by Rural Development Nonprofit Organizations in Cameroon. Discussion Paper No. 1/2010 Forschung zur Entwicklungsökonomie und –politik
- Brummett, R. 2011. Growing Fish to Make Money in Africa: Smart lessons real experiences, real development. International Finance Corporation World Bank Group DFID supported November 2011
- Dey, M.M., Paraguas, F.J., Kambewa, P., & Pems, D E. 2010. The impact of integrated aquaculture-agriculture on small scale farms in Southern Malawi. *Agricultural Economics* 41: 67-79
- Faruque, G. 2007. An exploration of impacts of aquaculture production and marketing on rural livelihoods in three regions in Bangladesh. PhD Thesis University of Stirling
- Haque, M.M., Little, D., Barman, B.K., & Wahab, M.A., (2010) The Adoption Process of Ricefield-Based Fish Seed Production in Northwest Bangladesh: An Understanding through Quantitative and Qualitative Investigation, *The Journal of Agricultural Education and Extension*, 16: 2, 161 — 177
- Irz, X., Stevenson, J. R., Tanoy, A., Villarante, P. & Morissens, P. 2007. The Equity and Poverty Impacts of Aquaculture: Insights from the Philippines. *Development Policy Review*, 25: 495–516
- Jahan, K.M., Ahmed, M., & Belton, B. 2010. The impacts of aquaculture development on food security: lessons from Bangladesh. *Aquaculture Research* 2010 41, 481-49
- Huong, N.H., & Cuong, T.H. 2012. Freshwater Aquaculture Contribution to Food Security in Vietnam: A case study of freshwater tilapia aquaculture in Hai Duong province. *Journal ISSAAS Vol 18 No 1: 6-17*
- E Jahan, K. M. & Pems, D E. 2011. The impact of integrated aquaculture - agriculture on small scale farm sustainability and farmers livelihoods: Experience from Bangladesh *Agricultural Systems. Agricultural Systems Volume 104, Issue 5, June 2011, Pages 392–402*
- Karim, M., Little, D.C, Kabir, M.S., Verdegem, M.J.C., Telfer, T., & Wahab, M.A., 2011, Enhancing benefits from polycultures including tilapia (*Oreochromis niloticus*) within integrated pond-dike systems: A participatory trial with households of varying socio-economic level in rural and peri urban areas of Bangladesh, *Aquaculture Volume 314, Issues 1–4, 4 April 2011, Pages 225–235*
- Morales, E. 2007. Self-recruiting species (SRS) in farmer managed aquatic systems: their importance to the livelihoods of the rural poor in Southeast Asia. PhD Thesis, University of Stirling UK
- Pant, J., Barman, B.K., Murshed-E-Jahanb, K., Belton, B., & Beveridge, M., Can aquaculture benefit the extreme poor? A case of landless and socially marginalized Adivasi (ethnic) communities in Bangladesh, in press May 2013 *Aquaculture*
- Parker, S., 2008, Extensive Shrimp Farming Provides an Important Livelihood for Poor Rural Communities in the Philippines, MSc Thesis, Stirling University
- Stevenson, J. R. & Irz, X. 2009. Is aquaculture development an effective tool for poverty alleviation? A review of theory and evidence. Editors Lazard, J.; Lésel, R. *Journal Cahiers Agricultures Vol. 18 No. 2/3 pp. 292-299 Special issue: Piscicultures: le poisson de demain*

Aquaculture: Issues of scale and type of aquaculture

African Development Bank. 2011. Environmental and social management plan summary. African Development Bank ADB Report: Lake Harvest aquaculture expansion project Aug 2011 13pp

Ali, H., Haque, M., & Belton B. 2012. Striped catfish (*Pangasianodon hypophthalmus*, Sauvage, 1878) aquaculture in Bangladesh: an overview. *Aquaculture Research* 2012 1-16

Asian Development Bank. 2005. An Evaluation of Small-Scale Freshwater Rural Aquaculture Development for Poverty Reduction. ADB Publishing

Belton, B., Haque, M.M, & Little, D . 2012. Does Size Matter? Reassessing the Relationship between Aquaculture and Poverty in Bangladesh. *The Journal of Development Studies* 48 (7)

Bhattacharya, P., & Ninan, K.N. 2011. Social cost-benefit analysis of intensive versus traditional shrimp farming: A case study from India. *Natural Resources Forum* 35: 321–333

Brummett, R., Gockowski, J., Pouomogne, V., & Muir, J. 2011. Targeting agricultural research and extension for food security and poverty alleviation: A case study of fish farming in Central Cameroon. *Food Policy* 36 (6): 805-814

Dey, M.M., Kambewa, P., Prein, M., Jamu, D., Paraguas, F.J., Pems, D.E., & Briones, R.M. 2007. Impact of Development and Dissemination of Integrated Aquaculture-Agriculture (IAA) Technologies in Malawi. In: *International Research on Resource Management: Advances in impact assessment*. Edited Waibel H and Zilberman D CABI Publishing 2007

Dickson, M.W. & Brooks A C. 1997. Fish Farming in Malawi A case study of the Central and Northern Regions Fish Farming Project. Report: Stirling Aquaculture 1997 70pp

Haa, T.T., Bush, S., & Dijk, H.V. 2013. The cluster panacea?: Questioning the role of cooperative shrimp aquaculture in Vietnam. *Aquaculture*. 388–391: 89–98

Hall, S.J., A. Delaporte, M. J. Phillips, M. Beveridge & M. O'Keefe. 2011. *Blue Frontiers: Managing the Environmental Costs of Aquaculture*. The WorldFish Center, Penang, Malaysia, 103 p

Kassam, L., Subasinghe, R., & Phillips, R. 2011. Aquaculture farmer organizations and cluster management Concepts and Experiences. FAO Fisheries and Aquaculture Technical Paper No. 563 90pp

Khiem, N.T., Bush S.R., & Coles C . 2011. Upgrading, downgrading and outgrading smallholders in the Vietnamese pangasius catfish value chain. In *Markets and Rural Poverty: Upgrading in value chains* Ed : Mitchell J and Coles C IDRC Earthscan

Kipkemboi, J., Van Dam, A.A., Ikiara, M.M., & Denny, P. 2007. Integration of smallholder wetland aquaculture agriculture systems (fingerponds) into riparian farming systems on the shores of Lake Victoria Kenya: socioeconomics and livelihoods. *The Geographical Journal* 173 (3): 257-272

Simon, D., & Benhamou, M. 2009. Rice Fish Farming in Guinea Forestiere - outcome of a rural development project. *Journal of Field Actions* Volume 2 17pp

Thompson, P.M., Firoz Khan, A.K., M & Sultana, P. 2006. Comparison of aquaculture extension impacts in Bangladesh. *Aquaculture Economics and Management* 10, 15-31

Sinh, L.X. 2009. Social Impacts of coastal aquaculture in the Mekong Delta of Viet Nam, In M G Bondad Reantaso & M. Prein (eds) pp 95-106 Measuring the contribution of small scale aquaculture : an assessment. FAO Fisheries and Aquaculture Technical Paper No 534 Rome FAO 180p

Tofique, K.A. & Gregory, R. 2008. Common waters and private lands: distributional impacts of floodplain aquaculture in Bangladesh. *Food Policy* 33, 587-594

Mediating Factors

Fisheries and governance reform

Allison, E. & Ellis, F. 2001. The livelihoods approach and management of small-scale fisheries. *Marine Policy* 25: 377-388

Allison, E.H., Ratner, B.D., Asgard, B., Willmann, R., Pomeroy, R. and Kurien, J. (2011) Rights-based fisheries governance: from fishing rights to human rights. *Fish and Fisheries*

Bavinck, M., Chuenpagdee, R., Diallo, M., van der Heijden, P., Kooiman, J., Mahon, R. & Williams, S. 2005. Interactive fisheries governance: a guide to better practice, Delft: Eburon Publishers. 72 pp.

Béné, C. 2003. When fishery rhymes with poverty, a first step beyond the old paradigm on poverty in small-scale fisheries. *World Development* 36(1): 945-975.

Béné, C., Belal, E., Baba, M. O., Ovie, S., Raji, A., Malasha, I., Njaya, F., Na Andi, M., Russell, A. & Neiland, A. 2009. Power struggle, dispute and alliance over local resources: analyzing 'democratic' decentralization of natural resource through the lenses of Africa inland fisheries. *World Development* 37(12), 1935-1950.

Béné, C. & Neiland, A. E. 2004. Empowerment reform, yes... but empowerment of whom? Fisheries decentralization reforms in developing countries: a critical assessment with specific reference to poverty reduction. *Aquatic Resources, Development and Culture* 1(1): 35-49.

Béné, C. & Neiland, A. E. (2006). From participation to governance: A critical review of the concepts of governance, co-management, and participation and their implementation in small-scale inland fisheries in developing countries. The Challenge Program on Water and Food & WorldFish Center. Policy, Economics and Social Science Discussion Paper Series. WorldFish Center, 74 p.

Crosoer, D., van Sittert, L. & Ponte, S. 2006. The integration of South African fisheries into the global economy: Past, present and future. *Marine Policy* 30: 18–29

Evans, L., Cherrett, N. & Pemsil, D. 2011 Assessing the impact of fisheries co-management interventions in developing countries: A meta-analysis. *Journal of Environmental Management* 1-12

Mansfield, B. 2004. Neoliberalism in the oceans: "rationalization," property rights, and the commons question. *Geoforum* 35: 313–326

Ponte, S. 2008. Greener than Thou: The Political Economy of Fish Ecolabeling and Its Local Manifestations in South Africa. *World Development* 36(1): 159–175

Sarch, M.T. 2001 Fishing and farming at Lake Chad: Institutions for access to natural resources. *Journal of Environmental Management* 62: 185-199

Sutinen J.G (2008) Major Challenges for Fishery Policy Reform: A Political Economy Perspective. OECD Food, Agriculture and Fisheries Papers No.8, OECD, Paris. (not assessed)

Thorpe, A., Whitmarsh, D., Ndomahina, E., Baio, A., Kemokai, M. & Lebbie, T. 2009 Fisheries and failing states: The case of Sierra Leone. *Marine Policy* 33: 393–400

Thorpe, A., Reid, C., van Anrooy, R. & Brugere, C. 2007 When fisheries influence national policy-making: an analysis of the national development strategies of major fish-producing nations in the developing world. *Marine Policy* 29: 211–222

Tubtim, N. & Hirsch, P. 2005 Common Property as Enclosure: A Case Study of a Backswamp in Southern Laos. *Society and Natural Resources*, 18:41–60

Gender

Badjeck, M.-C. 2012. Small scale fisheries through the well being lens. *Fish and Fisheries, Early View*

Bennett, E. 2005. Gender, fisheries and development. *Marine Policy* 29 2005. 451–459

Davis, D. L., & Nadel-Klein, J. 1992. Gender, culture and the sea: Contemporary theoretical approaches. *Society and Natural Resources*, 5, 135–147

Geheb, K., Kalloch, S., Medard, M., Nyapendi, A.-T., Lwenya & C., Kyangwa. 2008. Nile perch and the hungry of Lake Victoria: Gender, status and food in an East African fishery. *Food Policy* 33: 85–98

Matthews, E., Bechtel, J., Britton, E., Morrison, E. & McClennen, C. 2012. A gender perspective on securing livelihoods and nutrition in fish-dependent coastal communities. A report to The Rockefeller Foundation for the Oceans Search: Securing the Livelihoods and Nutritional Needs of Fish-dependent Communities

Ntombi Ngwenya, B., Keta Mosepele, K., & Magole, L. 2012. A case for gender equity in governance of the Okavango Delta fisheries in Botswana. *Natural Resources Forum* 36 (2012) 109–122

Overå, R. 1998. Partners and competitors: Gendered entrepreneurship in Ghanaian canoe fisheries. Unpublished Ph.D. thesis, Bergen, Norway: University of Bergen

Medard, M., Sobo, F., Ngatunga, T. & Chirwa, S. 2001. Women and gender participation in the fisheries sector in Lake Victoria. *Global Symposium on Women in Fisheries*

Tarisesei, J., & Novaczek, I. 2004. Gender and generation: crucial aspects of local fisheries management on Lelepa Island, Vanuatu. *Global symposium on gender and Fisheries, Seventh Asian Fisheries Forum 1-2 December 2004, Penang, Malaysia*

Tindall, C. & Holvoet, K. 2008. From the lake to the plate: Assessing gender vulnerabilities throughout the fisheries chain. *Development*, 2008, 51:205–211

Weeratunge N., Béné C, Siriwardane R., Charles A., Johnson D., Allison E: H., Nayak P: K: & Badjeck M:-C:, 2013, Small-scale fisheries through the wellbeing lens, *Fish and Fisheries* [online] DOI: 10.1111/faf.12016

Weeratunge, N., & Snyder, K. 2010. Gleaner, fisher, trader, processor: understanding gendered employment in the fisheries and aquaculture sector. *Fish and Fisheries*, 2010, 11, 405–420

Williams, M.J. 2008. Why Look at Fisheries through a Gender Lens? *Development*, 2008, 51:180–185.

Williams, M.S. & Choo, P. 2002. From Women in Fisheries to Gender and Fisheries. *Global Symposium on Women in Fisheries: Sixth Asian Fisheries Forum. Kaohsiung, Taiwan*

Mapping of other relevant initiatives

Birch, J. (ed.) 2010. Why no thought for food? A parliamentary enquiry into global food security. The All Party Parliamentary Group on Agriculture and Food for Development. Houses of Parliament, London

Foresight. The Future of Food and Farming 2011. Executive Summary. The Government Office for Science, London.

Wijeratna, A. 2013 Small scale, big impact: Smallholder agriculture's contribution to better nutrition. A briefing paper from the UK Hunger Alliance

World Bank & Food and Agriculture Organization (2009). The Sunken Billions: the economic justification for fisheries reform. Washington DC: World Bank, Agriculture and Rural Development Department - Sustainable Development Network, 86 p.

Conclusions

Arthur, R.I., Lorenzen, K., Homekingkeo, P., Sidavong, K., Sengvilaikham, B. & Garaway, C.J. 2010. impacts of introduced aquaculture species on native fish communities: Nile tilapia and major carps in SE Asian freshwaters. *Aquaculture* 299: 81-88

Hall, S.J., A. Delaporte, M. J. Phillips, M. Beveridge & M. O'Keefe. 2011. Blue Frontiers: Managing the Environmental Costs of Aquaculture. The WorldFish Center, Penang, Malaysia, 103 p.

Tran, N., Bailey, C., Wilson, N. & Phillips, M. 2013. Governance of Global Value Chains in Response to Food Safety and Certification Standards: The Case of Shrimp from Vietnam. *World Development* 45: 325–336

WHAT 2000. Governance for a Sustainable Future. Commission on Fisheries Resources as Part II of the WHAT (World Humanity Action Trust) Report <http://www.what.org.uk>, World Humanity Action Trust, London.

World Bank and Food & Agriculture Organization (2009). The Sunken Billions: the economic justification for fisheries reform. Washington DC: World Bank, Agriculture and Rural Development Department - Sustainable Development Network, 86 p.

World Bank, Food and Agriculture Organization & WorldFish Center (2010). The hidden harvest - the global contribution of capture fisheries . Washington DC: World Bank, agriculture and rural development department, 111 p.

Appendix 4: Initiatives reviewed

Current Initiatives

Institution	Type of institution	Programme(s) and/or specific projects	Duration	Geographical Focus	Fisheries, aquaculture or post harvest	Focal Area(s) relating to fisheries and aquaculture	Key research question / programme/project objectives relating to fisheries and aquaculture	Thematic area: fisheries, aquaculture or part of a broader theme? What is the broader theme?	Partners/ Collaborators	Level of engagement i.e. local, national, regional, global
ACIAR	Donor	Fisheries Program - Research	Ongoing	Indonesia, Timor-Leste, Philippines, PNG, Mekong, Pacific Islands	Fisheries, aquaculture and post harvest	Nutrition and food security; productivity and resilience; livelihoods; ecosystem services; responsible management; capacity building.	To improve the livelihoods of people dependent on capture fisheries and aquatic-farming systems in partner countries and in Australia. The main focus is to build and sustain the capacity of national research agencies in partner countries to manage capture fisheries and aquaculture industries for: <ul style="list-style-type: none"> • Food-security improvement • Positive economic impacts on the lives of smallholders 	Fisheries & aquaculture		Local, national and regional
APDRA	NGO	"Project for a Village Profitable fish farming in Central and Western Regions of Cameroon" (PVCOC)	2006 - 2011	Cameroon	Aquaculture	sustainable development and socio-economics	It was a pilot seeking to determine if the fish farmer model developed in West Africa was relevant to Cameroon	Theme is the development of aquaculture in West Africa	Volunteers France, Studies Service and Support to Populations Base (SEAPB), Information and Training Center Research for Development (CIFORD)	National

Asian Institute of Technology (Thailand)	Research Center	-		Asia	Aquaculture	Small scale systems, hatchery technologies associated to AIT Outreach in neighbouring countries		Aquaculture		
Auburn University (US)	Research Center	FISH Project - fisheries investment for sustainable harvest	Ongoing	Sub Saharan Africa, Caribbean, South and Central America	Aquaculture	Aquaculture development		Aquaculture		Local and national
Bangladesh Agricultural University Mymensingh	Research Center	-		Asia and Europe	Aquaculture	Sustainable aquaculture systems and value chain		Aquaculture		
Central Institute for Freshwater Aquaculture CIFA (India)	Research Center	-		India and Asia	Aquaculture	Sustainable freshwater aquaculture systems - multidisciplinary approach, farmer led, gender		Aquaculture		
CGIAR (Worldfish Center)	Research Centre	Aquatic Agricultural Systems	Ongoing	Mega deltas of Asia, small island systems of Asia-Pacific, inland wetlands of Africa, coastal Africa. Initial focus on Bangladesh, Cambodia, Philippines, Solomon Islands, Zambia.	Fisheries, aquaculture and post harvest	Rural livelihoods; approaches to enhance fisheries & aquaculture contribution, including value chains and governance with an integral focus on gender, power and rights; sustainable growth; food security;	The program aims to reduce poverty and improve food security for people whose livelihoods depend on aquatic agricultural systems. Fisheries as an element of rural livelihoods; approaches to enhance this contribution, including value chains and governance with an integral focus on gender, power and rights.	Broader theme of aquatic agriculture	national and regional research institutes, civil society organisations, academia, and the private sector	National

CGIAR (Worldfish Center)	Research Centre	Aquatic Agricultural Systems - Freshwater Aquaculture – Developing Inland Aquaculture in Solomon Islands	2011 - 2015	Solomon Islands	Aquaculture	Food and nutritional security	The aim of this large project is to identify the best ways for the Solomon Islands Government to carry out an inland aquaculture programme which will contribute to the nation's food and nutritional security - one specific question is: How can aquaculture be developed to optimise food and nutritional benefits for those most in need?	Aquaculture	Solomon Islands Ministry of Fisheries and Marine Resources (MFMR) Secretariat for the Pacific Community (SPC)	national
CGIAR (Worldfish Center)	Research Centre	Aquatic Agricultural Systems - Linking Fisheries and Nutrition: Promoting Innovative Fish Production Technologies in Ponds and Wetlands with Nutrient-dense Small Fish Species in Bangladesh	2010 - 2013	Bangladesh	Fisheries and Aquaculture	Nutrition and employment	project promotes innovative new technologies designed to increase the production of small nutrient-rich fish species	Fisheries & aquaculture	Department of Fisheries, Bangladesh	
CGIAR (Worldfish Center)	Research Centre	Livestock and Fish: Single program, under which many projects or project components sit, including work funded by USAID, EC and SDC.	Start 2012, ongoing	Bangladesh, Egypt, and a sub-Saharan Africa country will also be chosen. Ultimate goal is to scale out to more countries. Thematic research conducted where lessons can be most readily learned.	Aquaculture	Food and nutrition security; Employment and improved benefits for those engaged in target aquaculture value chains; thematic research on animal health, breeding and genetics, feeds and gender targeting.	To increase the productivity of small-scale livestock and fish systems in sustainable ways, making meat, milk and fish more available and affordable to poor consumers across the developing world. Promote pro-poor development of fish value chains that increase supplies of fish in target countries.	Fish systems part of a broader project on small scale livestock systems.	governments, non-governmental organisations, the private sector and large development agencies	Local and national

CGIAR (Worldfish Center)	Research Centre	Livestock and Fish: Building public private sector partnership to enhance the productivity and competitiveness of aquaculture in the ECA region	2012 - 2013	Uganda, Kenya and Tanzania	Aquaculture	Project is aimed at improving production, accessibility, profitability and consumption of farmed fish.	How to enable the aquaculture industry in the region to reach its potential to reduce poverty and hunger.	Aquaculture	CGIAR program on Livestock and Fish	National
CGIAR (Worldfish Center)	Research Centre	Livestock and Fish: Nobo Jibon - Multi Year Assistance Program (MYAP)	2010 - 2014	Bangladesh	Aquaculture	Food security, employment, value chain	expansion of adaptive small-scale aquaculture is seen as an important means of providing employment opportunities for the poor, especially women; helping achieve food security, and reducing the incidence of malnutrition in children	Aquaculture	International Development Enterprises (IDE) Helen Keller International (HKI) Community Development Centre (CODEC) Gono Unnayan Prochesta (GUP) South Asia Partnership – Bangladesh (SAP-BD) Speed Trust	National
CGIAR (Worldfish Center)	Research Centre	Livestock and Fish - Building Livelihood Security and Reducing Conflict in Freshwater Ecoregions	2011 - 2014	Zambia, Uganda and Cambodia	Fisheries and aquaculture	project aims to build resilient livelihoods among poor rural producers who depend on the highly contested natural resources in these freshwater ecoregions Nutrition, income, welfare improvement		Broader theme	Adelphi Research Lake Victoria Fisheries Organization Makerere Institute for Social Research, Uganda Uganda Department of Fisheries Zambia Center for Applied Social Science University of	National

									Zimbabwe Fisheries Administration Cambodia Development Resource Institute	
CGIAR (Worldfish Center)	Research Centre	Livestock and Fish - Improving Employment and Income through Development of Egypt's Aquaculture Sector (IEIDEAS)	2011 - 2014	Egypt	Aquaculture	Value chain, food security and employment	To increase employment in Egypt's aquaculture sector, o expand the industry in Upper Egypt and to benefit women fish traders and processors	Aquaculture	WorldFish, Care Egypt, Govt of Egypt, Fish Producers' Orgs	
CGIAR (Worldfish Center)	Research Centre	Livestock and Fish - Business models for small-scale aquaculture to help the poor	2012 - 2013	Cambodia and Indonesia	Aquaculture	Economic development	Aims to alleviate poverty by identifying innovative business models and finance options that will help small-scale aquaculture enterprises take their produce from catch to market.	Aquaculture	Leibniz University Hannover, Institute of Development and Agriculture Economics, Germany Innpact Sàrl, Germany Aceh Society Development (ASD) Cooperative, Indonesia	

CGIAR (Worldfish Center)	Research Centre	Agriculture for Health and Nutrition	Ongoing	Bangladesh, to be expanded to Zambia	Fisheries and aquaculture	Value chains	Aquaculture: Integrated household pond aquaculture with vegetable production in homestead and pond dykes, coupled with behaviour change communication for promotion of consumption of nutrient-rich fish and vegetables in the 1,000 days and adoption essential nutrition and hygiene actions. Fisheries: sustainable management and production of nutrient-rich fish species in wetlands, couples with the other elements at household level.	Broader theme of agriculture		
CGIAR (Worldfish Center)	Research Centre	Challenge Program on Water and Food (CPWF) - River Basin Development Challenge (BDC) Research Programs	2002 - 2013	Andes, Mekong, Nile, Ganges, Limpopo and Volta	Fisheries and aquaculture	Sustainable production; livelihoods resilience; benefit sharing mechanisms; water governance; poverty reduction; water resource management;	To increase the resilience of social and ecological systems through better water management for food production.	Broader theme	Various	Local, national regional

CGIAR (Worldfish Center)	Research Centre	Climate Change, Agriculture and Food Security	Ongoing	E Africa, West Africa and the Indo-gangetic plains. CCAFs has recently expanded into SE Asia and is looking at the Pacific.	Fisheries and aquaculture	Food security , sustainable development, climate change. CCAFs really focuses on agriculture but WF is trying to put fisheries and aquaculture on the agenda with some success. Overall Research Themes include Adaptation to progressive CC, Management of Climate Risk, Pro-poor CC mitigation, and Integrating CC into Decision Making.	To overcome the threats to agriculture and food security in a changing climate, exploring new ways of helping vulnerable rural communities adjust to global changes in climate.	Broader theme	Various	
CGIAR (Worldfish Center)	Research Centre	Various	Ongoing	Africa, Asia, Pacific	Fisheries, aquaculture and post harvest	Community based fisheries management (CBFM), adaptation to climate change, improved value chains, gender equality, nutrition and health, Policies and practice for resilience, aquaculture technologies	improving the livelihoods of those who are especially poor and vulnerable in places where fisheries and aquaculture can make a difference and 2) achieving large scale, environmentally sustainable, increases in supply and access to fish at affordable prices for poor consumers in developing countries.	Fisheries & aquaculture	Various partners at different levels including research institutes, universities, donors, government departments, NGOs, inter-governmental agencies.	Local, national, regional and international

CGIAR (Worldfish Center)	Research Centre	Policies, Institutions and Markets	Ongoing	global / developing countries		Food security, conservation, sustainable production	Forecasting role of fish in global food security, and international demand & supply to 2030 and beyond; and Identifying promising technologies and approaches, potential impact & rationale for investment	Broader theme	Various	
CIRAD/IFREMER	Research Center			Asia, Philippines, sub Saharan Africa (Uganda, Kenya and Cameroon)	Aquaculture	Sustainable small scale low input aquaculture systems. Genetics and breeding programmes		Aquaculture		
Conservation International	NGO	Food Security program; Global Marine - Sustainable Fisheries	Ongoing	Global	fisheries	Conservation and sustainable development with a view to improve livelihoods, wellbeing, food security	To ensure fishing is sustainable at the national scale within Exclusive Economic Zones (EEZ). This will include securing rights for individual fishers, cooperatives or associations to a proportion of the annual fisheries catch or to the catch in a specific area. Such de facto ownership creates incentives for improved governance and for limiting fishing so that fish stocks can increase and sustainable catches can become bigger over time.	Broader theme of conservation	Private sector, governments, fishing sector,	

Coral Triangle Initiative on Coral Reefs, Fisheries and Food Security (CTI-CFF)	Inter-governmental agency	The CTI-CFF is a multilateral partnership between the governments of Indonesia, Malaysia, Papua New Guinea, Philippines, Solomon Islands and Timor-Leste. 10 year CTI Regional Plan of Action	Start 2009	Indonesia, Malaysia, Papua New Guinea, Philippines, Solomon Islands, Timor-Lester	Fisheries	food security, climate change and marine biodiversity, sustainable development, poverty reduction and equitable benefit sharing.	The CTI-CFF seeks to address both poverty reduction through economic development, food security, sustainable livelihoods for coastal communities and biodiversity conservation through the protection of species, habitats and ecosystems.	Fisheries is one of the thematic areas	USAID, Aus Govt, ADB, GEF, CI, TNC, WWF plus	Regional and national
Coral Triangle Support Partnership	NGO consortium		2009 - 2013	Indonesia, Malaysia, Papua New Guinea, Philippines, Solomon Islands, Timor-Lester	Fisheries	Climate change, livelihoods, food security, conservation, government collaboration	To develop conservation guidelines, sustainable fishing practices and plan for a changing climate. Improving the management of biologically and economically important coastal and marine resources and associated ecosystems that support livelihoods and economies for the people of the Coral Triangle	Broader theme	WWF, Conservation International, and The Nature Conservancy	National and regional
DEFRA	Government Agency	DARWIN Initiative - Various projects, at present 4 relate to fisheries	Start 1992 - ongoing	Global	Fisheries	Institutional capacity building; training; research; work to implement the Biodiversity Convention; environmental education or awareness	The Darwin Initiative assists countries that are rich in biodiversity but poor in financial resources to meet their objectives under one or more of the three major biodiversity Conventions: the Convention on Biological Diversity (CBD); the Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES); and the Convention on the Conservation of Migratory Species of Wild Animals (CMS), through the funding of collaborative projects which draw on UK biodiversity expertise.	Broader theme of biodiversity	UK institutions and developing country bodies	Local

ESPA	Donor	Funded research programme - Various projects looking at how ecosystem services can contribute to poverty alleviation	Ongoing - 7 year project	Global	Fisheries	Poverty alleviation and ecosystem services	To provide new knowledge demonstrating how ecosystem services can reduce poverty and enhance well-being for the world's poor	Broader theme of ecosystem services and poverty alleviation		Local and national
EU	Donor	Aquaculture for Food Security, Poverty Alleviation, and Nutrition (AFSPAN)	2012 - 2015	Asia (Bangladesh, China, India, Philippines, Vietnam), Africa (Kenya, Uganda, Zambia), and Latin America (Brazil, Chile, Nicaragua)	Aquaculture	Food Security, Poverty Alleviation, and Nutrition	To better understand the current status of the contribution of aquaculture to food and nutrition security and poverty alleviation; and Improve coordination amongst development initiatives	Aquaculture	FAO, WorldFish, IDS, Universities, governments,	
EU	Donor	ACP FISH II Programme	2009 - 2014	Africa, Caribbean and Pacific states	Fisheries	Fisheries management, policy, control and enforcement, knowledge sharing, private sector investment	To contribute to the sustainable and equitable management of fisheries in ACP regions, thus leading to poverty alleviation and improving food security in ACP States. The specific objective of the Programme is to strengthen fisheries sectoral policy development and implementation.	Fisheries	regional organisations, government departments, universities and other tertiary sector research and training establishments	National and regional
FAO - RFLP		Regional Fisheries Livelihood Programme for South and Southeast Asia (RFLP)	2009 - 2013	Cambodia, Indonesia, Philippines, Sri Lanka, Timor-Leste and Viet Nam	Fisheries, aquaculture and post harvest	co-management, safety at sea, post harvest, strengthened and diversified income, microfinance, knowledge sharing, gender	improving livelihoods and reducing the vulnerability of small-scale fishing communities in the countries in which it operates.	Fisheries & aquaculture	Government ministries, local government, local authorities.	Local and National

FAO & Indian Ocean Commission (IOC)		Smart Fish	2011 - 2013	Burundi, Comoros, Djibouti, Democratic Republic of Congo, Eritrea, Ethiopia, Kenya, Madagascar, Malawi, Mauritius, Rwanda, Seychelles, Somalia, Sudan, South Sudan, Swaziland, United Republic of Tanzania, Uganda, Zambia, Zimbabwe, Mozambique, Reunion Island and South Africa	Fisheries	Food security is one of 5 focal areas which include trade, management, governance, and MCS	The overall objective of the programme is to contribute to an increased level of social, economic and environmental development and deeper regional integration in the Eastern and Southern Africa and Indian Ocean (ESA-IO) region through the sustainable exploitation of fisheries resources. The ultimate beneficiaries of the Programme will be the fishermen, coastal communities and wider populations of the ACP States of the ESA-IO region	Fisheries	Indian Ocean Commission (IOC), Common Market for East and Southern Africa (COMESA), the East Africa Community (EAC) and the Inter-Governmental Authority on Development (IGAD), Southern African Development Community (SADC), Indian Ocean Tuna Commission (IOTC), South West Indian Ocean Fisheries Commission (SWIOFC), the Lake Victoria Fisheries Organisation (LVFO) and the Lake Tanganyika Fisheries Authority (LTA)	
Ghent University	Research Center	-		Asia and Africa	Aquaculture	Sustainable aquaculture systems		Aquaculture		

GIZ	Donor	Wetland Biodiversity Protection Project Adaption to climate change through the promotion of Biodiversity	Ongoing	Bangladesh and Vietnam	Fisheries and aquaculture	Climate change, biodiversity and natural resource management, stewardship, and livelihoods	Ecosystem protection for the benefit of the local population, sustainable use of resources, biodiversity protection	Few fisheries themed programmes, majority of fisheries/aquaculture work falls under the broader themes of climate change, biodiversity and natural resource management.	Bilateral projects - Government institutions, sometimes NGOs and Universities Public-Private Partnerships (PPP)	Local and national
GIZ	Donor	Programme for sustainable management of natural resources	2005 - 2015	Philippines	Fisheries	conservation and sustainable use of the natural resources found in the nation's highland and coastal regions	Improved quality of life in the target areas	Broader theme of natural resource management	Philippine Department of Agriculture (DA), Department of Agrarian Reform (DAR) and Department of Environment and Natural Resources (DENR)	

GIZ / Ministère des Pêches et de l'Economie Maritime (MPEM)	Donor	Sustainable management of fishery resources	2010 - 2013	Mauritania	Fisheries	Sustainable economic policies are followed in Mauritania's fisheries sector. Resource conservation and resource utilisation are balanced.	By using its fish stocks sustainably, Mauritania can preserve some 40,000 jobs in the long run. This represents enormous economic potential in a country in which income from fisheries makes up almost half of profits from exports and about one-quarter of the national budget. As such, GIZ is supporting the preservation of traditional manual fishing skills and contributing to poverty reduction.	Fisheries	Mauritanian Government	
IFAD	Donor					Food security and nutrition; water,		Broader theme of food security and nutrition		Local, National and regional
IFAD	Donor	Fisheries Development Project	2010 - 2016	Eritrea	Fisheries	Food security, poverty alleviation, productivity, capacity building, institution strengthening,	To contribute to national and household food security and the alleviation of rural poverty; increase the fishery sector's contribution to the national economy; and to raise production and productivity of artisanal fishers while conserving fishery and other marine resources	Fisheries	Government ministries	Local and national
IFAD	Donor	Fisheries Investment Project	2012 - 2018	Yemen	Fisheries and aquaculture	Economic growth, livelihoods	To improve the economic status of small fisher households, by creating sustainable and diversified economic opportunities for poor women and men in fishing communities.	Fisheries & aquaculture	Government authorities	Local and national

Mekong River Commission	Inter-governmental agency	Fisheries Programme	1990 - ongoing 3rd phase 2011 - 2015	Cambodia, Lao PDR, Thailand and Viet Nam	Fisheries and aquaculture	Information generation; delivery of fisheries information; capacity building; fisheries ecology, valuation and management; aquaculture techniques; technical and institutional measures for fisheries management; governance; gender	“Riparian governments and other stakeholders make effective use of the Mekong’s fisheries resources to alleviate poverty while protecting the environment”. “Implementation of measures for sustainable fisheries management and development and improved livelihoods by regional and national organisations”	Fisheries & aquaculture	National government departments and ministries, SEAFDEC, ACIAR, ASEAN Regional Fisheries Management Mechanism (FMM), Network of Aquaculture Centres in Asia-Pacific (NACA), WFC, Wetlands Alliance (WA), WWF, and several major universities	Regional, national,
NEPAD	Donor	PAF - Partnership for African Fisheries Working groups on Trade and Governance, Aquaculture, IUU and Finance and Investment. West African Pilot Project (WAPP), Comprehensive African Fisheries Reform Strategy (CAFRS), Pan African Fisheries Framework and Reform Strategy (Think Tank)	Start 2005, ongoing	Africa	Fisheries, aquaculture and post harvest	Trade and Governance; IUU; Aquaculture; Finance and Investment; Fishery Improvement Projects (FIPs)	To improve the sustainability of Africa's fisheries and improve the returns provided by this sector. PAF supports emerging political commitment to strengthen Africa’s capacity to consider, determine and implement responsive policy reforms in fisheries governance and trade. Reforms are needed not only to ensure benefits are sustained, but also to generate and sustain wealth from fisheries	Fisheries & aquaculture	NEPAD, NPCA, National Government departments	National level focus

NEPAD & FAO	Donor	NEPAD-FAO Programme (NFFP)	Start 2012 - 4 years duration	Western and Central Africa	Marine fisheries and aquaculture	Governance, economic integration, ecosystem approach to fisheries and aquaculture, climate change adaptation, disaster risk management, sustainable development, post harvest value chain	Joint project aimed at boosting fisheries development in Africa and improving the standard of living of fishers on the continent. Its expected long-term impact is a significantly enhanced contribution of fisheries and aquaculture to poverty alleviation, food security and economic growth through improved and sustainable management of the fishery and aquaculture sectors.	Fisheries & aquaculture	NEPAD, FAO, NPCA, SIDA, National Government departments, local government.	Regional, national and some local pilot/case studies
NORAD	Donor			South and Southeast Asia and Sub Saharan Africa	Marine fisheries and marine aquaculture	Governance, natural resource management, ecosystem approach to fisheries and food security.	Programme is demand led through the embassies. Technical assistance can be provided for issues identified at the national level. NORAD also support larger programmes, including the EAF-Nansen programme and BOB-LME.	Fisheries & aquaculture	FAO, National Government departments, local government.	Regional, national and some local
Rhodes University (South Africa)	Research Center	-		Sub Saharan Africa	Aquaculture	Small scale aquaculture development including non fish and shrimp		Aquaculture		
Rockefeller Foundation		Strengthening Food Security: Alliance for a Green Revolution in Africa (AGRA)				Strengthening food security, Impacts and adaptation to Climate Change				
Royal Society Leverhulme	Research Center	-		Ghana	Aquaculture	Environmental and socioeconomic impact of cage culture on Volta lake		Broader theme of conservation		

Scotland Malawi Business Group	Donor	Aquaculture Enterprise Malawi	2013 - 2016	Malawi	Aquaculture	Food security, economic growth, commercially viable development	This new project aims to create and foster a supportive business environment in which an optimally located network of 60 small-scale fish farmers can operate on a commercial basis. The benefits deriving from the project will include employment opportunities throughout the production and supply chains and an increased supply of better value, high quality protein into Blantyre and its peri-urban markets, while directly and indirectly supporting the livelihoods of some of the poorer but entrepreneurial individuals in Malawi.	Aquaculture	Institute of Aquaculture - University of Stirling	Local
SEAFDEC - Southeast Asian Fisheries Development Center	Inter-governmental organisation	1) Developing and Promoting Responsible Fisheries for Poverty Alleviation and Food Security; 2) Addressing International Fisheries Related Issues from a Regional Perspective	1967 - present	South East Asia	fisheries, aquaculture and post harvest	food security, poverty alleviation	To develop and manage the fisheries potential of the region by rational utilisation of the resources for providing food security and safety to the people and alleviating poverty through transfer of new technologies, research and information dissemination activities	Thematic area	Development agencies, research centres, universities,	Regional and national
SEAFDEC - Southeast Asian Fisheries Development Center	Inter-governmental organisation	"Fisheries and Habitat Management, Climate Change and Social Well-being in Southeast Asia"	2013 - 2017	South East Asia	Fisheries				SIDA	Regional and national
SEI - Stockholm Environment Institute	Research Centre	Managing Environmental Systems - Food security, health and biodiversity	2010 - 2014	Southeast Asia and East Africa	Fisheries					
SEI - Stockholm Environment Institute	Research Centre	Sustainable Mekong Research Network Programme (Sumernet)		Southeast Asia	Fisheries		Research network in Southeast Asia that develops local research capacity and develops new knowledge on environmental and resource		National research centres	Regional and national

							management issues.			
SEI - Stockholm Environment Institute	Research Centre	EU-FP7 - ECOLIVA - Sustainable Ecosystem Services and Livelihoods through Aquaculture Development			Aquaculture	Ecosystem services and Livelihoods	Investigate the linkages between the provision and valuation of ecosystem services, aquaculture development and sustainable livelihoods	Broader theme		
UNEP	Research Centre	UNEP Marine and Coastal Strategy for Africa	2010 - 2014	coastal states south of the Sahara including small island developing states in the eastern Atlantic and western Indian oceans	Fisheries	Ecosystem based approach, governance, CC adaptation,	Improve environmental governance, promote synergies and strengthen the coordination mechanisms of regional initiatives for the protection, management and development of the marine and coastal environment in Africa. The programme will aim to further address the interactive and cumulative human impacts on marine and coastal resources and raise awareness of solutions to cope with the competing uses of these resources especially in alleviating poverty.	Part of broader theme of coastal and marine resources	NGOs and research institutions	regional and national
University of Stirling	Research Center	EC FP7 SEAT	2009-2013	Asia	Aquaculture	Sustainable aquaculture; value chains; research networks; livelihoods;	To provide the evidence-base for the creation of an 'Ethical Aquatic Food Index'. The development of simple measures for reducing environmental, social or health impacts such as improving product efficiency, reducing packaging and the application of diagnostic tools for contaminants.	Aquaculture	Universities, WordFish, FAO	National, regional, global

University of Stirling	Research Center	SARNISSA - Sustainable Aquaculture Research Networks for Sub Saharan Africa	2009 - 2012	Sub-Saharan Africa	Aquaculture	Initiating regular communication among stakeholders (researchers, commercial and market sectors, government agencies, NGOs, and others) in order that collaborations can be initiated and nurtured.	To deliver a comprehensive interdisciplinary knowledge base required for Sub Saharan African aquaculture to develop in a sustainable way and so fulfil its potential to help increase farmers' incomes and increase food security.	Aquaculture	researchers, commercial and market sectors, government agencies, NGOs	
Wageningen University (Netherlands)	Research Center	Fisheries and aquaculture research programme; IMARES - RESCOPAR, Rebuilding resilience of coastal populations and aquatic resources: habitats, biodiversity and sustainable use options; POND; Mangrove; SuPa; ACCCU	Ongoing	Asia and Africa	Fisheries and aquaculture	From organism to population to ecosystem combining physiology with ecology focusing on social and environmental setting and interaction with stakeholders.	Academic research and education on sustainable Aquaculture and Fisheries, with a focus on society relevant questions and on the interactions between aquatic organisms and their environment.	Fisheries & aquaculture		
Walimi Fish Farmers Cooperative	NGO	6th Annual Fish Farmers Symposium Kampala Jan 2013		East Africa	Aquaculture	National Fish Farmers Cooperative Uganda, value chain development	Value chain development	Aquaculture		
Wetlands Alliance	NGO		Ongoing	South East Asia	Fisheries, aquaculture and post harvest	Poverty alleviation; local development and management, aquatic resources, institutional policy change and securing the resources needed to use the capacity	Aimed at providing support to local demand-led research and action that builds capacity and knowledge to better manage natural resources and reduce poverty.	Broader theme of wetlands and aquatic resources	NGOs, research institutes, local partners and international agencies.	Regional, national and local

						developed				
World Bank	Donor	Global Program on Fisheries (PROFISH)	Start 2005, ongoing	Global	Fisheries and aquaculture	Define policy frameworks for economic growth, poverty reduction, food security and climate change resilience; Develop and apply reform pathways and build partnership support; Define and apply best practice business models; Design and evaluate market systems; Develop and apply metrics for monitoring and evaluation	To promote and facilitate the contribution that fisheries and aquaculture can make to sustainable economic growth, better nutrition, economic opportunities for women, and poverty reduction.	Fisheries	FAO, OECD, Worldfish, NEPAD, development organisations and the private sector	Global, regional and National

World Bank	Donor	West Africa Regional Fisheries Program (WARFP)	2009 - 2014	Cape Verde, Senegal, Sierra Leone & Liberia	Fisheries	Scaling up the principles of local empowerment and allocation of secure rights to reduce open access; improve surveillance of fisheries; infrastructure;	Sustainably increase the overall wealth generated by the exploitation of the marine fisheries resources of West Africa, and the proportion of that wealth captured by West African countries. The three APLs would achieve this objective by: (i) strengthening the countries' capacity to sustainably govern and manage their fisheries; (ii) reducing illegal fishing; and (iii) increasing the value and profitability generated by fish resources and the proportion of that value captured by the countries	Fisheries	National fisheries ministries	Regional, National and local
World Bank	Donor	Mindanao Rural Development Program (MRDP 2) - Natural Resource Management Project for Philippines	2009 - 2014	Philippines		Rural development, management and governance,	MRDP2 seeks to further improve rural incomes and achieve food security through agri-fisheries infrastructure, livelihood enterprise, and biodiversity conservation projects.	Broader theme of agriculture and natural resources	World Bank, Department of Agriculture and Local Government Units (LGUs)	Local and National
World Bank	Donor	Coastal Resources for Sustainable Development Project	2012 - 2018	Vietnam	Fisheries, aquaculture and post harvest	Economic growth	To improve the management of coastal resources in support of sustainable fisheries in selected coastal provinces of Vietnam. broader goal of supporting coastal livelihoods as well as the viability and competitiveness of the fisheries sector at the national level, thus contributing to longer term national sustainable socio-economic development goals	Broader theme of coastal management	Ministry of Agriculture and Rural Development	Local and national

Past Initiatives

Institution	Type of institution	Programme(s) and/or specific project	Duration	Geographical Focus	Fisheries, aquaculture or post harvest	Focal Area(s)	Key research question / programme / project objectives	Thematic area: fisheries, aquaculture or part of a broader theme? What is the broader theme?	Partners/ Collaborators	Level of engagement i.e. local, national, regional, global
ADB	Donor	Aquatic Resource Development and Quality Improvement Project in Sri Lanka	2002 - 2010	Sri Lanka	Inland fisheries and aquaculture	Increased production; resource management; private sector investment; community based fisheries management; quality improvement; access to credit; export and distribution of products; institutional strengthening.	To support aquatic resource development and quality improvement in order to enhance food security and reduce poverty, especially in rural areas.	Fisheries and aquaculture	Ministry of Fisheries and Aquatic Resource Development (MFARD), National Aquaculture Development Authority (NAQDA), National Development Bank, National Development Trust Fund (NDF), University of Peradeniya	National and local

ADB	Donor	North East Coastal Community Development Project	2003 - 2012	Sri Lanka	Fisheries and post harvest	Livelihood improvement; gender; microfinance; natural resource management; fisheries development; increased efficiency and productivity; improved post harvest handling; institutional strengthening	To reduce poverty and meet basic needs in coastal communities with emphasis on improving sustainable livelihoods and sound management of natural resources.	Broader theme of coastal community development	Ministry of Home Affairs, Provincial Councils, and Local Government (MHAPCLG); The Eastern Provincial Council (EPC); National Development Trust Fund (NDTF); Central Environment Authority (CEA); Ceylon Fishery Harbours Corporation (CFHC)	National and local
ADB	Donor	Coastal Resource Management Project	1999 - 2010	Sri Lanka	Fisheries and some post harvest	coastline stabilisation; environmental and resource management; fisheries management; institutional strengthening.	To establish the integrated management of coastal resources to strengthen their sustainability.	Part of a broader theme of coastal management		National and local
CGIAR (Worldfish)	Research Centre	Livestock and Fish: Greater Harvest and Economic Returns from Shrimp (GHERS) initiative under Poverty Reduction by Increasing the Competitiveness of Enterprises (PRICE)	2008 - 2012	Bangladesh	Aquaculture	Economic development	Increasing yield and integrating value chain actors	Aquaculture	Chemonics Incorporated	national

CGIAR & Worldfish	Research Centre	Challenge Program on Water and Food (CPWF): Small Reservoirs Project : Planning and evaluating ensembles of small, multi-purpose reservoirs for the improvement of smallholder livelihoods and food security: tools and procedures	2004 - 2008	Brazil, Volta Basin and Limpopo Basin		Livelihoods and food security		Part of broader theme: Theme 3 Aquatic Ecosystems and Fisheries 15%		
DANIDA	Donor	Agricultural Sector Programme Support Phase 2 (ASPS II), Regional Fisheries & Livestock Development Component (RFLDC)	2006 - 2012	Bangladesh	Fisheries and Aquaculture	Aquaculture and fisheries extension provision; community based organisations (CBOs) and farmer associations; private sector linkages; local institutional strengthening; capacity building; gender	Improved and sustainable productivity of and returns from fisheries and livestock systems of resource-poor households.	Broader agriculture theme	Government departments of Bangladesh, Community Based Organisations (CBOs),	National
DANIDA	Donor	Fisheries Sector Programme Support	Phase 1: 2000 - 2005 Phase 2: 2006 - 2010 Extension to 2012	Vietnam	Fisheries	Extension programme - poverty reduction	Targets the poorest of the rural poor to enable them to benefit from the dramatic growth in the fisheries sector	Fisheries	Vietnamese Ministry of Fisheries.	National and provincial

DFID	Donor	Renewable Natural Resources Research Strategy (RNRRS): Fisheries Management Science Programme (FMSP), Aquaculture and Fish Genetics Research Programme (AFGRP) and Post Harvest Fisheries Research Programme (PHFRP)	1995 - 2006	Global	Fisheries, aquaculture and post harvest	Fisheries management; income generating activities; knowledge of aquatic stocks and their selection, enhancement and culture; livelihoods; food security; poverty alleviation; conflict reduction.	To improve the livelihoods and food security; improve fisheries management and to sustainably enhance production and productivity of renewable natural resource systems.	Fisheries and aquaculture were main thematic areas in the broad theme of renewable natural resources.	Government ministries, inter-government organisations, research centres, etc.	Local, regional
DFID	Research	Research into Use - Aquashops		Kenya	Aquaculture	Development of small scale commercial input suppliers and extension	Overall goal was to address ways to scale up successful innovations from agricultural research. The intention of RIU was to deliver the impact from the 10-year (1995 to 2005) DFID-funded suite of programmes on Renewable Natural Resources (RNRRS).	Broader theme of agriculture and renewable natural resources	Public-private partnerships	Local

Future Initiatives

Institution	Type of institution	Programme(s) and/or specific projects	Duration	Geographical Focus	Fisheries, aquaculture or post harvest	Focal Area(s)	Key research question / programme/project objectives	Thematic area: fisheries, aquaculture or part of a broader theme? What is the broader theme?	Partners/ Collaborators	Level of engagement i.e. local, national, regional, global
IFAD	Donor	IFAD Fisheries, Coastal Resources and Livelihoods Project (FishCORAL)	7 years, start 2014	Philippines	Fisheries	food security and nutrition	Enabling poor rural people to improve their food security and nutrition, raise their incomes and strengthen their resilience	Broader theme		

EU	Donor	Promotion of Inclusive and Sustainable Growth in the Agricultural Sector: Fisheries and Livestock (2013/S 025-037687).	4 years - in planning phase	Cambodia	Fisheries and aquaculture	Economic growth	To trigger sustainable and inclusive socio-economic growth in the fisheries and livestock sub sectors, through adequate support by the government, civil society and development partners, in line with Program-Based Approach principles	Thematic area		
IFAD	Donor	Mozambique: Artisanal Fisheries Promotion Project (ProPESCA)	7 year project	Mozambique	Fisheries and post harvest (value chain)	Economic growth	To improve the incomes and livelihoods of poor households involved in artisanal fisheries in the selected growth poles. Its development objective is to increase the returns from fish sales for artisanal fisheries and small market operators on a sustainable basis	Thematic area	Government ministries	Local and national

Appendix 5: Search Log

Date of Search	Search Database	Search term	Field	Date range	Number of results	Other
21.02.2013	Science Direct	fisheries' and 'nutrition'	Title, Abstract, keywords	1990 - 2013	42	Journals only
26.02.2013	Science Direct	fisheries' and 'food security'	Title, Abstract, keywords	1990 - 2013	70	Journals only
26.02.2013	Science Direct	fisheries' and 'health'	Title, Abstract, keywords	1990 - 2013	249	Journals only
26.02.2013	Science Direct	fisheries' and 'human health'	Title, Abstract, keywords	1990 - 2013	97	Journals only
28.02.2013	Science Direct	fisheries and economic development	Title, Abstract, keywords	1990 - 2013	297	Journals only
28.02.2013	Science Direct	fisheries and "economic development"	Title, Abstract, keywords	1990 - 2013	47	Journals only

Date of Search	Search Database	Search term	Field	Date range	Number of results	Other
28.02.2013	Science Direct	fisheries and "economic growth"	Title, Abstract, keywords	1990 - 2013	13	Journals only
28.02.2013	Science Direct	fisheries and economic growth	Title, Abstract, keywords	1990 - 2013	106	Journals only
28.02.2013	Science Direct	fisheries AND contribution AND "economic growth"	Title, Abstract, keywords	1990 - 2013	2714	Journals only
28.02.2013	Wiley On-line Fish and Fisheries Journal	economic development	All	1990 - 2013	205	
01.03.2013	Wiley On-line Fish and Fisheries Journal	"economic development"	All	1990 - 2013	29	
01.03.2013	Wiley On-line	fisheries AND "food security"	Abstract	1990 - 2013	51	Journals only
01.03.2013	Wiley On-line	fisheries AND nutrition	Abstract	1990 - 2013	20	Journals only
01.03.2013	Science Direct	fisheries and income	Title, Abstract, keywords	1990 - 2013	147	Journals only
01.03.2013	Science Direct	fisheries and employment	Title, Abstract, keywords	1990 - 2013	76	Journals only
01.03.2013	Science Direct	fisheries and wellbeing	Title, Abstract, keywords	1990 - 2013	5	Journals only
01.03.2013	Science Direct	fisheries and "human rights"	Title, Abstract, keywords	1990 - 2013	2	Journals only
01.03.2013	Science Direct	Aquaculture and Poverty	All	1990 - 2013	1144	
01.03.2013	Web of Science	Aquaculture and poverty	All	all years	69	
01.03.2013	ASFA	Aquaculture and poverty	All	all years	367	
01.03.2013	Google Scholar	Aquaculture and poverty	All	1990 - 2013	53	
01.03.2013	Science Direct	Aquaculture and food security	All	1990 - 2013	1857	
01.03.2013	Web of Science	Aquaculture and food security	All	1990 - 2013	94	
01.03.2013	ASFA	Aquaculture and food security	All	all years	567	
01.03.2013	Google Scholar	Aquaculture and food security	All	1990 - 2013	89	

Date of Search	Search Database	Search term	Field	Date range	Number of results	Other
01.03.2013	Science Direct	Aquaculture and nutrition	All	1990 - 2013	10462	
01.03.2013	Web of Science	Aquaculture and nutrition	All	all years	460	
01.03.2013	ASFA	Aquaculture and nutrition	All	all years	9747	
01.03.2013	Google Scholar	Aquaculture and nutrition	All	1990 - 2013	254	
04.03.2013	science direct	fisheries and wealth	Title, Abstract, keywords	1990 - 2013	20	Journals only
04.03.2013	science direct	fisheries and welfare	Title, Abstract, keywords	1990 - 2013	48	Journals only
04.03.2013	Science Direct	Aquaculture and human health	All	1990 - 2013	12264	
04.03.2013	Web of Science	Aquaculture and human health	All	1990 - 2013	330	
04.03.2013	ASFA	Aquaculture and human health	All	1990 - 2013	2114	
04.03.2013	Google Scholar	Aquaculture and human health	All	1990 - 2013	31900	
04.03.2013	Science Direct	Fish farming poverty	All	1990 - 2013	2227	
04.03.2013	Web of Science	Fish farming poverty	All	1990 - 2013	31	
04.03.2013	ASFA	Fish farming poverty	All	all years	74	
04.03.2013	Google Scholar	Fish farming poverty	All	1990 - 2013	34900	
04.03.2013	Science Direct	Aquaculture economic growth	All	1990 - 2013	9587	
04.03.2013	Web of Science	Aquaculture economic growth	All	1990 - 2013	397	
04.03.2013	ASFA	Aquaculture economic growth	All	1990 - 2013	1859	
04.03.2013	Google Scholar	Aquaculture economic growth	All	1990 - 2013	40400	
19.03.2013	science direct	fish and human health	Title, Abstract, keywords	1990 - 2013	838	Journals only
22.03.2013	science direct	fisheries and gender	Title, Abstract, keywords	1990 - 2013	37	Journals only
22.03.2013	science direct	fishing and gender	Title, Abstract, keywords	1990 - 2013	38	Journals only
22.03.2013	Wiley online	fisheries and gender	Article Title	1990 - 2013	3	Journals only
22.03.2013	Wiley online	fisheries and gender	Abstract	1990 - 2013	17	Journals only
22.03.2013	Wiley online	fishing and gender	Abstract	1990 - 2013	160	Journals only
22.03.2013	Science Direct	Aquaculture gender	All	1990 - 2013	1719	
22.03.2013	Web of Science	Aquaculture gender	All	1990 - 2013	201	

Date of Search	Search Database	Search term	Field	Date range	Number of results	Other
22.03.2013	ASFA	Aquaculture gender	All	1990 - 2013	358	
22.03.2013	Google Scholar	Aquaculture gender	All	1990 - 2013	15600	