The Hidden Harvests
the global contribution of capture fisheries

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Agriculture and Rural Development Department
Sustainable Development Network

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THE WORLD BANK

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Prepared by

The World Bank
Food and Agriculture Organization
WorldFish Center

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ABBREVIATIONS AND ACRONYMS

ADB	Asian Development Bank
BNP	Big Numbers Project
CPC	Central Product Classification
DANIDA	Danish International Development Agency
DFO	Department of Fisheries and Oceans (Canada)
EEZ	Exclusive Economic Zone
EROI	Edible protein energy return on investment
EU	European Union
FAO	Food and Agriculture Organization of the United Nations
FCP	Fishery Country Profile (FAO publication)
GDP	Gross Domestic Product
GGP	Gross Geographical Product
GT	Gross tonnage
HP	Horse power
IDAF	Programme for Integrated Development of Artisanal Fisheries in West Africa
IPOA	International Plan of Action
ISIC	International Standard Industrial Classification of All Industrial Activities
IUU	Illegal, unreported and unregulated (fishing)
LIFDC	Low income food deficient country
LSF	Large-scale fisheries
MDGs	Millennium Development Goals
MRAG	Marine Resources Assessment Group Ltd
MRC	Mekong River Commission
NOAA	National Oceanic & Atmospheric Administration (USA)
NZ	New Zealand
PROFISH	Global Partnership on Fisheries
RFMO	Regional fisheries management organization
SCAFI	Strengthening of Capture Fisheries Management Project (DANIDA, Vietnam)
SFLP	Sustainable Fisheries Livelihoods Programme
SNA	Systems of National Accounts
SSF	Small-scale fisheries
SUMA	Support for Brackish Water and Marine Aquaculture project (DANIDA, Vietnam)
UBC	University of British Colombia
UK	United Kingdom
UN	United Nations
USA	United States of America
VAR	Value-added ratio

Units of measure

ton(s)	metric ton(s)
$	United States dollar
TT$	Trinidad Dollars
NOK	Norwegian Kroner

FOREWORD

The important contribution of fisheries to human well-being is frequently underestimated. This report highlights that contribution.

Not only do fisheries generate employment for millions, but fish provides vital nutrition to billions and is often essential to the diet of the poor. About half of those working in the fisheries sector are women, mostly engaged in marketing and processing. However, foundations of this natural bounty, this infinite cash flow are threatened by overexploitation, pollution and habitat loss. This study strengthens the case for investment in sustainable fisheries and improvement of fisheries and aquatic environmental governance.

The report has a focus on small-scale fisheries and developing countries because the livelihoods of 90 percent of the 120 million employed in fisheries are in the small-scale fisheries and almost all, 97 percent, live in developing countries. It focuses on small-scale fisheries because many small-scale fishing communities have high levels of poverty and poverty reduction is a core focus of the contributing partners to the report.

Raising awareness of the importance of small-scale fisheries is particularly relevant not only because these livelihoods depend on sustainable use of the natural resource base, but also because these fisheries provide vital local nutritious food and a safety net for many poor households in coastal communities in developing countries. In developing countries these fisheries also underpin the social fabric of many communities.

Because of their concentrated and largely urban base and visibility as an important earner of foreign exchange, large-scale fisheries have been the target of considerable management efforts. Because of their variety, dispersion and social complexity, small-scale fisheries are often poorly documented, poorly regulated and many of the complex management issues remain largely unresolved. At a time when fisheries resources are increasingly depleted and climate change poses a growing threat, failure to effectively address the issues confronting small-scale fisheries places the livelihoods of millions of people at risk. By quantifying the global economic and social footprint of fisheries, this study calls for increased attention to issues facing both large and small-scale fisheries.

The study compiles information from case studies on countries representing over half of the world's fishworkers and draws on a range of published information to provide a global picture of capture fisheries from a largely social and economic perspective. It presents an estimate of the contribution of the fisheries sector to GDP, including recreational fishing and post harvest activities and highlights the importance of subsistence fishing.

The report is the result of a collaborative effort by FAO, WorldFish Center and the World Bank's Program on Sustainable Fisheries (PROFISH).

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Kieran Kelleher is the Fisheries Team Leader in the World Bank. He prepared the overall terms of reference for the study, proposed the methodology for raising the GDP estimates to the global level, prepared the recreational fisheries component and drafted the report.

Lena Westlund (World Bank and FAO consultant) synthesized the country case study materials, drafted the background study on the relative contributions of large and small-scale fisheries and undertook the initial estimates of their respective global contributions.

Eriko Hoshino (World Bank consultant) assisted by Glen-Marie Lange (Senior Environmental Economist, World Bank), Kieran Kelleher and Petter Jern (FAO) prepared the background study to estimate the contribution of capture fisheries to global GDP.

David Mills (WorldFish Center), a member of the initial study design tem, prepared the background study on subsistence fisheries and coordinated the country case studies prepared by WorldFish Center and was supported by Yumiko Kura and David Walfoort. David Mills applied the term 'hidden harvest' to fisheries in the context of the subsistence case studies.

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The study is the result of a joint activity with FAO and WorldFish Center, both of which are partners in Global Partnership on Fisheries (PROFISH). This study is one of a series of knowledge products produced by PROFISH[2]. Complementary PROFISH knowledge products include: *The Sunken Billions. The economic justification for fisheries reform*; *Changing the Face of the Waters. The promise and challenge of sustainable aquaculture*; and *Rising to Depletion. Towards a dialogue on the state of national marine fisheries.* These publications are available at www.worldbank.org/fish. A background study for this report was also prepared to inform policy and decision makers participating in the 28th Session of the FAO Committee on Fisheries.

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This Conference Edition is provided to expedite dissemination of the study findings. It is subject to further technical and editorial review prior to final publication.

[1] Preliminary report, *Small-scale capture fisheries: a global overview with emphasis on developing countries,* available at: www.4ssf.org.

[2] The donors to the PROFISH Partnership have included: UK Department for International Development, Ministry Foreign Affairs, Iceland, Norway and Finland, Ministry of Fisheries New Zealand and Agence Française de Développement. PROFISH also benefited from the support of FAO, WorldFish Center and IUCN.

EXECUTIVE SUMMARY

The contribution of the world's fisheries to national and global economies is substantially greater than generally recognized by decision-makers. Commercial fishing constitutes the economic base for an extended value chain through processing and marketing, through retailing and the restaurant and food service industry. Subsistence fisheries are important for food security and livelihoods while in some countries recreational fisheries are of greater economic importance than the commercial capture fisheries.

About 120 million people are directly dependent on commercial capture fisheries for their livelihoods. Ninety-seven percent (116 million) of the 'fish people' live in developing countries and 92 percent are involved in the small-scale fisheries sector. In the small-scale fisheries, almost half (48 percent) work in inland waters (lakes, rivers, wetlands), and about half (47 percent) are women, mainly engaged in the post-harvest activities, handling the fish after it is caught and ensuring that this important source of nutrition reaches more than 1 billion consumers for whom fish is a key component of their diets.

The total commercial capture fisheries sector's contribution to the global GDP (including marine and inland harvest and post-harvest subsectors), is estimated at approximately US$274 billion in 2007, with a 95% confidence interval (CI) of between US$252 to US$303 billion.

In addition, subsistence fisheries constitute a vital but largely un-quantified economic activity and livelihood component of rural communities and particularly of the poor. In some cases, the unrecorded subsistence fish production is greater than the officially recorded production, particularly in inland waters and for dispersed coastal communities. Global expenditures on recreational fisheries are some $190 billion to the global economy and provide recreation and food for some 220 million anglers.

The study is directed at decision-makers, the development community and fisheries professionals to emphasize the importance and hidden economic potential of the sector. It provides details of these important and largely under-valued economic activities with a view to increasing their economic and environmental contributions in a sustainable manner.

Given the increasing environmental pressures on fish stocks – from fishing, pollution and environmental disasters, from climate variability and ecosystem change, planners and decision makers can benefit from a greater awareness of the real value of fisheries and the economic activities underpinned by these primary resources. Similarly awareness of the relative footprints of the small-scale and large-scale fisheries and understanding of the important contribution of subsistence and recreational fisheries can inform policies and planning processes. This knowledge is fundamental to improved fisheries governance, to balanced decisions on integrated marine, coastal and water basin management, to aquatic food production, to the climate change agenda and to valuation of ecosystem services.

OBJECTIVES AND APPROACH

The objective of the study is to document the importance of fisheries and the footprint of the main sub-sectors. The study: (i) provides a disaggregated profile or footprint of the world's small-scale and large-scale fisheries; (ii) provides an estimate of the contribution of commercial capture

fisheries to GDP, including processing and marketing activities. The study complements these profiles of commercial fisheries with profiles of (iii) subsistence and (iv) recreational fisheries, which in some countries can be of greater economic importance than the commercial fisheries, and which often compete for the same resources.

In Part 1, the approaches to these four exercises are described and the assumptions and caveats explained. Further details of the methods are provided in the annex. The results are presented and aggregated in Part 2. Part 3 discusses the results and the implications for policy makers.

Estimating the relative contributions of large and small-scale fisheries

Disaggregating the small-scale and large-scale fisheries presents challenges as many countries do not report these activities as separate economic segments. Key indicators on production, employment, productivity, and economic contributions were compiled using 17 developing country[4] case studies and available information from OECD countries and from other developing countries.

The case studies on 17 developing countries form the primary quantitative basis for the developing country module of the global study. The quantified profile of large-scale and small-scale fisheries in the case study developing countries was complemented with existing information from OECD countries and other developing countries where recent sector studies have been completed (e.g. Pacific islands countries). Differences among countries in the definitions of small and large-scale fisheries were not addressed.

The sample results were compiled and raised to the global level using global fisheries statistical information available for the countries where the primary data is not available. The primary raising factor was the national catches as reported to FAO. Developing and developed countries and marine and inland fisheries were treated separately.

Recognizing the value of subsistence and recreational fisheries

Specific case studies on subsistence fisheries were undertaken in Bangladesh, Vietnam and the Philippines to complement and extend the case studies described above.

Quantifying the economic value of recreational fishing is challenging because of the difficulties in collecting and comparing data on activities which occur in a relatively informal way across a fragmented and geographically dispersed sub-sector and because the fish caught by recreational fishers are not part of a market transaction. Studies quantifying the breakdown of angler's expenditures were compiled. The proportion spent on fishing tackle (for example on rods, reels, lines, lures and associated equipment) was extracted. Available global information on the total demand for fishing tackle was then used to estimate global expenditures on angling. The value added resulting from these expenditures was estimated based on a limited number of case studies.

Estimating the extended fisheries sector GDP

Available national fisheries sector GDP estimates were compiled and examined to ensure consistency and to establish whether post harvest or aquaculture segments were included, or excluded. For some countries estimates of the post harvest contribution of fisheries to GDP are available, for example, a series of studies have been done in West Africa, in the Pacific Islands

[4], Bangladesh, Brazil, Cambodia, China, Ghana, India, Indonesia, Lake Victoria (Kenya, Uganda, Tanzania), Mozambique, Myanmar, Nigeria, Philippines, Senegal, Thailand and Vietnam.

and in several OECD countries. This sample was used to raise the harvest level GDP estimates (available for more than 120 countries) to the global GDP value including the post-harvest economic activities. This broader measure of the fisheries GDP (i.e. including post harvest activities) is of considerable importance as almost half the global capture fisheries workforce is engaged in the post-harvest economy. The post-harvest economic activities are normally considered as 'manufacturing' under the System of National Accounts (SNA) and generally not included in the reported fisheries sector GDP contribution.

Methodological issues

The study encountered three types of methodological issues: (i) issues of definition; (ii) issues of data; and (iii) assumptions.

A key definitional issue is the distinction between small-scale and large-scale, or industrial fisheries and the distinction between commercial and subsistence fishing. The definitions of small-scale and large-scale fisheries applied were those used by each of the case study countries. Consequently, at the aggregate or global level, the dividing line between small and large-scale is inevitably blurred. Similarly, there is an inevitable blurring of the lines between commercial, recreational and subsistence fishing. However the key message is that each of these segments generates wealth and benefits, and for each, good governance is underpinned by knowledge of their contributions to wealth and welfare.

As with many global studies, the lack of data for some countries, or the lack of disaggregation of data requires assumptions to fill these data gaps. The major data gaps encountered were in relation to: (i) deficiencies in the official records of the numbers and production of small-scale fishers, particularly in the highly dispersed inland fisheries; (ii) records, or estimates of post harvest labor in small-scale fisheries; (iii) deficiencies in assessing the scale and importance of subsistence fisheries; and (iv) the basis for national fisheries GDP estimates.

The outcomes of sample country analyses (case studies and other available country data) were extrapolated to the global level. The case study countries were selected to ensure coverage of countries where some 80% of the world's fishers live rather than presuming to be a representative sample. For example, in terms of catch, the Brazil case study does not reflect the dominance of large scale fisheries in other Latin American countries, such as Peru and Chile. Similarly, the global post harvest GDP contribution is raised on the basis of a limited number of GDP estimates, which disaggregate aquaculture, capture fisheries harvesting, and capture fisheries post harvesting activities.

Because of these issues, the results should be treated with due caution and critical evaluation in the light of emerging information or additional precision obtained from further studies. Additional work to quantify the scale and contribution of subsistence fisheries can refine the results presented in this study, as these findings are based on a quite limited number of country studies.

RESULTS

The following are the key results:

- About 120 million people are directly dependent on commercial capture fisheries for their livelihoods as fulltime or part time workers, including employment in the post-harvest sector.
- 97 percent of these people live in developing countries (116 million) and
- Over 90 percent work in the small-scale fisheries sector.
- 47 percent of the total workforce is women.
- Inland water fisheries are particularly important in developing countries and over half (60 million) of those employed in fisheries in developing countries work in small-scale inland fisheries.
- Subsistence fisheries remain largely un-quantified, but a vital resource for the poor and for food security. In some countries unrecorded and subsistence catches may be a substantial proportion of the total catch.
- Commercial capture fisheries including post-harvest activities are conservatively estimated to have contributed an estimated $274 billion to global GDP in 2007.
- Upstream economic activities (such as boatbuilding) and recreational fisheries may add a further $160 billion to the GDP estimate.
- Global estimated expenditures by some 220 million recreational fishers are in the order of $190 billion annually. Recreational fisheries can be of greater economic importance than commercial fisheries in some countries and contributes in the order of $70 billion to global GDP.

The country studies show the following:

- In the developing country case studies, there are 25 million fishers.
- When adding postharvest activities, there are 84.5 million fulltime and part time fishers and fish workers[5] in developing countries.
- The vast majority of fishers and fish workers work in the small-scale sector - only 6 percent are employed in large-scale fishing activities.
- In developed countries, there are about 1 million fishers and 2 million post-harvest workers, taking the total employment of the sector to about 3 million.

Extrapolating the 17 developing country case studies to the global set of developing countries shows:

- Total employment of 116 million in the sector of which almost 32 million are small-scale fishers.
- Close to 56 million of all jobs are held by women.
- Most of the fishers and fish workers live in Asia - almost 23 million (73 percent).
- In addition to fulltime and part time employment, the small-scale sector – in particular in inland waters – provides a source of food and income to millions of occasional fishers and fish workers.
- The sector plays an important role in food security and poverty prevention, constituting a security net for poorer populations both in inland water and coastal areas.
- Over half of the catch in developing countries is produced by the small-scale sector and 90-95 percent of the small-scale landings are destined for local human consumption.

[5] For Kenya, Tanzania and Uganda, only employment on and around Lake Victoria is included.

In addition, subsistence fisheries are a vital but largely un-quantified economic activity and livelihood component of rural communities and are particularly important for the poor and for food security. The unrecorded subsistence fish production may, in some cases, be greater than the officially recorded production, particularly in inland waters, or for dispersed coastal communities. The numbers of subsistence fishers at the global level and the importance of fish to such households are poorly quantified. There are an estimated 5.8 million fishers in the world earning less than $1 a day (FAO 2002a). Further, fish is a vital source of nutrition and feeds more than 1 billion consumers to whom fish is a key component of their diets.

Large-scale fisheries land more fish, but small-scale fisheries produce more fish for domestic human consumption. Like other primary production sectors, the fisheries sector tends to be more important in developing economies than in developed economies. The catch per unit of fossil fuel is similar in motorized small-scale and large-scale fisheries, but small-scale fisheries employ several times more fish people per ton of harvest than large-scale fisheries and generate less wastage in the form of discards (unwanted catch dumped at sea).

The global aggregate capture fisheries GDP (fishing and postharvest value-added combined) is slightly below 1 percent of global GDP. In addition, fisheries also create upstream employment and economic activity in other sectors such as boat building, gear manufacturing, port services, telecommunications, retailing and restaurants.

CONCLUSIONS AND RECOMMENDATIONS

The central aim of the study is to create a greater awareness of the socioeconomic contribution of fisheries to inform policy formulation both in the fisheries sector and in the broader political economy linked to the sector.

The economic and social contribution of fishing and the economic activities founded on fishing are frequently undervalued. In particular, the contribution of small-scale fisheries to livelihoods, to food security and food supply is often poorly recognized, partly because of weaknesses in compiling and disseminating knowledge on fisheries. Because of these knowledge gaps, policy-makers have often neglected comprehensive efforts to manage this complex and politically sensitive sector.

The study shows that official records substantially underestimate production, employment and fish consumption and economic activity associated with fisheries. The reasons include reduced investment in knowledge and statistical systems, a failure to capture diverse, dispersed or seasonal activities in standardized data collection schemes, fragmentation of data sources and sets, and weak human capacity in developing countries.

The solutions begin with making the knowledge systems more relevant to decision making, thereby justifying investment in monitoring key indicators which are directly relevant to economic productivity of the fisheries, to their role in poverty reduction, in economic growth, or in food security.

Much of the attention of fisheries managers has focused on large-scale fisheries, partly because they are urban-based, produce much of the fish entering international trade and because the

reporting units are more readily captured in statistical systems. However, even in the case of the large-scale fisheries the nature of the available information may not identify key trends in economic performance, for example, profitability, sustainability, or the impacts of competition with small-scale fisheries.

In the case of small-scale fisheries, the case studies show that the standard fishery production statistics frequently fail to approximate employment and socioeconomic contributions of small-scale fisheries, of subsistence production, or of recreational fisheries. As a result, the real economic importance of these fisheries often remains hidden, the pressure on fish resources under-estimated and the sector neglected in national, regional and local policies and plans. The developing country case studies also show that many of these fishery-dependent small-scale communities have high levels of poverty and may be further marginalized by a failure to recognize the importance of fisheries.

While the study compiles estimates for key indicators, it also highlights numerous limitations at local, national and global levels with regard to data availability, data use and data interpretation. The study reveals serious information deficiencies which undermine the understanding of decision-makers of the importance of the fisheries sector. In particular there is a lack of accurate and accessible information on the social and economic performance of fisheries, on their importance for employment and food supply, their role in poverty reduction and as a source of wealth and economic growth.

GDP and beyond

The economic contribution of fisheries as reported in national accounts does not reflect or capture the economic benefits generated by the entire fisheries value chain. Moreover, official fisheries GDP values tend to focus on large-scale commercial fisheries and may often under-estimate small-scale and subsistence production, trade and barter. In particular, the contribution of subsistence fisheries is unlikely to be reflected in GDP values and is substantially under-estimated in national fisheries production statistics in some countries. Similarly, as recreational fishing is often reported as part of the tourism sector, its value may remain inadequately acknowledged and actions to support its important economic contribution may fall victim to a lack of coordination between fisheries, environment and tourism authorities.

Despite a focus of this study on GDP, GDP values are but one indicator of the economic contribution of fisheries. GDP values do not necessarily reflect the potential of the sector to create net benefits, or economic rents, or contribute to employment and food security. An increase in fisheries GDP may simply mean increased costs of fishing, rather than an increase in productivity, or net benefits. Consequently, increases in sector GDP or employment need to be complemented with reference to indicators of the productivity of the sector and its economic and environmental sustainability – such as the state of fish stocks, long-term profitability and governance. [6]

Investing in knowledge for decisions

Capture fisheries have been described as ‘underperforming assets’ and a sector requiring governance reforms including strengthened tenure and fishing rights.

[6] See for example: World Bank reports *The Sunken Billions* and *Rising to Depletion* and WRI Governance Indicators.

The introduction of new or enhanced tenure schemes requires an inventory of users and use patterns. Fisheries dimensions of national policy and planning instruments, such as Poverty Reduction Strategy Programs, plans for river basins, coastal zones or marine spatial allocation also require quantification of the social and economic contribution of fisheries. The decisions made – either by communities, administrators, or politicians - need to be informed be an accurate characterization of the economic performance of the fisheries, their social contribution and their sustainability. Tracking performance means developing and monitoring actionable indicators including indicators of transparency in relation to tenure and resource allocation issues. Such registries of vessels, community rights, or catch entitlements serve both as an instrument of reform and a means to characterize the sector.

Consequently on many grounds there is ample justification for investment in fisheries data and knowledge. However, while recognizing the value of core data sets, action or decision-orientated indicators linked to economic performance and social welfare are more likely to be recipients of new investment in knowledge.

In developing countries it is unlikely that major investments in fisheries data collection and analysis will take place. Some reinforcement of the fisheries administrations' capacity can be built into sector projects, but given limited resources, synergies with other national data handling agencies are likely to be both cost effective and help stream fisheries concerns into decision matrices. Such agencies include units undertaking national accounts, household and nutrition surveys, or project impact assessment (for example, on dams, or offshore oil extraction). An increased capacity in the fisheries administration can target such linkages, finance inclusion of sector-specific questions in surveys and establish periodic sampling process for small-scale and subsistence fisheries.

The study also illustrates the key role of women in fisheries. Awareness of this role needs to be highlighted in projects and processes. The role of women in fisheries is not only in processing and marketing, but also as investors, as sources of credit, as managers of the household's fishing receipts and as consumers making important decisions on family nutrition. Improved knowledge of this role will inform policies, while empowerment of women through greater knowledge will improve decisions of fisheries households.

Countering threats

In an era of volatile fuel and food prices, changing climatic conditions, overfishing and growing environmental stresses, the declining economic and environmental efficiency of both small-scale and large-scale fisheries evokes the need for a clearer understanding of the sector's vulnerability and threats to sustainability. Small-scale fisheries are often part of diverse and complex livelihoods - at times a livelihood of last resort and a vital nutritional safety net and highly vulnerable to external and internal threats. Accurately characterizing their role and contribution is a first step towards improved management of these fisheries and building political will for reform.

Recommendations

1. National and international fisheries agencies and non-governmental organizations direct the attention of policy and decision-makers to the value of capture fisheries as a primary industry which underpins the economic activities of an extended value chain which can have an economic contribution several times the landed value of the catch. Short concise policy briefs can highlight the contribution to poverty reduction, nutrition and employment and emphasize that with good governance, sustainable fisheries can substantially increase economic wealth.

2. National fisheries authorities direct increased attention to the knowledge gaps exposed by the study. These include improved estimates of contribution of the entire sector to GDP, including post-harvest and upstream activities. While important to economic planners, the GDP values need to be complemented with social and environmental indicators, reflecting employment along the entire value chain, contributions to poverty reduction and food security and the economic performance of different fisheries.

3. The development community consider collaboration in preparation of:

(a) guidelines to evaluate the contribution of subsistence fisheries, including guidance on the use of household and nutrition surveys and poverty profiling to characterize subsistence fisheries;
(b) guidelines to estimate the extended GDP of the fisheries sector (consistent with the existing UN guidance7), including a typology of sector-specific multipliers and value chain analyses, including for developing countries;
(c) consensus guidelines on the preparation of estimates of economic rents and associated indicators of economic performance of fisheries;
(d) further development of fisheries governance indicators[8].

4. National fisheries specialists coordinate efforts to characterize subsistence and small-scale fisheries with agencies undertaking studies on household income and expenditure, nutrition and rural economy studies in developing countries to provide policy-relevant information for the development of pro-poor fisheries governance approaches. National fisheries authorities reinforce collaboration with tourism authorities and angler associations to evaluate and manage recreational fisheries.

5. National statistic offices and fisheries agencies in association with the development community collaborate to improved data collection and reporting of fisheries related economic activities, including specific attention to subsistence and recreational fisheries. These efforts may include:

(e) Disaggregation of fisheries statistical information at country level into large and small-scale in relation to specific policy issues such as access rights, food security and economic growth based on sustainable fisheries.
(f) Development of fisheries satellite accounts in national accounts.

[7] UN and FAO 2004. Integrated Environmental and Economic Accounting for Fisheries. Studies in Methods Handbook of National Accounting.

[8] For example: J. L. Anderson and C.M. Anderson, 2010

(g) Incorporation of specific fisheries data collection into existing information tools, such as household income and expenditure surveys to include fisheries information in the broader context of national economic growth, poverty reduction and wellbeing.
(h) Ensure effective use of limited resources by engaging with survey agencies (bureau of statistics, agriculture, nutrition departments) to provide specific advice and training on question design as well as specificities of the sampling frames required to capture the diversity of fishing activities and livelihoods and subsistence fisheries in particular.
(i) Agree on key indicators for the different segments of the fisheries sector to enable effective policy formulation and tracking of progress and trends. Make provisions for regular collection, compilation and dissemination of this key information.
(j) Develop partnership arrangements at regional and global level to improve quality and availability of key information on small scale fisheries and to support and improve the capacity for appropriate data collection and analysis, particularly in developing countries.

6. Development community consider development of partnerships or programs to make the value of the fisheries statistics/ knowledge more relevant and useful for decision-making and ensure that project level monitoring is streamed into country knowledge management systems

7. Use the formal mechanisms of the FAO[9] to improve collection and interpretation of statistical data on fisheries at national, regional and global levels including validation and improvement of the results presented.

8. Critically review the results presented with a view to improving the underlying data, rendering definitions and data sets more compatible and enhancing the basis for assessing the economic contribution for capture fisheries with the overall objective of improving fisheries management and laying a robust foundation for reforms.

[9] In particular the Coordinating Working Party on Fishery Statistics (CWP) http://www.fao.org/fishery/cwp/en with strengthened links to the Global Strategy to Improve Agricultural and Rural Statistics.

1 INTRODUCTION

The objective of the study is to demonstrate the importance of fisheries in economies, in particular in the economies of many developing countries. The study shows that the contribution of the fisheries sector is often poorly recognized, largely as a result of the fragmented nature of the harvest, post-harvest, subsistence and recreational activities and their treatment in reporting on the economy. The study indicates that because the primary harvesting activities support a range of economic activities, efforts to improve the governance of the sector warrant substantial additional attention from policy makers.

The importance of fisheries, especially small-scale fisheries, as a source of nutrition, employment and income for many of the world's coastal and rural poor is generally underestimated. In particular, small-scale fishing is a key livelihood strategy for millions of households in coastal and rural communities in developing countries and plays an important part in food security and poverty alleviation. The growing threat to sustainable fisheries represented by overcapitalization, overfishing and environmental degradation is not only a global concern, but is often a matter of survival for the many small-scale fishers and fish workers in developing countries who are dependent on these primary resources as a key component of their livelihood strategies.

Global and national economic statistical information on fisheries is particularly deficient for several reasons. Catching operations are highly dispersed making collection of comprehensive catch information challenging, particularly in developing countries. The variety of species and products, and the means of counting or measuring production (e.g. shell on/off, gutted, whole, dried, or salted) at point of harvest or first sale presents major technical problems. Illegal and deliberately unreported fishing is ubiquitous. Waste and discarding can account for over half the catch. The relationships between catches and economic returns are non-linear and complex.

Yet these basic information requirements are essential for policy and planning. The deficiencies lead to substantial underestimates of the economic importance of fisheries and undermine investment in good governance.

In particular disaggregated data showing the characteristics of the small-scale and large-scale sectors is lacking. Sector profiles distinguishing between marine and inland fisheries and distinguishing between harvest and post harvest employment and their respective economic contribution of these segments are often deficient. The contributions of the different fisheries segments – harvest and post-harvest are generally not clearly appraised and in particular the contribution of fishing to subsistence livelihoods - subsistence fisheries - remains poorly quantified. Improved knowledge is fundamental to address social and environmental issues in fisheries.

This under-reporting of production and underestimates of socioeconomic contributions of small-scale inland fisheries in particular undermines policy formulation on fisheries management, on the allocation of rights to waters, on inclusion in poverty reduction programs, and on assessment of losses from environmental damage.

The study addresses these critical knowledge gaps with a particular focus on small-scale fisheries in developing countries to direct the efforts by policy-makers and planners to address core tenure, allocation and valuation issues and to raise awareness of communities and authorities on the economic and social value of their fisheries.

Objectives

The primary objective of the study is to document the importance of fisheries and the footprint of the main sub-sectors. The study has three closely related objectives:

(a) to provide a disaggregated profile, or footprint, of the world's small-scale and large-scale fisheries.
(b) to provide an estimate of the economic importance of the fisheries sector, including processing and marketing activities.
(c) to complement these profiles of commercial fisheries with a profile of subsistence and recreational fisheries. In many countries, recreational fisheries can be of greater economic importance than the more extractive commercial fisheries, with which they often compete for the same resources.

The study addresses this knowledge gap with a robust methodology and a sample covering countries where the vast number of the world's small-scale fishers lives. The characteristics and contributions of the small-scale and large-scale commercial capture subsectors are compared and contrasted with particular emphasis on small-scale fisheries in developing countries. The study draws on information from 17 case studies in developing countries, representing over half of the world's fish people. It draws on existing analyses on developed countries and on independent studies on developing countries to build a global picture of small and large-scale fisheries.

The following sections describe the methods used, present the results and their implications for policy makers and planners. Further details of the methods used and the data analyzed are provided in the annex.

2 PART I. ESTIMATING THE ECONOMIC CONTRIBUTION OF GLOBAL CAPTURE FISHERIES

Part I provides an overview of the methods used in making the estimates. Additional details of the methods and the data used are provided in the annex. The terminology used in the study is as follows:

The focus of the study is on capture fisheries and references to 'the *fisheries sector*' generally mean commercial capture fisheries. The '*fisheries sector*' is taken to include post-harvest activities such as fish processing and economic activities which directly support fish production, such as net manufacture, or fishing vessel construction. Similarly '*fisheries GDP'* generally means the contribution of commercial capture fisheries to GDP. The fisheries sector, however also includes 'non-commercial' recreational and subsistence elements and, depending on the context, the term '*fisheries sector'* may also embrace these activities. Marine fisheries, inland fisheries, recreational fisheries and post-harvest activities are referred to as *'sub-sectors'*. Large-scale and small-scale fisheries and their associated post-harvest and supporting activities are referred to as *'segments'*. Though aquaculture is an increasingly important sub-sector, it is not considered in this study[10].

2.1 DISAGGREGATING SMALL AND LARGE-SCALE CAPTURE FISHERIES

The following sections of this report present and discuss how the estimates have been made and the underlying data issues, including how the fish landed by the different subsectors is utilized; the importance of fisheries for employment and in livelihoods; the apparent trends in fossil fuel consumption; and how fisheries contribute to national and local economies.

2.1.1 Diversity and scale

Capture fisheries is an extremely diverse sector that uses a wide variety of fishing techniques and technologies to harvest wild living aquatic resources. These range from hand-held rods and spears to trawls or purse seines over a kilometer long operated by industrial fishing vessels longer than a football field.

The term 'fisheries' means not only the harvesting of fish – the actual fishing operations – but also include processing and other postharvest and supporting activities. These related activities add further layers of complexity to the compilation of global knowledge on the sector.

Within this great diversity, there are vast differences in scale. Commonly the sector is divided into small-scale fisheries and large-scale fisheries. The definition of small-scale and large-scale, poses problems, especially at the global level (see annex for discussion). Nevertheless, several attributes distinguish these diverse sub-sectors. Large-scale fisheries, sometimes referred to as industrial fisheries[11], are often associated with high capital costs and sophisticated technologies.

[10] See: *Changing the face of the waters. The challenge and promise of sustainable aquaculture*. World Bank 2007, for a review of aquaculture.

[11] The term "industrial fisheries" is sometimes used for "fisheries which do not target species for direct human consumption, i.e. the capture of fish for reduction into fish meal and fish oil" (see, for example,

They tend to substitute labor with technology and tend to have an urban rather than rural or community base. Large concentrated landings tend to require specialized catch preservation and distribution and the economic benefits accrue directly through labor and indirectly thorough profit distribution and taxation. Small-scale fishing uses smaller fishing vessels (sometimes no vessels) and relatively low-technology fishing methods. Small-scale fisheries tend to be more labor intensive. They are often seen as an activity of low productivity, with low yield rates and low product value product directed mainly to local consumption. However, modern small-scale fisheries can be economically efficient and produce high value products for international markets. Technological developments, in particular motorization, modern navigation and communication equipment, globalization and food safety requirements have changed the way many small-scale fisheries operate. The diversity within each sub-sector is enormous with multiple areas of overlap between the sub-sectors providing a continuum, or spectrum of production and marketing systems from shoreline collection of shellfish to electronic auctions.

Nevertheless, the respective attributes of each sub-sector remain consistent across countries and continents. There are fundamental differences between large-scale and small-scale fisheries, differences that call for different approaches and perhaps different values to be applied in these different but coupled segments of a vital industry. This report justifiably focuses on the small-scale sub-sector – the fisheries less measured and managed, yet as important, if not more important than the large-scale fisheries.

Disaggregated information and separate analysis of large-scale, small-scale and inland fisheries creates a better understanding of their respective roles and social and economic importance. It can inform the tradeoffs between objectives: between poverty reduction and employment, foreign exchange and food supply; and it can inform the policies underpinning effective fisheries management. Investment in reforms and capacity to develop and implement governance systems adapted to the local specifics of small-scale fisheries will require political will founded on a greater understanding of the social, economic, nutritional and cultural importance of these fisheries.

2.1.2 The special focus on small-scale fisheries

Small-scale fishing and the associated commerce and food security is a key livelihood strategy for many millions of households living near coastal and inland waters, particularly in developing countries. As this report highlights, 97 percent of the world's fishers and fish workers live in developing countries and over 90 percent are employed in small-scale activities. In addition seasonal or occasional fishing often provide vital supplements to other livelihood activities in times of difficulty, or as a recurring if occasional activity. Fish supplied by small-scale fishers generally plays an important role in local food supplies and represents a vital source of animal proteins in local diets. At the same time, fish entering international markets provide much needed income and foreign exchange. These important roles provide strong rationale for devoting increased attention to small-scale fisheries.

2.1.3 Developing country case studies

Case studies on 17 developing countries formed the quantitative basis for the developing country module of the global study. The case studies were executed in full collaboration with the national authorities with a view to progressively accounting for the disparities and securing greater

www.fishonline.org/information/glossary/). However, in this report the term is used with reference to scale and is synonymous with large-scale fisheries.

inclusion of previously unaccounted fishing activities. The selected countries are not a random sample but include countries home to 70 percent of the world's fish workers and account for 40 percent of the world's and 56 percent of developing county reported catches. Additional detailed case studies were undertaken on subsistence fisheries in Vietnam and Bangladesh (described separately below). The developing countries were:

- Asia: Bangladesh, Cambodia, China, India, Indonesia, Myanmar, Thailand, Vietnam and Philippines
- Africa: Ghana, Mozambique, Nigeria, Senegal and three countries around Lake Victoria (Kenya, Tanzania, Uganda)
- Latin America: Brazil

Information on the following characteristics of the fisheries was compiled.

Production
- *Catch*
- *Catch for human consumption*
- *Waste and discards*

Employment
- *Numbers of harvesters*
- *Numbers of post harvest workers by gender*
- *Employment per ton of catch*

Efficiency
- *Catch per fisher*
- *Catch per ton of fuel*

Economic contribution
(aggregate GDP – see below)
- *Harvest GDP*
- *Post-harvest GDP*
- *Recreational GDP*

2.1.4 Developed country sample

The quantified profile of large-scale and small-scale fisheries in the case study developing countries was complemented with existing information from OECD countries and other countries where recent studies have been executed (e.g. Pacific island countries).

Information was compiled from a sample of 11 developed countries, representing about 14 percent of global reported catches and 47 percent of developed country catches[12]. These countries included eight EU members (Denmark, France, Greece, Italy, the Netherlands, Portugal, Spain and the UK) and Canada, Japan and Norway.

An approach similar to that used for the developing country case studies was applied with regards to the sub-sector definitions. However, information on the share of the catch for domestic human consumption and on discards was not available at subsector level in the sample countries.

Data were sourced from official statistics and research study reports and the most recent values available were used. Most data are from the 2005-2007 period, but some earlier data was used as necessary.

Because of the way in which data were available, most of the information on employment – both fishers and postharvest employment – was expressed in fulltime equivalents. The postharvest jobs

[12] Calculated using average landings 2004-06 from FAO FishStat Plus (FAO, 2008).

referred mainly to employment in fish processing and include employment related, not only to processing of fish from domestic capture fisheries, but also from aquaculture production and imported fish. In general, jobs in marketing and sales, in particular at the retail level, are not captured. Employment in upstream and support activities (e.g. boat building, gear repair, provision of fuel) is not included.

The sample of developing and developed countries account for 88 percent of reported marine catches and 74 percent of reported inland catches. Summary tables of the data collected for the sample developed countries are included in the annex.

2.1.5 Use of statistical data

The data was disaggregated to separate small-scale from large-scale fisheries on the basis of the definitions used by the countries studied; to separate marine from inland (freshwater) fisheries; and to separate harvest from post harvest activities. The studies assessed employment, catches, food fish supply and investment and operation costs, including fuel consumption. These variables – mainly focusing on food security at the household level – were selected largely because they had also been included in earlier analyses (see annex).

Several of the case study countries did not have formal definitions of small and large-scale fisheries but a classification was agreed upon with national experts and government officials for the purpose of the case study. However, no attempt was made to harmonize the definition of small-scale and large-scale fisheries across countries. The definition used for each case study country is given in the summary tables in the Annex (see Annex for more detailed discussion on definitions).

Throughout the study, the term *catch* is considered as equivalent to *landings.* However, the two terms are not equivalent and discards are generally not included when referring to catch (see below). Quantities of all aquatic animals are given as 'live weight equivalents', that is, the weight of the catch prior to gutting, heading, or similar treatment. Seaweed and other aquatic plants, pearls and marine mammals are generally excluded from the study. Reference to the catch of a country or in a region means the catch of the fleets registered in that country or region, rather than the catch taken from the waters of that country, or region. Catches from recreational fisheries are generally not included in the disaggregated profiles as the estimates represent only commercial fisheries (and subsistence and recreational fisheries only to the extent that they are included in official fisheries statistics).

2.1.6 Raising the sample data to the global level

2.1.6.1 Developing countries

The results of the case studies were used to estimate key indicators for all developing countries as a group. Because important fish meal producing countries were not represented in the developing country case study sample, the share of production for domestic human consumption was not included in this exercise. As estimates of discards in the developing country case studies were largely based on external information, no attempt was made to assess discards for all developing countries based on the case study results.

To obtain the aggregate employment values, the number of fishers and fish workers by subsector in case study countries was included as per case study estimates. For other countries, the case studies' average catch per fisher ratio and re-estimated catch quantities were used to calculate the number of fishers in each subsector. The basis for re-estimating catches was the difference that

case study data on catches by subsector showed when compared with marine and inland production averages for 2004-06 from FAO FishStat Plus data. For all case study countries excluding China[13], the case study data showed, on average, 10 percent higher catches in the marine subsector and 70 percent higher for inland fisheries, reflecting assumed underreporting. The production of all other developing countries was raised proportionately, dividing it between small and large-scale fisheries according to the averages obtained in the case study countries. Small-scale fisheries represented 64 percent of total marine catches and 96 percent of inland catches. Adjustments were made, based on complementary data (e.g. FAO Fishery Country Profiles), with respect to known anomalies. By dividing these re-estimated catch quantities with the catch per fisher ratios from the case studies, estimates of the number of fishers by country were obtained. These estimates were cross-checked with other available information and adjusted as and when required.

Post-harvest sector employment was calculated according to the average multiplier (number of postharvest jobs divided by number of fishers) of the case studies. Likewise, the number of women involved in the fisheries sector was calculated using the average proportion of women in total employment as derived from case studies.

2.1.6.2 Developed countries

To arrive at employment numbers for developed countries as a group, the same principles and method were used to extrapolate sample country data as were used for developing countries. The number of fishers by subsector in the non-EU sample countries was included as given. For the EU (EU-25), data were available on total fulltime and part time employment[14]. For other developed countries, the sample countries' average catch per fisher ratio and the recalculated catch volumes were used to calculate the number of fishers in each subsector.

For the re-estimate of catches, data from the sample developed countries were combined with FAO FishStat Plus data (averages of catches for 2004-06 in marine and inland waters) for other countries to provide totals for marine and inland catches by all developed countries. Using the findings from the developing country case studies as well as considering estimates of IUU fishing (Agnew *et al.* 2008), the total marine production was then raised by 10 percent overall and large-scale marine fisheries by another 5 percent, re-estimating the total marine catch at some 13 percent higher than reported catches according to the FAO FishStat Plus data[15]. Comprehensive information on inland fisheries was not available for most of the sample developed countries. The division of catches between small and large-scale fisheries in the marine sector was based on the average proportions of the sample countries; 23 percent of marine catches were assumed small-scale production. All inland catches were considered to be small-scale. The re-estimated catches

[13] The Chinese case study provided catch estimates that were about 10 percent lower than officially reported catches (compared to the FAO FishStat Plus data), both for marine and inland production. While these estimates were considered valid for the country itself, it was deemed incorrect to allow this particular case to influence the re-estimation of catches for other countries.

[14] From Salz *et al*, 2006. Unlike the information in the individual sample country data compilation that was generally expressed as fulltime equivalents, Salz *et al* give total fulltime and part time employment figures. These were adjusted for assumed decreases in employment from the year of the study (2005) to present day levels, i.e. 2008 (based on personal communication, P. Salz).

[15] According to Agnew et al (2008), key IUU fisheries include large-scale international fisheries and IUU catches amounted to between 11 and 26 million tonnes in 2003, representing between 13 and 32 percent of total global landings when compared to the reported catch figure of 81.5 million tonnes (FAO, 2007). The BNP study applies the lower range of this estimate to the re-estimation of catches by the developed country group.

were divided by the average catch per fisher values obtained from the sample of developed countries to arrive at an aggregate number of fishers for all developed countries.

2.1.7 Assumptions and issues

There is a large global diversity of fisheries and fishery systems, but there are sufficient common features to distinguish small-scale and large-scale fisheries as two principle segments for the purposes of global policy discussions or country-level monitoring efforts. The definitions of large-scale and small-scale fishing used in this report are those specified in the respective national or regional (in the case of the EU) statistical systems. It is recognized that summing these categories across countries presents certain difficulties and every effort will be made to standardize the units. Official fisheries data on catches and employment at these different scales are not always reliable. This is the case for all types of fisheries but it is of particular concern with regard to small-scale fisheries. Due to their informal and dispersed characteristics, catches of and employment in inland fisheries tend to be greatly underreported. In particular estimates of the importance and extent of subsistence fishing are deficient. This study addresses this gap, but for a limited number of countries.

While the sample countries do not constitute a random sample, they cover a large percentage of the world's capture fisheries. The selected countries are home to some 70 percent of the world's estimated capture fishers and fish workers and account for about 40 percent of reported global catches and 56 percent of the reported catch of developing countries[16]. However, the group of case study countries did not include any of the major fish meal producing countries in Latin America. This makes the results less representative for a wider group of developing countries with regard to estimates of the use of catches (e.g. the share of production used for domestic human consumption).

However, as the disparate information has been compiled and synthesized across highly diverse fisheries and countries, the results must be treated with due caution. For example, there is no universally accepted definition of small-scale fisheries and as already noted, statistical information on small-scale fisheries can be deficient, or even non-existent.

The sample data is raised to the global level using a variety of different raising factors. The primary raising factor is country-level catch as reported to FAO. In the absence of evidence to the contrary, inland fisheries catches were assumed to be from small-scale fisheries - some inland waters, such as the Caspian Sea and North America's Great Lakes, are known to have important large scale fisheries. It is assumed that the sample reflects the global disaggregation of small and large-scale fisheries.

Disparities between official statistics, e.g. numbers of fishers, and the values obtained through the case studies exist. Consequently a global estimate, for example global catch, based on the case study results is higher than that estimated by FAO on the basis of the aggregate of the catches officially reported catches. The values presented are not intended to substitute for the official national, or FAO values. Rather, the anomalies demand that additional effort and resources are required to resolve the differences and that such resource are justified given that the contribution of capture fisheries to economies is considerably greater than portrayed by the official statistics.

[16] Calculated using averages 2004-06 based on data from FAO FishStat Plus (FAO, 2008). The grouping *developing countries* has been defined as listed in FAO FishStat Plus (FAO, 2008) with one exception; Cyprus has been removed from developing countries (to belong to developed countries in Europe).

The study complements official statistics allowing for a better understanding of the contributions and roles of small-scale and large-scale capture fisheries and the people they support

In some countries, separating statistical information on aquaculture from the information on capture fisheries presents particular challenges and a variety of cross checks were used to ensure consistency within and across countries. The assumptions used in raising the sample to the global level are described in the preceding section. The results can be considered as best estimates to which future studies can add precision.

2.2 UNCOVERING THE HIDDEN HARVESTS OF SUBSISTENCE FISHERIES

Subsistence fisheries can be considered a sub-set of the small-scale fisheries and also have a close link to recreational fisheries. The process of preparing the developing country case studies indicated that the contribution of subsistence fisheries was considerably more important than anticipated. Consequently three detailed studies on subsistence fisheries were undertaken: Bangladesh, Vietnam, Philippines – in each case using available data, that is, no field surveys were undertaken.

The working definition of subsistence fisheries used was:

> *'….those fishers who are poor, fish mainly for food and may exchange or sell surplus harvest to meet other basic needs' (*Sowman 2006).

The methods used differed substantially in Bangladesh and Vietnam, because of the nature, perceived reliability and coverage of the available data. A failure to satisfactorily complete the Philippines study indicates the complexity and difficulty in assessing the subsistence fisheries.

In the case of Bangladesh, detailed studies, prepared over a 10-year timespan as part of the Flood Action Plan (FAP), were reanalyzed. The outputs from 34 districts were extrapolated to national level using a neighbor/ influence model and updated using the 2001 population census values. The Compartmentalization Pilot Project (CPP) was used to calibrate changes resulting from flood control measures.

The Vietnamese case study took separate approaches to assessing the magnitude of, and involvement in, fishing activities. Direct and indirect data was used in a production balance sheet to re-assess the likely magnitude of capture fishery activities, inclusive of subsistence fishing. These estimates were compared to alternative estimates for total supply. A series of detailed provincial case studies provided data on fishery participation and laid a basis for scenarios extrapolating these data to the national level.

The Bangladesh study is considered the more robust while the Vietnam results are considered to provide reasonable estimates given the weakness of the underlying data. The data gaps means that the Vietnam estimates do not include the marine sector for which additional field work would be of benefit. Additional details of the case studies are provided in the annex.

2.3 ESTIMATING THE EXTENDED GLOBAL GDP CONTRIBUTION OF COMMERCIAL CAPTURE FISHERIES ALONG THE VALUE CHAIN

This study provides an estimate of the commercial capture fisheries sector's contribution to global GDP. GDP was selected as a key indicator of the role of fisheries in a country's economy. Capture fisheries employment is addressed in a previous part of the study. Fisheries sector trade balance[17] and other important indicators were not included in the scope of this study. The term 'commercial' is used essentially to distinguish the segment from recreational or subsistence fisheries, while acknowledging that there may be overlap with these segments.

Within the System of National Accounts (the standardized approach to quantifying a country's various economic activities, see annex for details), the contribution of the fisheries sector to GDP is generally recorded in terms of the value at the point of harvest, or first sale. This means that, for example, the economic value of associated and dependent economic activities, such as boatbuilding or fish processing, are recorded as part of the manufacturing sector. In estimating the global economic contribution of capture fisheries, this study considers not only the economic activities to the point of first sale, but also the downstream economic activities.

This is referred to as the 'extended GDP contribution' and was estimated s follows:

(a) Available GDP estimates were compiled for 129 countries, in 26 of which GDP information disaggregated into harvest and post-harvest sub-sectors was available.
(b) A GDP post-harvest multiplier (ratio of harvest to post-harvest GDP) was derived based on these 26 countries (value = 1.76, with a range of 1.55 to 2.04 at a confidence interval of 95%)
(c) The GDP post-harvest multiplier was applied to the reported harvest GDP for those countries for which post-harvest GDP was not available (109 countries).
(d) The percentage contribution of both harvest and post-harvest subsectors to total national GDP for each of the 129 countries was calculated.
(e) The percentage contribution was converted into monetary value, using the reported national GDP data[18] (measured in current U.S. dollars in 2007) from the World Development Indicator database.
(f) The extended global GDP contribution of commercial capture fisheries is the sum of these monetary values.
(g) Lack of GDP data, weak specification, or disaggregation of the available GDP data precluded isolation of the aquaculture sub-sector (GDP data available for only 18 countries, representing 7% of global production) and the upstream economic activities (e.g. fishing vessel construction).

Based on available literature and online sources, efforts were made to separate the contribution from catching and farming subsectors for these 18 countries. In the absence of evidence to the contrary, the available GDP values were assumed to include aquaculture and were adjusted using the proportion of the harvest contributed by aquaculture as per the FAO Fishstat production values.

The study also provides an overview and selected results from alternative approaches to measuring the contribution of the fisheries sector to GDP (value added ratios, value chain

[17] The global supply and demand for fish is being addressed in a separate study.
[18] Source: http://siteresources.worldbank.org/DATASTATISTICS/Resources/GDP.pdf

analyses and input-output analyses, see annex). The report identifies the information gaps, issues and limitations of the current approaches and available GDP estimates.

2.3.1 Methodological challenges

Several issues and challenges were identified during the estimation exercise.

(a) Many countries do not publish these GDP estimates, or statistics on value-added in the fishery sector. Where such data exist, insufficient detail is made available to enable the values to be compared or compiled across countries.
(b) Informal fisheries sector activities, such as non-commercial subsistence fishing, are generally not recorded in official catch or economic statistics. In addition, where significant levels of illegal fishing exist, the related economic activity may not be captured in available estimates of GDP.
(c) Other important economic activities which can be attributed to the fisheries sector, such as recreational fishing are rarely included in the estimates of the economic contribution of the fisheries sector.
(d) '*the compilers of national accounts do not appear to have consulted the relevant fisheries agencies or the industry when preparing their estimates'* (Gillett and Lightfoot, 2001).
(e) The year for which individual country harvest GDP estimates were available varies between 1990 and 2007. However, the majority of data referred to the 2000 to 2007 period (specification of the year was deficient for 14 countries).
(f) Where there is extensive vertical integration in the fishing industry primary production (harvesting) may not be fully reflected in the harvest level GDP estimates, for example, if the first sale is by a processing plant that owns a fishing fleet.
(g) GDP estimates are not derived using a common methodology across countries.

For these reasons, a consistent method, such as a simple compilation of National Accounts Statistics (NAS), to estimate the value-added from the fisheries sector at the global scale was not possible. The approach assumed that the harvest/ post harvest ratio derived from the 26 sample countries represents the universe of harvest/ post harvest GDP ratios. However, the extended GDP estimate can clearly be improved when more comprehensive, clearly specified and disaggregated fisheries sector GDP data becomes available.

2.3.2 Information sources

The National Accounts Statistics (NAS) compiled each year by the United Nations (UN) are the primary source of information on GDP and value-added by industry. These include statistics on value-added by industry for all reporting countries, but generally provide insufficient detail to identify fisheries sector activities. For example, data are presented as an aggregated value such as "Agriculture, hunting, forestry and fishing" (see Annex). Consequently, it is difficult to estimate the value-added from the fisheries sector at the global scale employing a consistent method such as the use of the NAS.

The values provided through the NAS need to be complemented and interpreted using other information sources. The study compiled data on fisheries/fishing GDP contributions for 129 countries, including 101 developing and 28 developed countries. Further details of the sources of information are provided in the annex.

Fisheries and Aquaculture Country Profiles produced by the FAO were a primary information source, providing fisheries GDP figures for 69 countries across all geographic regions. However, in many Country Profiles examined, the method used to estimate the reported GDP value was not specified and it was unclear whether the value referred to the primary sector alone, or included processing and related activities. In many Country Profiles it was also unclear whether the values for primary production included aquaculture. The exceptions were Belize, Fiji, Madagascar, and Norway, where aquaculture production was specifically included. Unless otherwise specified it was assumed that the data refer to the primary (harvest) sector alone.

GDP values were also obtained from the official economic and fisheries reports produced by individual countries and from online sources. As in the FAO Profiles, in many cases the method used to estimate GDP and the data sources were not sufficiently specified. For the developing countries, the values available for the South Pacific islands countries (Gillett and Lightfoot 2001, Gillett 2009) and for West and Central Africa (various SFLP project reports) are notable exceptions, stating clearly how the values were obtained and the economic activities included in the estimates.

2.4 ESTIMATING THE ECONOMIC CONTRIBUTION OF RECREATIONAL FISHERIES

Recreational fisheries may be considered as a special form of small-scale fisheries. To some extent they overlap with subsistence fisheries as part of the catch is consumed by the fisher or the fisher's family, or associates. In some cases some or all of the catch may be sold to offset the costs to the sport, or small-scale commercial fishing may masquerade as recreational.

The fish caught by recreational fishers are not part of a market transaction, so the economic contribution of the recreational sub-sector requires alternative approaches to valuation. The approach taken in available national assessments is either to estimate the 'economic welfare' or the total expenditures made by anglers. The 'economic welfare' measure includes not only the aggregate market transactions (total purchases made by anglers), but also an estimate of their 'willingness to pay' (i.e. an angler may be willing to pay more than the cost of the fishing license for the authorization to fish). The approach taken in this study is to determine the aggregate value of the purchases made by anglers, e.g. expenditure on registration fees, ice, bait, accommodation, boat hire, fishing equipment, and travel costs. Most studies acknowledge some overlap and possible double accounting with the tourism sector.

Expenditures made by anglers for recreational fisheries, estimates of the sub-sector's contribution to GDP (total expenditure and/ or value added) and estimates of numbers of recreational fishers (anglers) were compiled from available literature. From the available studies the percentage of expenditures attributable to fishing equipment was derived. The sample value (mostly from OECD countries) was raised to the global level using available regional and global estimates of the sales of recreational fishing equipment. The numbers of recreational fishers, or anglers was estimated in the same manner.

3 PART II. RESULTS

The results are presented in the following order:

(a) The global profiles of small-scale and large-scale commercial fisheries are presented, as extrapolated from the case studies and sample countries, followed by
(b) the details of the developing country case studies and sampled developed countries.
(c) These country studies are complemented and amplified by the results of the subsistence fisheries case studies.
(d) The estimates of the contribution of commercial capture fisheries to global GDP and
(e) the economic importance of recreational fisheries are presented.

3.1 THE GLOBAL PROFILES OF SMALL-SCALE AND LARGE-SCALE COMMERCIAL FISHERIES

The sample of developing and developed country fisheries profiles were extrapolated to the global level. The following three tables quantify selected characteristics of the global capture fisheries. Key points include:

- There are an estimated 35 million commercial fishers in both developing and developed countries (harvest sector).
- Adding employment in the post-harvest sector indicates that some 119 million people are directly dependent on capture fisheries for their livelihoods, as fulltime or part time workers.
- Ninety-six percent of these people live in developing countries (116 million) and
- The vast majority of fishers and fish workers (over 90 percent) are employed in the small-scale sector; only 8 percent work in large-scale fisheries.
- Inland water fisheries are particularly important in developing countries and over half (60 million) of those employed in fisheries in developing countries work in small-scale inland fisheries.
- Fisheries are more important to national economies in developing countries than in developed.
- Large-scale fisheries land more fish in total but small-scale fisheries produce more fish for domestic human consumption.
- Almost half of the fish people - the workforce - are women (47 percent).
- Almost half the workforce operates in inland waters (48 percent).
- Small-scale fisheries generate less wastage in the form of discards, that is, catch that is not landed but disposed of at sea.
- The catch per unit of fossil fuel consumed by the motorized fleets is similar in the small and large-scale sector, that is, the level of fuel efficiency is similar

The importance of fisheries, especially small-scale fisheries, as a source of nutrition, employment and income for many of the world's coastal and rural poor is generally underestimated. In particular, small-scale fishing is a key livelihood strategy for millions of households in coastal and rural communities in developing countries and plays an important part in food security and poverty alleviation. The scale of subsistence fisheries has proved difficult to verify empirically,

but it is clear that it is substantially underestimated and that conventional fisheries statistics do not reflect its importance.

Fish is the world's most traded food about 37 percent of reported production (FAO 2006). Large-scale fisheries account for a substantial proportion of most of the trade in capture fishery products. In many countries large-scale fisheries provide important foreign exchange earnings and imports of the products of large scale fisheries (particularly small pelagic fish such as sardines, or mackerel) are vital to fish food security in a number of developing countries, particularly in sub-Saharan Africa where fish consumption is about half the global average.

The following three tables summarize the profiles of small-scale and large-scale fisheries at global level and in developing country and developed countries. The tables were prepared based on the sample countries and raised to the global level as described in the methodology.

Table 1. Global profile of small-scale and large-scale fisheries

The fisheries	**Small-scale**			**Large-scale fisheries**			***Total***
	Marine	Inland	***Total***	Marine	Inland	***Total***	
Production and utilization							
Total annual catch (million tons)	34	14	*48*	56	1	*57*	***105***
Value (billion $)	37	9	*46*	49	0	*50*	***96***
Discards (expressed as share of total catch)	4%	0%	*3%*	13%	3%	*13%*	***8%***
Employment (million fulltime and part-time)							
Number of fishers	14	18	*32*	2	1	*3*	***35***
Number of jobs in postharvest	38	38	*76*	7	0.5	*8*	***84***
Total workforce	52	56	*108*	9	2	*11*	***119***
% of women in total workforce	36%	54%	*46%*	64%	28%	*60%*	***47%***
Efficiency							
Catch tons per fisher	2.5	0.8	*1.5*	25.7	0.6	*18.3*	***3.0***
Tons of fish caught per ton of fuel	1-3	N/A	*N/A*	1-4	N/A	*N/A*	***N/A***

* Refers to catch that is not going to non-food uses or is exported.

In the developing country case studies, small-scale fisheries land more fish compared to large-scale fisheries, but at the global level – when taking developed countries and major fish meal producers into account – large-scale fisheries account for the majority of the landings. However, small-scale fisheries produce more fish for domestic human consumption and in developing countries over half of the catch for this purpose is produced by the small-scale sector.

Table 2. Developing countries' profile of small-scale and large-scale fisheries

	Small-scale fisheries			Large-scale fisheries			
	Marine	Inland	*Total*	Marine	Inland	*Total*	***Total***
Production and utilization							
Total annual catch (million tons)	28	13	*41*	34	0.5	*35*	***76***
Value of catch ($ billion)	28	8	*37*	35	0.5	*35*	***72***
Discards (% of catches)	1%	0%	1%	5%	2%	5%	3%
Employment (million)							
Number of fishers	13	18	*31*	2	1	*3*	***34***
Number of jobs in postharvest	37	38	*75*	7	0.5	*7.5*	***82.5***
Total	50	56	106	9	1.5	10.5	116.5
Women in total workforce (%)	36%	54%	46%	66%	28%	62%	47%
Efficiency (tons)							
Catch per fisher	2.1	0.7	1.3	18.3	0.6	13.4	2.2
Fish catch per ton of fuel consumed	0.5-4	N/A	N/A	1-5	N/A	N/A	N/A

Note: Developing countries are defined according to the FAO FishStat Plus database (FAO, 2008).

Table 3. Developed countries' profile of small-scale and large-scale fisheries

	Small-scale fisheries			Large-scale fisheries			***TOTAL***
	Marine	Inland	*Total*	Marine	Inland	*Total*	
Production and utilization							
Total annual catch (million tons)	6	1	*7*	22	Very little	*22*	***29***
Value of catch ($ billion)	9	0.5	*9*	15	Very little	*15*	***24***
Discards (% of catches) (%)	15%	1%	*13%*	25%	N/A	*25%*	***22%***
Employment (million)							
Number of fishers	1	Very few	*1*	0.5	Very few	*0.5*	***1.5***
Number of jobs in postharvest	1	Very few	*1*	0.5	Very few	*0.5*	***1.5***
Total	2	Very few	*2*	1	Very few	*1*	***3***
Women in total workforce (%)	43%	44%	*43%*	38%	N/A	*38%*	***42%***
Efficiency (tons)							
Catch per fisher	9.5	8.6	*9.4*	67.8	N/A	*67.5*	***26.9***
Fish catch per ton of fuel consumed	1-2	N/A	*N/A*	2-4	N/A	*N/A*	***N/A***

Based on the developing country case studies, inland fisheries account for 23 percent of the total catch and some 90 percent of this production is used for domestic human consumption. In developed countries, inland fisheries are far less important although accurate data on catches (including recreational and subsistence fishing) are generally lacking.

The following sections provide additional details of these profiles.

3.1.1 Employment

3.1.1.1 Employment in developing countries

When extrapolating the case study results to all developing countries (using catch per fisher ratios and re-estimated catch quantities as described), the total employment in the sector is estimated at 116 million of which almost 32 million are small-scale fishers. Most of the fishers and fish workers live in Asia; almost 23 million or 73 percent (see table).

Table 4. Employment in capture fisheries in developing countries, by continent (thousands)

Continent	Small-scale fishers	Total fishers	Post-harvest employment	Total employment	% all developing countries
Africa	7,389	7,827	17,640	25,467	22%
America	1,156	1,523	4,086	5,609	5%
Asia	22,920	24,723	59,736	84,459	73%
Oceania	126	137	387	524	>1%
TOTAL	31,951	34,210	81,849	116,059	100%

Other estimates have been made of the total number of people employed in fisheries. FAO suggests there may be as many as 170 million people in full and part time employment in the whole fishery industry (that is, including aquaculture). The people employed generally provide for dependants and household members and the fisheries sector may support over half a billion people, almost eight percent of the world's population (FAO, 2009b). This figure does not include all those that depend on fishing and related activities as an occasional or complementary source of food and income along with other livelihood strategies.

3.1.1.2 Catch and employment by subsector in developed countries

While employment in fisheries has generally declined in developed countries (FAO, 2009 b), the employment in the sector still totals some 3 million, of which about 1 million is in the harvest and 2 million in postharvest activities. The small-scale sector with 74 percent of all jobs is the more important employer (see table).

Table 5. Summary results from developed countries (thousands)

	Small-scale fisheries			Large-scale fisheries			TOTAL
	Marine	Inland	Total	Marine	Inland	Total	
Number of fishers	663	98	761	326	2	328	1,089
Post-harvest employment	1,259	206	1,465	457	1	458	1,923
Total employment	1,922	304	2,226	783	3	786	3,012
Share of women in total workforce	43%	44%	43%	38%	29%	38%	41%

While these numbers may appear relatively low, especially compared with the developing country estimates, fisheries can be far more important at the local level than the aggregate values indicate. Moreover, multiplier effects can play an important role. In addition the employment figures for many countries are expressed in full-time equivalent so the actual number of people receiving income from fisheries is considerably higher. Estimates from the US indicates up to 27 percent 'ripple effect', that is, if output increased to create 100 new commercial fishing jobs, 27 jobs would also be generated in other sectors supplying inputs (US BEA, 2008). In the UK, a multiplier analysis, encompassing both indirect and induced impacts[19], estimated that the removal of the sea fishing and fish processing sectors would result in the loss of 138,000 jobs (Seafish 2007). This can be compared with the direct employment in the two sectors of about 22,000[20]. Additional information on multipliers is provided in the section on GDP estimates.

[19] An employment multiplier accounts for direct and indirect effects. However, there is also an induced effect employees spend get salaries and increase demand for other products and services, in turn requiring additional employment in the sectors producing these goods (The Scottish Government 2008)
[20] Fulltime equivalent.

3.1.2 The role of women

Women account for some 47% of the workforce, indicating that some 56 million jobs in the harvest and post-harvest sectors are held by women. While FAO and the World Bank have already addressed this topic[21], considerable additional efforts are required.

3.1.3 Production and utilization

The total annual capture fisheries production of the eleven developed sample countries amounts to 11.8 million tonnes. Small-scale fisheries account for 24 percent of this production. Officially reported catches from inland fisheries represent less than 1 percent of the total[22].

In the developing country case studies, small-scale fisheries land more fish compared to large-scale fisheries, but at the global level – when taking developed countries and major fish meal producers into account – it is the other way around. However, small-scale fisheries generally produce more fish for domestic human consumption and in developing countries it is estimated that over half of the catch for this purpose is produced by the small-scale sector. In the developing country case studies, inland fisheries account for 23 percent of the total catch and some 90 percent of this production is used for domestic human consumption. In developed countries, inland fisheries are far less important although accurate data on catches (including recreational and subsistence fishing) are generally lacking.

The case study information on the percentage of the catch used for direct local consumption (not used for animal feed or exported) is summarized below. While it is not possible to extrapolate the case studies to the global level, the available data suggest that some 45 percent of the global catch may be used for direct local human consumption.

Table 6. Percentage of catch used for local human consumption

	Small-scale fisheries			Large-scale fisheries			TOTAL
	Marine	Inland	Total	Marine	Inland	Total	
Lake Victoria, Bangladesh, Brazil, China, Ghana, Nigeria, Senegal, Thailand	77%	91%	81%	56%	N/a	57%	77%
Excluding China	88%	97%	93%	44%	N/a	46%	75%

Source: Case studies

3.1.4 Fuel and discards

Developing country fisheries and small-scale fisheries show significantly greater fuel efficiency. Many inland fisheries in developing countries do not use motorized vessels.

The discard rates tabled below should be interpreted with caution as the source data (Kelleher 2005) was compiled on the basis of fishing gears and not with a view to disaggregating small-scale and large-scale fisheries.

[21] See *Gender in Agriculture Sourcebook, Module 13 Gender in Fisheries and Aquaculture.* Agriculture and Rural Development Department of the World Bank, the UN Food and Agriculture Organization (FAO), and the International Fund for Agricultural Development (IFAD). Available at: www.worldbank.org/genderinag

[22] With a few exceptions, inland fisheries catch quantities for the sample countries were compiled from FAO FishStat Plus, averages for 2004-2006 (FAO, 2008).

Table 7. Catch per ton of fuel in marine fisheries (tons per ton of fuel)

	Small-scale fisheries			Large-scale fisheries			
	Marine	Inland	*Total*	Marine	Inland	*Total*	***Total***
Developing countries	2.2	0.7	1.3	18.3	0.6	13.0	2.2
Developed countries	1.9			3.5			3.2

Table 8. Discard rates in developing and developed countries (tons and %)

	Small-scale			Large-scale			
	Marine	**Inland**	**Total**	**Marine**	**Inland**	**Total**	**Total**
Developing – catch	30	12	42	34	-	34	76
Discard rate %	1	0	0.8	5	2	5	3
Developed - catch	6	1	7	22	0	22	29
Discard rate %	*15**	1	*13**	25	25	25	22
Total	36	13	49	56	0	56	105
%	3	0	3	13	25	13	8

Source: case studies; Kelleher 2005.

Notes: Rates according to case studies & Kelleher 2005 and adjusted to match total estimates made in Kelleher 2005 (8% global; 3.7% small-scale marine).

* The sample of fisheries in Kelleher 2005 is biased towards fisheries with high discard rates, which tends to increase the discard rate for small scale fisheries in developed countries.

3.2 SMALL AND LARGE-SCALE FISHERIES IN THE SAMPLE COUNTRIES

The results of the developing country case studies are summarized in the following table which divides fisheries into 'quadrants': small-scale and large-scale fisheries in marine waters and in inland waters. In summary:

- There are almost 25 million fishers in the case study countries. When adding postharvest activities, there are over 84 million fulltime and part time fishers and fish workers[23].
- 47% of the total workforce is women.
- The vast majority of fishers and fish workers work in the small-scale sector; only 6 percent are employed in large-scale activities.
- In small-scale fisheries, over half work in inland waters.
- Small-scale fisheries produce more fish for domestic human consumption than large-scale fisheries.
- In inland fisheries, which are mainly small-scale, 90 percent of the production is used for domestic human consumption.
- Small-scale fisheries generate less wastage in the form of discards, that is, catch that is not landed but disposed of at sea (expressed as a proportion to landed catch).

[23] For Kenya, Tanzania and Uganda, only employment on and around Lake Victoria is included.

Table 9. Summary results of developing country case studies

Developing country fisheries	Small-scale		Large-scale		Total
	Marine	Inland	Marine	Inland	
	(percent of total)		(percent of total)		
Number of fishers (million)	23.3		1.5		24.7
	40%	54%	4%	2%	
Post-harvest employment (million)	56.1		3.6		59.7
Total employment (million)	79.3		5.1		84.4
	45%	49%	5%	1%	
Number of women in total workforce (million)	36.6		3.1		39.7
	36%	55%	67%	31%	47%
Total catch (million tons)	28.9		11.4		40.3
	50%	22%	27%	1%	
Catch for domestic human consumption (million tons)	23.5		6.2		29.7
	77%	91%	56%	N/A	74%
Discards (expressed as % of total catch)	0.5%		5%		2%
	0.5%	0	5%	2%	

Source: Authors from case studies, Kelleher 2005.

Table 10. Summary results of developed country sample

	Small-scale fisheries			Large-scale fisheries			TOTAL
	Marine	Inland	Total	Marine	Inland	Total	
EMPLOYMENT							
Number of fishers	268,351	7,108	275,459	148,341	1,200	149,541	425,000
% of total	63.1%	1.7%	64.8%	34.9%	0.3%	35.2%	100.0%
Number of other jobs	507,853	14,724	522,577	211,925	510	212,435	735,012
Ratio	1.9	2.1	1.9	1.4	0.4	1.4	1.7
Total	*776,204*	*21,832*	*798,036*	*360,266*	*1,710*	*361,976*	*1,160,012*
*Total adjusted**	*763,301*	*21,745*	*785,046*	*350,537*	*1,710*	*352,247*	*1,137,293*
Women*	324,721	9,479	334,200	134,135	504	134,639	468,839
% Women*	43%	44%	43%	38%	29%	38%	41%
PRODUCTION AND UTILISATION							
Total annual catch (tons)	2,746,912	82,064	2,828,976	8,989,268	22,612	9,011,880	11,840,856
% of total	23.2%	0.7%	23.9%	75.9%	0.2%	76.1%	100.0%
Value of catch ($ million)	9,196	642	9,838	14,297	28	14,325	24,163
Average value ($/ton)	3,348	7,823	3,477	1,591	1,237	1,590	2,041
Contribution to domestic animal protein intake **							12%
% of catch used for local human consumption ***	75%	92%	75%	58%	58%	58%	62%
Catch/fisher (tons)	10.2	11.5	10.3	60.6	18.8	60.3	27.9
Tons fish caught / ton fuel (1)	1.9		1.9	3.5		3.5	3.3
Discards (% landings)(2)							11.1%

Source: sample country studies. * Excluding Norway ; ** Only EU countries excluding France and UK.
*** Same proportions among subsectors as in developing countries assumed
(1) Marine fisheries. EU countries only.
(2) Only Norway, Canada, Japan & France

The following sections of this report explore these results further and also briefly discuss related issues such as production estimates, fish consumption and trade, and fuel consumption and costs.

3.2.1 The people in commercial fisheries

3.2.1.1 Developing countries

In the developing country case study countries, there are close to 25 million fishers. However, while fishing itself is clearly an important source for employment, the bulk of fisheries employment is in the postharvest sector, that is, in fish processing and marketing. The case studies indicate that for each person employed as a fisher, on average, there are 2-3 people employed in post-harvest activities. When postharvest activities are included, there are over 84 million fulltime and part time fishers and fish workers in the case study countries. Over 90 percent of this total workforce is employed in the small-scale fisheries sector and over half work in inland waters - lake, river, flood plain and wetland fisheries (see table and box below). In addition there are many millions of occasional, or subsistence fishers although the importance of fish to their complex livelihood strategies is poorly quantified (see section on subsistence fisheries).

Table 11. Fulltime and part time fishing and postharvest employment in the case study developing countries (thousands)

Country	Number of fishers	Postharvest fish workers	Total employment	Percentage in small-scale	Percentage inland waters
*Bangladesh**	*1,576*	*1,677*	*3,253*	*97*	*67*
Brazil	391	102	493	82	48 [a)]
Cambodia	624	1	1,624	90	96 [a)]
China	3,522	8,556	12,078	99	10
Ghana	205	167	372	97	31
India	2,063	8,254	10,317	82	57
Indonesia	2,397	N/A	N/A	94 [b)]	23 [b)]
Mozambique	230	35	265	98	35
Myanmar	3,751	N/A	N/A	88 [b)]	40 [ab)]
Nigeria	1,230	5,270	6,500	95	26
Philippines	1,500	N/A	N/A	99 [b)]	48 [b)]
Senegal	85	45	130	92	34
Thailand	3,300	391	3,691	87	85
*Vietnam**	*3,653*	*N/A*	*N/A*	*96 [b)]*	*83 [b)]*
Lake Victoria (Kenya, Tanzania, Uganda)	196	30	226	89	100
TOTAL	**24,723**	24,528	38,949	92	42

Source: developing country case studies.
[a)] Includes fishers and fish workers in the large-scale sector as well. [b)] Fishers only. * see section on subsistence fisheries also. N/A: information not available.

The sector also generates employment upstream, i.e. related to input supplies such as boat building, engine and gear manufacturing and repairs, as well as providing various support services in harbors and at landing sites. These jobs are not as numerous as in the post-harvest sector but still constitute a non-negligible workforce. Case study information from Ghana and Senegal indicated that employment in backward linkages add another 5-10 percent to the total number of people employed, fulltime and part time, in fisheries.

Box 1: Inland fisheries in Cambodia

The extensive inland capture fisheries of Cambodia are based on two systems: the Mekong River and the Tonle Sap Great Lake. Small-scale fishing commonly involves family labor, using non-motorized small vessels – or no boats – in flood plains or rice fields. Fishing and related activities are generally integrated with other livelihood activities. It is estimated that there are some 496,000 fulltime and part time inland fishers, some of which are subsistence fishers. In addition, more than 920,000 people are involved in small-scale processing of inland catches. This takes place during the peak fishing period after the rainy season and employment is hence mainly part time and often organized on a household basis.

Source: Thouk et al, 2008 (Cambodia case study).

3.2.1.2 *Developed countries*

While employment in fisheries has generally declined in developed countries (FAO, 2009 b), the sector still provides a total of some 3 million jobs. There are about one million fishers and the remaining two thirds of the jobs are in postharvest activities. The small-scale sector is more important as an employer than the large-scale; 74 percent of all jobs are in small-scale activities.

Table 12. Estimated employment in developed countries (thousands)

	Small-scale fisheries			Large-scale fisheries			TOTAL
	Marine	Inland	Total	Marine	Inland	Total	
Number of fishers	663	98	761	326	2	328	1,089
Post-harvest employment	1,259	206	1,465	457	1	458	1,923
Total employment	1,922	304	2,226	783	3	786	3,012
Share of women in total workforce	43%	44%	43%	38%	29%	38%	41%

Source: Authors, based on sample countries.

While these numbers may appear relatively low, especially compared with the developing country estimates, it should be remembered that fisheries can be far more important at the local level than the aggregate values may indicate. Moreover, multiplier effects can play an important role. Estimates from the US indicates up to 27 percent ripple effect, i.e. if output increased so that 100 new jobs were created in commercial fishing, 27 jobs would also be generated in other sectors supplying inputs (US BEA, 2008). In the UK, a multiplier analysis, encompassing both indirect and induced impacts[24], estimated that the removal of the sea fishing and fish processing sectors in the UK would result in the loss of 138,000 jobs (Seafish, 2007). This can be compared with the direct employment in the two sectors of about 22,000[25].

3.2.2 The role of women

Gender roles in fisheries commonly portrays men as fishers – going out on boats to catch the fish – and women as fish sellers and processors on land. While this generalization is largely correct, a closer examination of gender in fisheries reveals a more complex array of roles according to country and cultural contexts. For example, in Benin, Cambodia, Republic of the Congo, Mali, and Thailand, women fish or collect fish on lakes using their own boats. In Uganda, it is taboo for women to be on board a fishing vessel but they can own boats and hire men as crew. As fish buyers, it is common for women to finance the working capital for fishing trips against a guaranteed supply of fish when the catch is landed (Holvoet 2009, Westlund 2009). In Bangladesh, fishing was traditionally a low caste Hindu occupation and only men in fishing

[24] . An employment multiplier would indicate these direct and indirect effects. There will also be an induced effect because the people employed get salaries that they will spend and hence increase demand for other products and services, requiring additional employment in the sectors producing these goods (The Scottish Government 2008)

[25] Fulltime equivalent (sample country table for the UK).

communities were engaged in catching fish. While still relatively few women work in fisheries today – an estimated 3 percent of the total female workforce is involved in harvesting – significant numbers of poor women are catching shrimp fry in coastal areas, irrespective of their religion, age or marital status (Mustafa 2008 - Bangladesh case study).

Estimates of women's participation in the fisheries workforce in the developing country case studies varied considerably from one country to another (see table below). On average, however, there are almost as many women as men employed in the fisheries sector when also including post-harvest activities. Excluding China, the average proportion of women fishers and fish workers approaches 60 percent. This is true both for the small and large-scale sectors with somewhat higher numbers of women in marine fisheries than in the inland subsector. Surveys in the Lower Mekong Basin show that women are often heavily engaged in subsistence fishing and collection of aquatic animals and plants in inland waters. However, as with other data on inland fisheries, this is not always adequately reported (FAO/RAP, 2003). The conventional division of labor is also often less strict than in marine fisheries with more women and children involved in small-scale fishing (ODI, 2002).

Table 13. Share of women in total fisheries workforce (fulltime and part time; fishing and postharvest activities) in selected case study countries

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

Source: developing country case studies.

Data on fisheries employment in Europe shows that very few women work onboard vessels. Nevertheless, they represent a third of the total sector workforce of some 400,000 people (fulltime and part time), although there are important differences between countries (Salz *et al.* 2006). In the sample developed countries, women represented on an average 41 percent of the total employment, mostly employed in the fish processing industry. Examples from the sample countries are provided in the following table.

Table 14. Share of women in total fisheries workforce (fulltime and part time; fishing and postharvest activities) in selected case study countries (thousands)

Country/case study	Total workforce	Percentage women
Japan	864	46
Portugal	20	30
Canada	75	29
Spain	54	29
Netherlands	7	29
Denmark	7	29
United Kingdom	22	28
France	27	23
Italy	33	20
Greece	27	4

Source: Authors, compiled from sample of developed countries.

3.2.3 Production estimates

The case studies show important differences between officially reported inland catches and the estimates made in the context of the studies. For example, official inland catches in Ghana averaged 75,000 tons per year in 2004-2006 (FAO, 2008), but the Ghana case study estimated catches from Lake Volta alone to be 346,000 tons, based on information from Yeji fish market surveys. The most important cases of underreported inland water catches uncovered in the developing country case studies are presented in the following table.[26]. On average, inland water catches appeared to be underreported by an average of 70 percent in all the case study countries. Marine catches also showed variations but not to the same extent as the inland production - on average, about 10 percent. [27]

Table 15. Reported and estimated catches in inland capture fisheries (thousand tons)

Country	Officially reported landings	Case study estimates	Ratio estimate / officially reported	Year of case study data
Bangladesh	849	985	1.2	2005/2006
Cambodia	332	438	1.3	2006
Ghana	75	398	5.3	2006
Mozambique	16	24	1.5	2007
Myanmar	530	741	1.4	2005
Senegal	50	64	1.3	1999/2000
Thailand	200	1,060	5.3	2004
Viet Nam	203	1,191	5.9	2003

Source: FAO, 2008 (FISHSTAT Plus, average 2004-2006) and developing country case studies.

The total annual capture fisheries production of the eleven developed countries in the sample is 11.8 million tons. Small-scale fisheries account for 24 percent of this production. Officially reported catches[28] from inland fisheries represent less than 1 percent of the total[29].

Table 16. Fish production in the sampled countries (million tons)

	Small-scale fisheries			Large-scale fisheries			TOTAL
	Marine	Inland	Total	Marine	Inland	Total	
Developed	2.747	0.082	2.829	8.989	0.023	9.012	11.841
Developing	19.956	8.991	28.948	11.035	0.329	11.364	40.311
Total	22.703	9.073	31.777	20.024	0.351	20.376	52.152

Source: case studies

3.2.4 Utilization of catches

3.2.4.1 Fish consumption

The average apparent per capita fish consumption in the world was 16.7 kg in 2006, based on the FAO Food Balance Sheets derived from data officially reported by member countries (FAO 2009

[26] The table includes all case study countries showing a difference greater than 10 percent (smaller differences may be due to differences in reporting years). It should be noted that the China case study indicated inland catches to be 10 percent *less* than the officially reported figure (not included in the table).
[27] These averages exclude China because it is considered a special case. If China is included, the average level of underreporting is 40 percent in inland waters and not notable for the marine sector.
[28] Among 22 countries that submitted inland fishery catch data to FAO, 6 reported both commercial and recreational data, 11 only commercial catches, and 5 only recreational catches (Garibaldi 2007).
[29] With a few exceptions, inland fisheries catch quantities for the sample countries were compiled from FAO FishStat Plus, averages for 2004-2006 (FAO, 2008).

b).[30] The average reported per capita fish consumption in all developing countries as a group is estimated at 14.4 kg per person (2005), compared to 23.9 kg in developed countries (Laureti 2007).

The Food Balance Sheets show great variations between countries. For example, apparent per capita consumption in developing country case studies ranged from 4.6 kg in Mozambique to 32.6 kg in the Philippines (in 2005) (Laureti, 2007). In-country variations are not reflected in these national averages and fish consumption is known to be considerably more important in some areas.

Given the underreported landings previously described, consumption is likely to be substantially greater than the estimates based on production statistics, in particular where small-scale inland capture fisheries are prevalent.

Studies on fish consumption in the Lower Mekong Basin show that the average per capita consumption of fish and other aquatic animals (inland and marine) in the basin is about 50 kg (Hortle 2007). This contrasts with a value of 28 kg - the total average apparent per capita fish consumption for the four countries concerned, as calculated in the Food Balance Sheets (Laureti 2007). However, these numbers are not entirely comparable since only part of each country forms part of the Lower Mekong River Basin. The differences in catch estimates arising from recorded production and consumption surveys are further addressed in the section on subsistence fisheries.

In the following table, the apparent per capita fish consumption derived from the Food Balance Sheets for Thailand and Vietnam has been recalculated using the higher catch estimates provided in case studies. Per capita consumption figures for Cambodia and Lao PDR have been included in the table (as estimated by Hortle 2007), since 95 and 93 percent of the populations of Cambodia and Lao PDR respectively are residents of the Lower Mekong River Basin. The differences in apparent consumption compared to the FAO Food Balance Sheet estimates are considerable (see following table). The MRC consumption study, however, includes some supply from subsistence fisheries.

Table 17. Comparison of apparent per capita fish consumption in the Lower Mekong Basin (kg/ capita/ yr)

	Cambodia	***Lao PDR***	***Thailand***	***Vietnam***	***Total / average***
MRC Consumption study (Cambodia and Lao PDR) and estimates based on case study catch data (Thailand and Vietnam)	*52.4*	*43.5*	*53.8*	*48.7*	*49.6*
FAO Food Balance Sheets (average 2003-2005)	*23.4*	*18.7*	*32.6*	*25.4*	*27.7*

Sources: Hortle, 2007; Laureti, 2007, and Lymer et al, 2008; Nguyen, Bach and Mills, 2008 (case studies Thailand and Vietnam).

Even relatively low annual fish consumption levels can be of vital importance for nutrition and health. Because of its highly nutritious value – including proteins, micronutrients and essential fatty acids – fish often constitutes a vital supplement to low quality diets. Moreover, per capita food fish supplies data do not explain the relative importance of fish in animal protein intakes. It

[30] *Apparent per capita consumption* equals the *per capita food fish supply* in the Food Balance Sheets calculated on a country basis as *(production – non-food uses + imports – exports +/- stock variations) / population*. The calculation includes production both from capture fisheries and aquaculture and based on the live weight equivalent of fishery products.

has been estimated that fish globally provides more than 1.5 billion people with almost 20 percent of their average per capita intake of animal proteins (FAO, 2009 b). In some small island developing states, as well as in, for example, Bangladesh and Ghana, fish provides at least half of the total animal protein intake (FAO 2007, Laureti 2007). In the Lower Mekong River Basin, the contribution of fish to the nutritional level of the average diet is high; inland fish and other aquatic animals alone contribute 47-80 percent of animal protein consumption in the four countries (Hortle 2007).

3.2.4.2 Different use of small-scale and large-scale production

Small-scale inland fisheries production tends to be used almost entirely for local human consumption (91 percent) and plays an important direct role in food security.

Although there are important differences at the local level, the developing country case studies show that, at the aggregate level, small and large-scale fish production have significantly different patterns in utilization of the catch. Generally, a higher proportion of the small-scale marine production is used for direct domestic human consumption than of the large-scale production. In other words, it is not exported or used for reduction into fish meal or as animal feed.

With the exceptions of China, Thailand and Vietnam, fish production in the case study countries is generally used directly as food, either locally or for exports. In China, a major part of the large-scale fisheries production is used for fish meal and other non-food purposes, while 18 percent of the catch of the small-scale fisheries is used for animal feed. In Thailand and Vietnam, some 20-30 percent of the total fish production is destined for non-food uses (Laureti 2007; developing country case studies: Xie 2008, Lymes *et al.* 2008, Nguyen, Bach and Mills 2008).

3.2.4.3 Trade

Fish and fishery products are among the world's most traded food products - some 37 percent of the total production enters international trade (FAO, 2009 b). About 25 percent of this volume was produced through aquaculture while the bulk was capture fisheries production, i.e. about 40 million tons[31]. The economic importance of fish trade varies among countries. Developing countries have increased their share in food fish exports and as a group account for 51 percent of world exports by volume[32]. Most export products are from marine waters but there are notable exceptions. Among the case study countries, Nile perch exports from Lake Victoria, freshwater fish and prawn exports from Cambodia and *kapenta* (Tanganyika sardine) exports from Mozambique are of note (van der Knaap 2008, Thuok *et al.* 2008, Menezes 2008).

The impact of international trade on the poor and food security is complex. Although trade generally stimulates economic growth, and trade in food is essential for food deficit countries, international trade is not an unqualified remedy for poverty reduction or food security, as food security depends both on domestic production and foreign exchange availability (for food importing countries). Trade liberalization may reduce food security if it removes protection for domestic producers, or impacts heavily on small scale producers if imports capture market share from traditional products. Declining fish export prices combined with rising prices for imported fuel and fishing gear pose growing threats. Economic slowdown, changes in the composition of consumers' shopping baskets and vulnerability of global food supply system to trade disruption pose additional threats (Kelleher 2008). High export prices are beneficial for fishers but if

[31] Live weight equivalent (FAO, 2009 b).
[32] In 2004; including aquaculture products (FAO, 2007).

sustainable resource management practices are absent, international market demand may foster overexploitation (FAO 2005, Kurien 2005).

3.2.5 Fueling fisheries

Fish catching operations are heavily dependent on fossil fuel. The global fishing fleet consumes some 42-45 million tons of fuel per year (Tyedmers, Watson and Pauly 2005, Tyedmers 2004, Smith, in prep.). This means that on average the fleet catches somewhat less than two tons of fish per ton of fuel consumed (based on catches reported to FAO)[33].

Active demersal fishing gears, such as dredging, bottom trawling, beam trawling and Danish seining, represent energy intense fishing methods, while passive fishing gears, such as, hook and line, gill nets, or raps, require less energy. Active pelagic fishing with, for example, mid-water trawls, purse seines and ring nets, tends to be moderately energy intense.

3.2.5.1 Developing countries

Small-scale fisheries use passive gear more often and are generally more fuel efficient than the large-scale fisheries. Because of the great diversity in the subsector, the average estimated fuel efficiency rates calculated from the developing countries case studies[34] varied greatly (see table) and, in some cases, showed similar levels of fuel-efficiency for small and large-scale marine fishing. Small-scale fishing in inland waters, on the other hand, appears to be less energy intense although data on this are particularly limited[35].

Nevertheless, non-motorized vessels are an important part of the small-scale fisheries and fishing with non-motorized craft, or with hand held gear is obviously the most fuel-efficient method. However, vessels fishing in inland waters in Cambodia, or the shore operated lift nets, common in some Asian countries, have become increasingly mechanized. Most artisanal canoe fisheries in developing countries now include some motorized vessels.

[33] Based on 2000 catches: 80.4 million tonnes. Only direct fuel consumption, i.e. account is not taken for indirect energy use related to input supplies, boat building, etc, and reported marine fishing (freshwater fisheries and IUU fishing are not considered) (Tyedmers, Watson and Pauly, 2005).
[34] Data on selected fleet segments were provided in the Big Numbers Project case studies from Ghana, Bangladesh, Cambodia, China and Senegal.
[35] The Big Number Project Chinese case study gave an average of 10.9 tonnes caught per tonne of fuel consumed in inland waters of Hubei province. In Lake Volta in Ghana, the average rate was 6.1 tonnes of fish / tonne fuel.

Table 18. Fuel efficiency estimates: examples from developing country case studies – marine fisheries (tons per ton of fuel)

Country	Type of vessel/fishing	Fish catch (tons) per ton of fuel
Senegal	Small-scale: average "pirogues", different gear	4.2
Cambodia	Small-scale: <10HP	3.1
Ghana	Small-scale: Ali/ Poli/ Watsa	1.4
China	Small-scale : Gill-netters and stow boats in E China Sea (Zhejiang province)	0.9
Bangladesh	Small-scale: Average motorized vessels	0.3
Ghana	Large-scale: Tuna purse seiners	4.8
Senegal	Large-scale: Off-shore tuna	3.9
China	Large-scale: Purse-seiners, trawlers and hooking boats in E China Sea (Zhejiang province)	1.7
Bangladesh	Large-scale: Vessels<150GT	1.4
Cambodia	Large-scale: Average trawlers, seiners and other off-shore boats	1.2

Source : developing country case studies.

3.2.5.2 Developed countries

Data from the EU sample countries showed that large-scale vessels were more fuel efficient than the smaller fleet - 3.5 tons of fish per ton of fuel consumed compared to 1.9 tons fish / ton of fuel. For example, estimates of fuel usage based on observer data, by fisheries in the northeast US show greater differences between gear types than between vessel sizes with regard to fuel efficiency. Overall, large vessels (> 24 meters) appeared twice as fuel efficient as medium (12-24 meters) and small vessels (<12 meters). However, if mid-water pair trawling and purse seining for herring and mackerel (high volume, lower value species) are excluded, the smaller vessels as a group landed more fish per ton of fuel used than the medium and large boats (see table). This finding is consistent with other observations that purse seine fisheries for small pelagic species destined for reduction (fish meal and oil) are more fuel efficient than fishing for high-value (food) fish (Tyedmers, Watson and Pauly 2005). Otter and scallop trawling are the by far least fuel-efficient fishing methods both for small and large vessels with average catches of 1.5 tons per ton of fuel consumed (see following table).

Table 19. Fish caught per ton of fuel consumed in fisheries in the Northeast USA

Fleet segments / gear types	Gillnet	Long-line	Otter Trawl	Mid-water pair trawl	Purse seine	Scallop dredge	Scallop Trawl	TOTAL
Large vessels (> 24 m) *(All values in metric tons)*								
Fish landed			14,441	35,237	-	15,106	46	64,830
Fuel consumed			8,925	2,519	-	4,236	35	15,715
Landings per ton of fuel			1.6	14.0		3.6	1.3	4.1
Medium vessels (12 – 24 m) *(All values in metric tons)*								
Fish landed	2,619	325	16,193	1,862	4,599	5,673	282	28,934
Fuel consumed	682	136	11,828	233	97	1,919	190	14,402
Landings per ton of fuel	3.8	2.4	1.4	8.0	47.6	3.0	1.5	2.0
Small vessels (< 24 m) *(All values in metric tons)*								
Fish landed	716	375	104	-	-	22	282	783
Fuel consumed	173	94	74	-	-	7	190	364
Landings per ton of fuel	4.1	4.0	1.4			3.2	1.5	2.2
Average for all vessels *(All values in metric tons)*								
Fish landed	3,335	700	30,738	37,099	4,599	20,801	328	94,265
Fuel consumed	855	229	20,827	2,751	97	6,162	225	30,291
Landings per ton of fuel	3.9	3.1	1.5	13.5	47.6	3.4	1.5	3.1

Source: Kitts, Schneider and Lent. 2008; pers. comm. A. Kitts.

3.2.5.3 Historical trends in fuel use

There is evidence that some fisheries use an increasing quantity of fuel to catch the same amount of fish due to the declining state of many fish stocks, and expanding fleet and increasingly powerful fishing boats (Tydemers 2004). A comparison with fuel-efficiency rates calculated in 1980 (Thomson 1980) shows a clear decline in volume of fish caught per unit of fuel used. In 1980, small-scale fisheries were estimated to catch 10-20 tons per ton of fuel; large-scale fisheries 2-5 ton. By 2006, these values had decreased to 4-8 tons and 1-2 tons for small and large-scale fishing, respectively (see annex).

Data available through this study indicates a likely decline in fuel efficiency in small-scale fisheries and small-scale fisheries do not prove to be more fuel efficient than their large-scale counterparts. However, these estimates are based on a limited sample, particularly for developing countries. Moreover, as fishing by non-motorized boats and by handheld gear in small-scale fisheries are not included in the sample, the above conclusion should be considered as indicative of motorized fishing only.

3.2.5.4 Fuel as a proportion of total harvesting costs

Prices paid for fuel for fishing generally do not vary between countries as much as for the transport sector, since fuel for fishing tends to be less taxed. However, studies on the economic performance of marine capture fishery fleets[36] show that fishing vessels in developing countries have relatively higher fuel costs than vessels in developed countries[37]. When expressed as a percentage of the revenue of the fish landed, fuel costs were almost twice as high in developing countries as in developed. This difference was even more pronounced for vessels using passive gears; the studies showed that developing country fishers using passive gears spend three times as much on fuel – expressed as a proportion of revenues – than their counterparts in developed countries. Overall, the relative importance of fuel costs has increased and is estimated to represent about 37 percent of gross revenues globally, and 20 percent and 43 percent in developed and developing countries, respectively (see table).

Table 20. Fuel costs as share of revenue from fish landed (%)

	1995-1997	*1999-2000*	*2002-2003*	*2005 (estimated)*
Global average (%)	15	17	19	37
Developed countries (%)	11	10	10	20
Developing countries (%)	19	21	22	43

Source: FAO 2007, page 132.

The developing country case studies provided some information on the relative weight of fuel costs, supporting the above mentioned average for developing countries. Although the data are insufficient for calculating exact proportions, the studies indicate that fuel represents a larger percentage of gross revenues in the marine small-scale sector than in marine large-scale fisheries. Considering the current volatility of fuel prices, this could be of significant concern for the future viability of small-scale fisheries and related livelihoods in some of these countries.

[36] See Le Rey, Prado and Tietze, 1999; Tietze *et al*, 2001; Tietze *et al*, 2005. The studies included both developed and developing countries and covered small and large-scale fisheries. In the most recent study (Tietze *et al*, 2005), fleets in Antigua, Argentina, Barbados, France, Germany, India, Norway, Peru, Republic of Korea, Senegal, South Africa, Thailand, and Trinidad and Tobago were surveyed.

[37] This situation is not specific for the fisheries sector but is general for all industries. The energy intensity, measured as the amount of energy needed to produce a unit of GDP, tends to decrease in maturing economies (FAO, 2007).

3.2.6 Bycatch and discards

Globally, the quantity of fish discarded at sea has declined in recent years. Increased utilization of bycatch, in particular in Asia; use of more selective gear; reduced fishing if there are high levels of unwanted bycatch; and more efficient bycatch management have reduced discards. However, global discards are around 7 million tons annually; effectively 8 percent of catch is 'dumped' before landing (Kelleher, 2005). Tropical shrimp trawl fisheries have the highest discard rates, followed by other shrimp and finfish trawl fisheries. Small-scale fisheries tend to have lower discards than large-scale fisheries. Purse-seine, handline, jig, trap and pot fisheries have relatively low discard rates (Kelleher 2005).

Box 2: Defining bycatch and discards

Bycatch includes in its broadest sense "all non-target animals and non-living material (debris) which are caught while fishing" and can also include "animals and non-living material that interact with the fishing gear but do not make it to the deck of the fishing boat" (Eayrs, 2007), but more commonly the term refers to the total catch of non-target animals (Kelleher, 2005).

"Discards, or discarded catch is that portion of the total organic material of animal origin in the catch, which is thrown away, or dumped in the sea for whatever reason. It does not include plant materials and post harvest waste such as offal. The discards may be dead, or alive." "The discard rate is the proportion (percentage) of the total catch that is discarded." It should be noted that discards are not a subset of bycatch, since target species may be discarded as well (Kelleher, 2005).

The developing country case study countries showed low discard rates. On an average, the discard rate was estimated to be 0.5 percent in the small-scale sector and just about 5 percent for large-scale fisheries.[38] Small-scale inland fisheries showed almost no discards, while tropical shrimp trawl fisheries in some countries (for example, Indonesia, Mozambique, Nigeria and Senegal) influenced the higher discard rates noted for the large-scale sector in general. In Asia, including China, discards are negligible since bycatch is used either for human consumption or as animal feed. Bycatch collection at sea by small-scale operators takes place in many countries, including the case study countries such as Ghana, India, Mozambique, Nigeria, Senegal and Thailand (Béné, Macfadyen and Allison, 2007).

Box 3: Bycatch collection in Mozambique

In Mozambique, artisanal fishers have collected bycatch from shrimp trawlers since the 1970s. In Nampula and Zambezia provinces, the collection is realized on the basis of an exchange. The artisanal fishers exchange their shrimp catch for bycatch with the semi-industrial or industrial vessels. The fish is sold fresh for local consumption or dried for more distant markets. Many fishers in the two provinces believe that the activity is more profitable than fishing.

Source: Menezes, 2008 (Mozambique case study)

3.3 THE HIDDEN HARVEST OF SUBSISTENCE FISHERIES

During the preparation of the developing country case studies it became evident that the important contribution from subsistence fisheries was not adequately reflected in official fisheries production values and only partly captured in the 17 case studies undertaken. Three detailed

[38] Based on case study data and the FAO discards data base (Kelleher 2005).

studies on subsistence fisheries were commissioned – on Vietnam, on Bangladesh and on the Philippines.[39] The results of two of these studies are presented below. In the case of the Philippines it was not found possible to satisfactorily disaggregate subsistence from small-scale commercial fishing.

The subsistence fishing case studies essentially present a complex picture of the activity - an activity which is only partially captured in official fisheries or household survey statistics. A number of key points emerge:

(a) If production is primarily for household consumption, production volumes per household are low. This is largely borne out by the profiles of subsistence and commercial fishers in the case studies. Where production is far higher than required by the immediate kin of fishers, fishing has moved beyond subsistence into the commercial realm.
(b) The activity is difficult to define (see annex for a discussion of the definitions) and can be highly seasonal such that one-off surveys may not indentify its importance. For example, in studies in the Mekong Delta all communities were dominated by those identifying themselves as rice farmers. Yet, in excess of 60% (up to 83%) of the population engaged in fishing at some time of the year. This is also consistent with studies of riverine areas in adjacent countries where in excess of 80% of the rural population engage in fishing activities (UNICEF 1994, Sjorslev 2000). Households switch from no-fishing to subsistence fishing to commercial fishing in accordance with the seasonality of livelihood opportunities and household division of labor.
(c) Conventional fisheries statistics do not reveal the extent or importance of subsistence fisheries and household income and expenditure surveys may not capture its importance if conducted in a non-fishing season.
(d) Food consumption surveys and food balance sheets can indicate a substantially greater level of dependence on subsistence fisheries than shown by the other approaches. However, the design of the survey requires some sensitivity to the nature of subsistence fisheries.

3.3.1 Bangladesh

The following are some key findings of the Bangladesh study:

(a) Re-analysis of data collected from the 1980s and 1990s indicate up to 15.2 million households (inhabited by 68 million people) directly engaged in capture fishery activities at a subsistence or commercial level for at least part of the year.
(b) The more recent Household Income and Expenditure Survey (HIES) from 2005 provides an estimate of 13 million households (inhabited by 63 million people) involved in fish production; both fisheries and aquaculture sectors.
(c) Direct questions in the HIES regarding household fish production underestimated by a minimum of 40% the number of people engaged in the fish production sector.
(d) Capture fisheries constitute a much higher proportion of household income for poor households (see figure).

[39] Mills, D. 2010. Fisheries' Hidden Harvest. Case-studies of data collection for subsistence and household-level fisheries. Prepared by WorldFish Center for the World Bank Global Program on Fisheries (PROFISH).

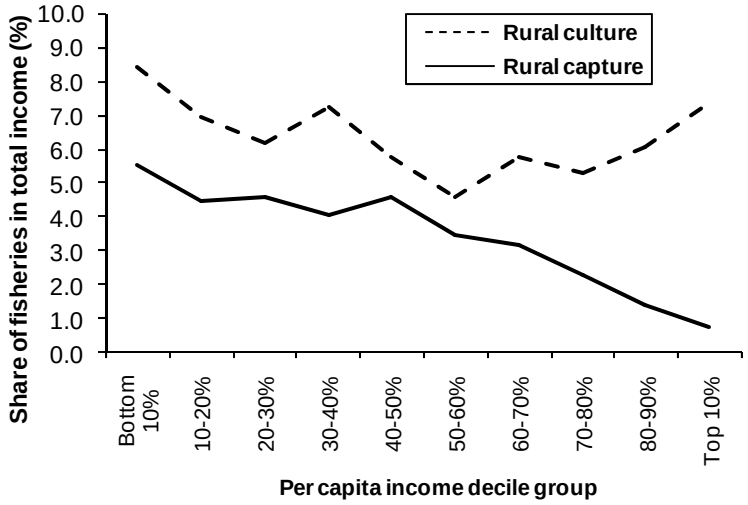

Figure 1. Income from fisheries in Bangladesh by income group (HIES 2005)

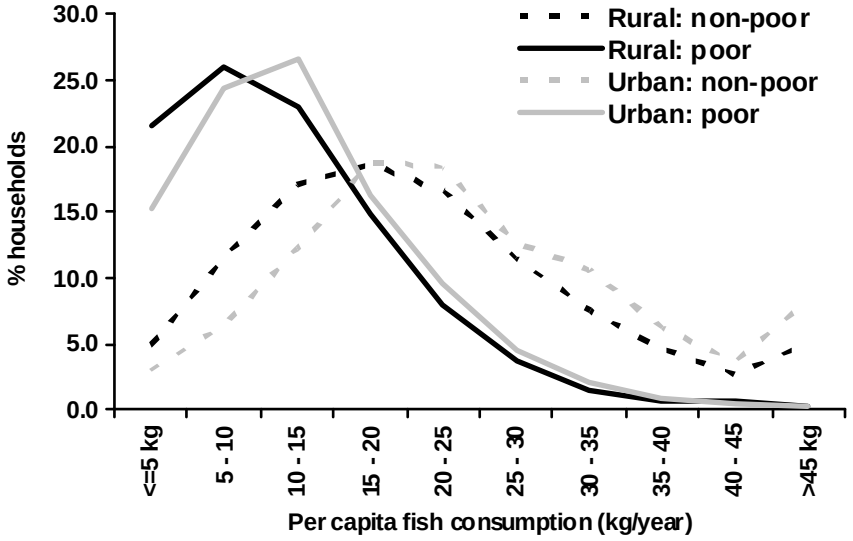

Figure 2. Bangladesh fish consumption of rural and urban poor and non-poor (HIES 2005)

(e) Seasonality and inter-annual variability in fishing yields and participation are high. 'Snapshot' (single sample) data collection systems fail to capture the diversity of fishing activities and ultimately the value of the fisheries sector.

(f) The discrepancy between estimates from these two data systems relates at least in part to the changing nature of fish production in Bangladesh, but also to a mismatch between temporal and spatial scales of sampling in the HIES and the non-random temporal and spatial distribution of fishing activities.

(g) As well as providing a direct measure of the nutritional importance of fish, consumption data proved a substantially better indicator of fish supply than did direct household measures of fish production. The value of consumption as an 'averaging' device to remove biases in production estimates should not be overlooked.

(h) It is not possible to predict the relative importance of subsistence and commercial fishing at a district level based on estimates of yield, nor the level of subsistence fishing based on estimates of commercial fishing. A far more complex set of drivers including geo/hydrography, urbanization and social issues act to negate simple correlation. Accordingly, data on commercial fishing that dominates fisheries data systems is often a poor indicator of the importance of fishing at a district and ultimately national level.

3.3.2 Vietnam

The following are some key findings of the Vietnam study:

(a) Studies of fish consumption in the Mekong Delta indicate that inland capture fisheries production is more than five times that reported in official statistics. Extrapolation to the country-level indicates inland fisheries production in excess of 1 million tons per year.
(b) Alternative estimates of both inland and marine capture fisheries suggest national supply of fish per capita may be as high as 40 kg per year (see table). This is some 40 percent higher than the official estimate for fish consumption.
(c) The study suggests that a minimum of 15 million household members rely directly on 4 million fishers to fulfill part of their nutritional requirements at some stage during the year. This number could be as high as 25 million household members and 8 million fishers. This extrapolation, however, involves significant assumptions, as key characteristics of fisheries differ among regions.
(d) In 10 provinces adjacent to the Mekong Delta, an estimated 8.13 million people rely directly on the capture of fish and aquatic animals to meet part of their nutritional requirements. These people live in 1.82 million households from which 2.5 million people are actively engaged in fishing.
(e) Stakeholders in Vietnam acknowledge that existing data systems do not provide an adequate picture of the entire fisheries sector and that data on subsistence fishing being largely absent. Fish consumption studies were of considerable value of in detecting fish production which is not captured by direct sampling methods.
(f) The study adopted a 'balance sheet' methodology for calculating fish supply per capita under a range of fish production scenarios developed from alternative data sources. The importance of fisheries to livelihoods in the Mekong Delta has resulted in comprehensive studies being conducted in recent years. Data on participation and production of inland fisheries outside the Mekong Delta are deficient.
(g) Studies of inland provinces tended to provide detailed statistics on participation in fisheries by the general population, while those of marine provinces concentrate on data collection from fishing households only, creating difficulty in characterizing the importance of subsistence fishing in coastal provinces.

A comparison of (i) the official production and consumption estimates with (ii) results of the first case study (which had the objective of disaggregating small and large scale fisheries) and (iii) the second case study (which focused on subsistence fisheries) is presented in the following table. The comparison illustrates that the official values may underestimate fish production and consumption by some 40 percent.

Table 21. Comparison of Vietnam fish production case studies (million tons and kg/person/yr)

Production and trade	Official estimates	Disaggregation case study	Subsistence case study
Marine capture	1,647,482	1,647,482	2,584,313
Inland capture	208,872	1,129,298	1,129,298
Brackish/marine Culture	443,135	443,135	443,135
Inland culture	559,960	559,960	559,960
Total production	2,859,449	3,779,875	4,716,706
Less marine trash for feedstock	411,870	411,870	933,183
Less exports	544,159	544,159	544,159
Plus imports	29,420	29,420	29,420
Available for local human consumption	1,932,840	2,853,226	3,268,784
Equivalent to (kg/person/year)	23.89	35.26	40.41

Table 22. Estimated participation in Vietnam inland fisheries under alternative scenarios (millions)

Scenario/ assumptions	Inland fishing Households	Inland fishers	Total fishers	Household members
Same catch for non-Mekong households	2,82	4,09	4,72	14,45
Half catch for non-Mekong households	4,99	7,24	7,91	23,91
30% of rural households outside Mekong Delta fish	4,97	7,20	7,88	23,81

Source: Mills 2010.

Note: Scenario 1) is based on a conservative assumption that households (HH) outside of the case study area catch the same quantity of fish as those within the immediate delta area. Scenario 2 is based on a more reasonable assumption that HH outside of this highly productive area catch on average half the quantity of fish as those within the study area. Scenario 3 is based on a similar conservative assumption that 30% of rural HH outside of the study area are engaged in fishing.

3.4 THE CONTRIBUTION OF COMMERCIAL FISHERIES TO GDP

The contribution of a sector to total GDP is a key macroeconomic indicator frequently referred to by decision makers and donors when highlighting the particular sector's importance to a national economy. Information on the contribution of a natural resource sector to GDP is useful not only to monitor the progress of sustainable resource management, but also to gain the attention of important policy makers, and to highlight the contribution of the sector to poverty alleviation (FAO 2004).

The total fisheries sector's contribution, including marine and inland harvest subsector plus post-harvest subsector, to the global economy was estimated at approximately $274 billion in 2007, with a 95% CI of between $252 and 303 billion. Further details of the estimate are tabled in the annex.

If a conservative upstream multiplier of 1.3 is applied (a limited number of studies suggest a multiplier in the order of 1.6) there is an additional contribution to GDP in the order of $90 billion.

The global capture fisheries GDP estimates is based on information from 129 countries. Future analyses can significantly improve the accuracy of the estimate when further country-level post harvest GDP values become available.

The estimates included only the direct impacts from commercial fisheries (primary production of harvest and post-harvest subsectors). Indirect, induced economic impacts were not included. The aquaculture subsector was not included. The available GDP values underestimate the economic contribution from subsistence fisheries, as the majority of the countries did not include these activities, or did so marginally. The exceptions include some Pacific island countries and some estimates prepared in West and Central Africa.

3.4.1 Summary statistics

Harvest subsector
Out of 129 countries where the fisheries related GDP data were available, the contribution from "harvest" (catching) subsector was identified for 111 countries. The remaining 18 countries reported the combined contribution of catching and farming (aquaculture) of fishery products (primary production) to national GDP.

Table 23. The contribution from the fisheries harvest subsector to national GDP (%)

	Range	Average	Median
Global	0-30	2.8	1.3
Developing		3.5	1.8
Developed		0.4	0.2
Oceania		8.5	

Source: Hoshino et al., Kebe et al., Gillett, 2010.

The contribution from the harvest subsector to national GDP varies between almost zero and 30 percent with a median contribution of 1.28% (see annex tables). The contribution is significantly higher for developing countries, with a median contribution of 1.8%, compared to median of 0.2% for developed countries. With a median contribution of 4.6%, countries in Oceania tend to have higher harvest subsector contribution to GDP than other regions. The average (mean) values are extremely sensitive to the presence of outliers (some countries with extremely high GDP contribution), and median value is more appropriate indicator of central tendency.

Post-harvest and non-harvest subsector(s)
Out of 129 countries, the contribution of the post/non-harvest subsectors was identified for 26 countries. Of these, 10 countries used estimates prepared by the SFLP for sub-Saharan countries (see annex), which included not only the post-harvest subsector (marketing, processing, handling of fish), but also the sale and repair of fishing boats and equipment. For the remaining 11 countries, the precise activities included in the non-harvest subsector were not fully specified.

In the 26 countries, the non-harvest contribution varies between 10.3 percent (Sao Tome and Principe) and 75 percent (Uganda) of the total fisheries contribution to GDP, with an average contribution of about 41.3 percent. This means that, on average, harvest subsector alone captures just over a half of the actual contribution from the fisheries sector. The contribution of non-harvest activities appears slightly higher in developing countries (44.7 percent) than in developed countries (40.7 percent), although the difference is not statistically significant.

The non-harvest share of total fisheries GDP is not significantly correlated with other factors[40]. The post-harvest contribution tends to have a lower share of GDP in European countries while the

[40] Such as country economic status, population, total annual production, inland production, marine production, GDP, or species composition (demersal, shellfish, pelagic, and freshwater) in landings.

post-harvest contribution tends to have a higher share in countries with high demersal and freshwater landings (inland production in general). The correlations are not statistically significant.

Information on value-added generated from recreational fisheries subsector, including marine and inland tourism, was compiled for 7 countries (Australia, Belize, Canada, Namibia, New Zealand, north-west Trinidad, and the USA). Together, these 7 countries directly contributed approximately $49 billion per year to the global economy and if indirect impacts are included, some $74 billion per year.

3.4.2 Value added ratios, value chain analyses and input-output analyses

Studies done in 15 countries in Africa show that the harvest sub-sector accounts for 60-70% of the value generated by the sector. The remaining 30-40% is generated largely by post-harvest marketing and processing activities (Kebe 2008). Studies using a value added ratio (VAR) approach in Pacific island developing economies estimate the revised fisheries sector GDP (that includes non-harvest activities) to be from 4% to 63% higher than the 'official' estimates (generally the harvest sub-sector) (Gillet and Lightfoot, 2009) and was on average 30% higher (Gillett and Lightfoot, 2001). Other studies (US Pacific Territories and Uganda) indicate that revised fisheries sector GDP is about twice the 'official' estimates (Zeller et al. 2006, Yaron et al. 2004).

A value chain study from Nigeria indicates that approximately 3 times the farm gate value of farmed catfish is generated post-harvest in marketing and specialized fish restaurants. Approximately 80% of the export value of processed Indonesian blue swimming crab is generated post harvest. Other studies report value-added at the harvesting level accounted for between 4% (Moroccan anchovy fishery) and 18% (Icelandic cod) of the retail value, while the retail sector captured in the order of 60% of the retail value (Gudmundsson et al. 2006).

Table 24. Value-added ratios (VARs) for fisheries subsectors in developing countries in the Pacific

Subsector	*Value added ratio (%)*
Large-scale offshore fishing	40-55
Small-scale commercial fishing	55-70
Subsistence fishing: motorized	65-75
Subsistence fishing: non-motorized	90
Non-vessel fishing	89-92
Aquaculture	21-72

Source: Gillett and Lightfoot, 2001.

The economic impact of marine capture fisheries to the global economy has been estimated at about US$380 billion per year using an Input-Output (IO) analysis. This is some 4.5 times greater than the first sale value of the fish produced (Dyck and Sumaila 2009).

Table 25. Value-chain analysis for Lake Victoria Nile Perch

	Euro/kg	%
Boat owners	0.58	9%
Middlemen	0.71	2%
Agents	0.89	3%
Processing factories	1.48	9%
Exporters	2.72	19%
Wholesale	3.60	14%
Retail	6.40	44%

Source: case studies

In Canada, the seafood sector (commercial fishing, aquaculture and fish processing) created the equivalent of 37,255 full-time direct jobs, and another 25,200 in spinoff (secondary) activities, generating a household income of C$2.3 billion or (approximately US$2.2 billion[41]) in 2006 (Pinfold, 2009). The GDP impact of the sector was estimated at C$3.9 billion when direct plus secondary activities were accounted for, while the final product value of the seafood industry overall was just under C$5 billion. A study in Norway conducted in 2008[42] showed that, in 2006, the fishing and aquaculture industry in Norway contributed NOK 38.9 billion to GDP, approximately 1.8 % of both Norway's GDP and total employment in the country. Details of sector economic multipliers are provided in the annex.

3.5 THE CONTRIBUTION OF RECREATIONAL FISHERIES TO GDP

There are an estimated 225 million recreational fishers, or anglers worldwide – almost twice the numbers of commercial fishers (see annex). "It is estimated that among 1.3 billion Chinese population, there are 90 million whose hobby is fishing. Fishing is promoted as part of the National Healthy Exercise Plan" (Min Guo 2006).[43]

The sub-sector tends to be sublimated into the tourism sector and its economic contribution often receives limited attention. The sector is also closely aligned with subsistence fishing as many 'weekend anglers' fish expressly to provide food. The activity is also closely linked to marine and aquatic recreation. Neither of these latter activities is addressed in this study.

In the USA, 18 of 22 maritime states derive greater economic impacts from recreational fisheries and the aggregate economic impact from marine recreational fisheries is more than three times that of the commercial fisheries. In Iceland, the value of a commercially netted salmon was found to be about 1/35th of the value of such a salmon in an angling fishery ($600-1000 per angled salmon).[44]

[41] Canadian $1 = US$ 0.95 as of March 1, 2010

[42] http://www.regjeringen.no/en/dep/md/documents-and-publications/government-propositions-and-reports-/Reports-to-the-Storting-white-papers-2/2008-2009/report-no-37-2008-2009-to-the-storting/4/1.html?id=577903#note3

[43] Three Ways to Develop Recreational Fishing. *China Fisheries Report*. May 31, 2006, translation by J. Chu from http://www.chinabreed.com/fishery/develop/2006/05/2006053160863.shtml).

[44] Arni Isaksson and S. Oskarsson, , *Economic Value of Icelandic Salmon (Salmo salar L.) in Angling and Net Fisheries*. Prepared for the Technical Workshop on Social and Economic Values of Atlantic Salmon, NASCO, 2002. Directorate of Freshwater Fisheries

Employment generated by recreational fishing is significant, for example, almost three times the number employed in commercial fisheries in the US. In Wales, the economic contribution of angling is more than twice that of commercial fishing and aquaculture combined (Nautilus 2007). The impact of recreational fishing on fish stocks can be considerable. For example, in France, sea angling (including collection of shellfish) is estimated to harvest some 30,000 tons annually[45].

There is no standard method of estimating the value of recreational fishing. The wide variety of studies often target either inland or marine angling – rarely both. Different studies include or exclude different costs (e.g. exclusion of capital costs, which may also exclude fishing tackle).There is an insufficient number of case studies undertaken with a consistent approach to enable a robust estimate of value added or multipliers. However, studies from US and UK indicate that income value added is in the order of 0.37 for each unit of angler expenditure, so that total value added would be in excess of this value.

The estimate of the global contribution of the sub-sector (see table) uses a median value (10%) for the percentage of recreational fishing expenditures attributable to fishing tackle for which a global estimate of demand is available. For example, studies indicate the Chinese market for recreational fishing may be in the order of $3.5 billion if the annual per capita consumption for recreational anglers is around 200 Yuan (about $35), then the Chinese recreational fishing market is in the order of 20 billion Yuan ($3.5 billion)" (Min Guo, 2006)[46].

Using a conservative ratio (25% below the median of 10% - average 12%) and with an adjustment to 10% for developing countries the total annual expenditure on recreational fisheries is conservatively estimated at over $190 billion (see following table).

Table 26. Estimation of total expenditures on recreational fishing for 2009 ($ million)

Country/ region	Expenditures on fishing tackle	Tackle as % of total expenditure	Estimated total expenditure	Independent estimates of expenditures
France	850	0.075	11,333	
Germany	508	0.075	6,773	
Italy	653	0.075	8,701	
UK	1,122	0.075	14,960	2,890 (UK pounds)
Spain	162	0.075	2,161	
Russia	245	0.1	2,448	
Rest of Europe	2,554	0.1	25,540	
US	4,532	0.075	60,423	82,000
Canada	376	0.075	5,008	
Japan	1,403	0.075	18,711	
Australia	146	0.075	1,947	1,900 (A$)
China				3,500
Rest of Asia-Pacific	1,667	0.1	16,672	
Latin America	1,341	0.075	17,880	
Total	15,558		192,556	

Source: Bizacumen, authors.

If value added is assumed to be in the order of 40%, the contribution to GDP may be in the order of $70 billion annually. The recreational fisheries subsector from 7 countries alone contributes

[45] Ifremer et BVA, 2008. Enquête relative à la pêche de loisir (récréative et sportive) en mer en Métropole et dans les DOM.

[46] translation by J. Chu from http://www.chinabreed.com/fishery/develop/2006/05/2006053160863.shtml)

additional $74 billion per year to the global economy, when direct and indirect impacts are taken into account (Hoshino 2010).

In addition to its contribution to GDP, employment generated by recreational fishing is significant, for example, almost three times the number employed in commercial fisheries in the US. In Wales, the economic contribution of angling is more than twice that of commercial fishing and aquaculture combined (Nautilus 2007). The impact of recreational fishing on fish stocks can be considerable. For example, in France, sea angling (including collection of shellfish) is estimated to harvest some 30,000 tons annually[47]. In South Africa, the commercial linefish fishery accounts for 79 percent of the catch, whereas the recreational component generates over 80 percent of the employment and revenue (Griffiths and Lambert 2002).

[47] Ifremer et BVA, 2008. Enquête relative à la pêche de loisir (récréative et sportive) en mer en Métropole et dans les DOM.

4 PART III. DISCUSSION AND IMPLICATIONS FOR DECISION-MAKERS

The study is an effort to compile and interpret disparate indicators of global capture fisheries. It should be seen as one step in a process of building knowledge of the importance of capture fisheries to economies, to livelihoods, for food security and for environmental sustainability.

The methodologies and their results form a coherent and valuable baseline for fisheries policy making and governance. The results should be seen as best estimates rather than definitive values, given that the underlying data and assumptions should be open to constructive criticism and improvement. The results highlight a number of key considerations:

The economic and social importance of capture fisheries is substantially underestimated. The importance of capture fisheries, particularly in developing countries, is substantially underestimated in conventional reporting, namely through national fisheries statistics and national accounts. Effective policy making must move 'beyond GDP' and its basis in recorded production, or landing statistics to consideration of the extended value chain and to recreational and subsistence fisheries. In developing countries, the contribution of fisheries to poverty alleviation, rural community stability and its role in environmental sustainability needs to be highlighted to policy makers.

'Hidden harvests' mean that the sector is undervalued in terms of its perceived economic contribution. This translates to inadequate weight in policy development, in poverty reduction strategies and allocation of public resources. Decisions that compromise the integrity and productivity of the concerned ecosystems may follow, for example in relation to water extraction, drainage of wetlands, or offshore oil extraction. Already marginalized communities may become further disadvantaged.

Healthy small-scale fisheries are vital for employment, pro-poor fisheries policies, for food security and for rural livelihoods in many communities. The relative contributions of large-scale and small-scale fisheries, and their interactions, in terms of competition for shared fish resources, needs increased attention from policy-makers. The substantial under-reporting of small-scale catches constrains conventional approaches to fisheries management and undermines the social and economic valuation of these activities. In particular, these small-scale and community fisheries require increased attention to their assessment and governance.

Small-scale and large-scale fisheries merit separate consideration, not only in developing countries but also in many developed countries. The underestimated social, economic and nutritional contributions of small-scale fisheries tend to undermine decisions and policies which may favor fishing communities. Fisheries managers and economic planners have tended to focus on the large-scale fisheries and marginalized small-scale fishing communities may not receive equitable benefit from public investment in roads, water transport, schools and other social infrastructure. There is also a growing consensus that small-scale fisheries assessment and governance approaches need to be fundamentally different to those used in large-scale industrial fisheries. The approaches must address not only the particular vulnerability of the small-scale sector but how to use of science to inform community-level decisions. Some of these approaches are outlined in the Code of Conduct for Responsible Fisheries (see box in annex) and the relevant

Technical Guidelines[48] and other authors (Béné et al 2007, Garcia *et al*.2008, Berkes *et al.* 2001, Andrew *et al* 2007, Westlund *et al*. in press).

Subsistence fisheries and poverty require explicit attention. The two subsistence case studies indicate substantial under-reporting of subsistence fisheries. As a result, its contribution to food security and poverty alleviation in developing countries is not sufficiently recognized. This under-valuation implies that the sub-sector is already marginalized despite its likely high importance to the lives of the rural poor. Effective assessment of subsistence fisheries requires active collaboration with non-fisheries information systems, such as nutrition and household income surveys.

Subsistence fisheries policy implications. The studies did not specifically assess the poverty level of the subsistence fisher, although the notion that subsistence fishers are poor also provides a measurable characteristic. It is clear however, that subsistence fishers are generally poor, and have limited capital and assets available to provide alternatives if access to fish supply is curtailed. This has important policy implications for design of 'rights-based' management regimes and makes the case for specific consideration of subsistence fishing activities in any measures to limit access.

Recreational fisheries deliver substantial economic benefits. Per kilogram of fish, recreational fisheries yield orders of magnitude more economic value. They can also generate substantial employment. In addition to their market valuation, studies indicate that society attributes additional non-market values to recreational fisheries (Toivonen 2000). While recreational fisheries tend to have a relatively greater importance in developed countries, rising incomes in developing countries provide opportunities to develop and sustain these fisheries and build on the links to tourism and other aquatic recreational activities. The food value of recreational fisheries should not be ignored – it extends into subsistence fisheries.

However, by their nature recreational fisheries overlap with both subsistence and commercial fisheries. They may compete with both and can exert significant pressure on the fishery resources giving rise to conflicts and policy issues. It means that all three activities must be responsibly managed and that the governance regime and allocation processes balance the competing needs of the interest groups and society. The rents generated by recreational fisheries can be significant and are not captured in a recent estimate[49] of the global loss of rents in marine capture fisheries. Recreational fisheries provide a rich array of examples of fisheries governance arrangements with application beyond these fisheries. These arrangements include indigenous people's rights over these fisheries, separation of angling and land rights, community leasing of water bodies, stock enhancement, licensing and levies, catch reporting, management cost recovery approaches, and payments for ecosystem services.

A conservative GDP estimate. Based on the available data, the commercial fisheries sector's contribution to global GDP is estimated at $274 billion in 2007 (including marine and inland harvest subsector and post-harvest subsector). The estimate is considered conservative for several reasons: (i) the analysis omitted several countries for which GDP data was not available and that in aggregate account for about 10% of global seafood production; (ii) the contribution from recreational fisheries subsectors were not included; (iii) subsistence fisheries remain largely

[48] FAO. 2005. *Increasing the contribution of small-scale fisheries to poverty alleviation and food security*. FAO Technical Guidelines for Responsible Fisheries. No. 10. Rome, FAO. 79 pp.
[49] *The Sunken Billions*

unaccounted; (iii) upstream economic activities are not included; and (iii) only direct impacts were included, while spinoff (indirect and induced) impacts were not.

If provisional estimates of these additional economic activities are included the estimated contribution to GDP would be considerably greater. For example:

- Including, on a pro-rata basis, the countries accounting for 10% of reported production and for which GDP values are unavailable, increases the estimate by $27 billion dollars to a total of $301 billion dollars.
- If a conservative provision for upstream economic activities – a multiplier of 1.3 – is applied to this value, the estimate increases by an additional $90 billion.
- If a conservative provision of 5 percent is made for unrecorded catches including subsistence fishing the value increases by an additional $15 billion
- If a conservative estimate of the value added by recreational fishing is included ($70 billion), the contribution of the sector to global GDP rises to $476 billion.

The global estimate is within the range of an estimate of approximately $380 billion per year derived from input-output analyses (Dyck and Sumaila 2009). However this estimate is not directly comparable as it refers to the marine fisheries sub-sector only and includes marine tourism.

The simplified approach suffers from a large degree of uncertainties given the data limited environment. It is recognized that the estimates provided can be substantially improved when further country-level data become available, when the scope of existing country estimates are more rigorously defined and when the determinants of harvest/ processing multipliers can be more clearly identified.

Accounting for the contribution of the sector to national GDP (and by extension to global GDP) fisheries sector has exposed common methodological challenges and pitfalls in measuring consistent fisheries GDP. Improvement of the national level data through documenting a clear description of what is being measured is the initial step to address these challenges. Ideally, national statistic offices and relevant fisheries agencies should work closer together for improved data collection and reporting of fisheries related economic activities. Knowledge of the fisheries sector's contribution to national economies can help governments address the people's dependence on fishery resources, and improve future planning for sustainable management of the fisheries sector.

Fisheries are highly vulnerable to internal and external threats. Dam construction, water extraction, oil and mining activities, wetland conversion, deforestation, pollution, and coastal development degrade environments and habitats critical to aquatic ecosystem function and fisheries. Ensuring that the economic value of the fisheries sector is adequately reflected at national level builds arguments to take due account of the sector in environmental decision-making.

Justifying investment in good fisheries governance. The estimated economic losses attributable to weak fisheries governance - estimated at over $50 billion annually – also provides ample justification for investments in good sector governance to build future economic rents. Sustaining rural livelihoods can offset the growing costs of urban migration. Control of industrial fleets in coastal areas combined with responsible practices by small-scale fishing communities can recover these economic rents and maintain the integrity of fishery dependent communities.

RECOMMENDATIONS

The following recommendations are those given in the Executive Summary.

9. National and international fisheries agencies and non-governmental organizations direct the attention of policy and decision-makers to the value of capture fisheries as a primary industry which underpins the economic activities of an extended value chain which can have an economic contribution several times the landed value of the catch. Short concise policy briefs can highlight the contribution to poverty reduction, nutrition and employment and emphasize that with good governance, sustainable fisheries can substantially increase economic wealth.

10. National fisheries authorities direct increased attention to the knowledge gaps exposed by the study. These include improved estimates of contribution of the entire sector to GDP, including post-harvest and upstream activities. While important to economic planners, the GDP values need to be complemented with social and environmental indicators, reflecting employment along the entire value chain, contributions to poverty reduction and food security and the economic performance of different fisheries.

11. The development community consider collaboration in preparation of:

(a) guidelines to evaluate the contribution of subsistence fisheries, including guidance on the use of household and nutrition surveys and poverty profiling to characterize subsistence fisheries;
(b) guidelines to estimate the extended GDP of the fisheries sector (consistent with the existing UN guidance[50]), including a typology of sector-specific multipliers and value chain analyses, including for developing countries;
(c) consensus guidelines on the preparation of estimates of economic rents and associated indicators of economic performance of fisheries;
(d) further development of fisheries governance indicators[51].

12. National fisheries specialists coordinate efforts to characterize subsistence and small-scale fisheries with agencies undertaking studies on household income and expenditure, nutrition and rural economy studies in developing countries to provide policy-relevant information for the development of pro-poor fisheries governance approaches. National fisheries authorities reinforce collaboration with tourism authorities and angler associations to evaluate and manage recreational fisheries.

13. National statistic offices and fisheries agencies in association with the development community collaborate to improved data collection and reporting of fisheries related economic activities, including specific attention to subsistence and recreational fisheries. These efforts may include:

[50] UN and FAO 2004. Integrated Environmental and Economic Accounting for Fisheries. Studies in Methods Handbook of National Accounting.

[51] For example: J. L. Anderson and C.M. Anderson, 2010

(a) Disaggregation of fisheries statistical information at country level into large and small-scale in relation to specific policy issues such as access rights, food security and economic growth based on sustainable fisheries.
(b) Development of fisheries satellite accounts in national accounts.
(c) Incorporation of specific fisheries data collection into existing information tools, such as household income and expenditure surveys to include fisheries information in the broader context of national economic growth, poverty reduction and wellbeing.
(d) Ensure effective use of limited resources by engaging with survey agencies (bureau of statistics, agriculture, nutrition departments) to provide specific advice and training on question design as well as specificities of the sampling frames required to capture the diversity of fishing activities and livelihoods and subsistence fisheries in particular.
(e) Agree on key indicators for the different segments of the fisheries sector to enable effective policy formulation and tracking of progress and trends. Make provisions for regular collection, compilation and dissemination of this key information.
(f) Develop partnership arrangements at regional and global level to improve quality and availability of key information on small scale fisheries and to support and improve the capacity for appropriate data collection and analysis, particularly in developing countries.

14. Development community consider development of partnerships or programs to make the value of the fisheries statistics/ knowledge more relevant and useful for decision-making and ensure that project level monitoring is streamed into country knowledge management systems

15. Use the formal mechanisms of the FAO[52] to improve collection and interpretation of statistical data on fisheries at national, regional and global levels including validation and improvement of the results presented.

16. Critically review the results presented with a view to improving the underlying data, rendering definitions and data sets more compatible and enhancing the basis for assessing the economic contribution for capture fisheries with the overall objective of improving fisheries management and laying a robust foundation for reforms.

[52] In particular the Coordinating Working Party on Fishery Statistics (CWP) http://www.fao.org/fishery/cwp/en with strengthened links to the Global Strategy to Improve Agricultural and Rural Statistics.

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6 ANNEX

6.1 DETAILS OF THE METHODS USED

6.1.1 Definitions

Fisheries sector. The 'fisheries sector is taken to include the harvest (catching) sub-sector, downstream industries such as fishing vessel construction and net-making and upstream economic activities such as processing and marketing. Recreational fishing and its associated economic activities are considered a sub-sector. Some other aquatic recreational activities (e.g. diving) may be part of the sector but are not included in this study (see Dyke and Sumaila 2009).

Small-scale fisheries. The terms 'small-scale fisheries' and artisanal fisheries' are used interchangeably in this report. The term "small-scale fisheries" is commonly defined in national legislation, so definitions depend largely on location (Johnson, 2006). A small-scale fishing vessel in one country may be considered large-scale in another. Thus multiple national definitions are used in this report and the values with respect to small-scale fisheries are aggregated across these varied definitions. Attempts made to render the definitions compatible for the purposes of aggregation were not considered useful. Further discussion of the definition is provided below.

Industrial fisheries. The term is used interchangeably with 'large-scale' fisheries and should not be confused with 'forage' fisheries, that is fisheries that produce fishmeal.

Inland fisheries. Fisheries in rivers, lakes and other freshwaters. The terms 'inland fisheries' and 'freshwater fisheries' are used interchangeably.

> **Subsistence** fisheries. The definition used in the subsistence case studies is *'….those fishers who are poor, fish mainly for food and may exchange or sell surplus harvest to meet other basic needs'* (Sowman 2006). The various definitions of subsistence fisheries are presented below.

6.1.1.1 Defining small-scale fisheries

An FAO Working Group on small-scale fisheries concluded that it is not be possible or useful to attempt to formulate a universal definition of small-scale fisheries considering their diversity and dynamism. Accordingly, the following description of the sub-sector was agreed upon:

> *Small-scale fisheries can be broadly characterized as a dynamic and evolving sector employing labour intensive harvesting, processing and distribution technologies to exploit marine and inland water fishery resources. The activities of this sub-sector, conducted full-time or parttime, or just seasonally, are often targeted on supplying fish and fishery products to local and domestic markets, and for subsistence consumption. Export-oriented production, however, has increased in many small-scale fisheries during the last one to two decades because of greater market integration and globalization. While typically men are engaged in fishing and women in fish processing and marketing, women are also known to engage in near shore harvesting activities and men are known to engage in fish marketing and distribution. Other ancillary activities such as net-making, boatbuilding, engine repair and maintenance, etc. can provide additional fishery-related employment and income opportunities in marine and inland fishing communities. Small-scale fisheries operate at widely differing organizational levels*

> *ranging from self-employed single operators through informal micro-enterprises to formal sector businesses. This sub-sector, therefore, is not homogenous within and across countries and regions and attention to this fact is warranted when formulating strategies and policies for enhancing its contribution to food security and poverty alleviation.*
>
> (FAO, 2004, quoted in Béné, Macfadyen and Allison, 2007, p 7)

Many countries categorize their fisheries - small-scale fisheries are generally a distinct category. However, the terminology varies and can include a wider range of categories: artisanal, traditional, subsistence, or recreational (see box). Some countries (e.g. Norway) use a category 'coastal fisheries', implying fishing closer to the shore and with relatively small boats.

Box 4: Terminology and sub-categories of small-scale fisheries

In addition to small-scale and large-scale, there are several other terms used for describing the different fisheries subsectors. *Artisanal fishery* is commonly used when describing a traditional fishery, e.g. the canoe fisheries off West Africa. It is a term of Latin origin with a socio-economic foundation and "tends to imply a simple, individual (self-employed) or family type of enterprise [...], most often operated by the owner" (FAO, no date). It also tends to refer to the use of low levels of technology rather than the scale of the activity. However, the terms artisanal fisheries and small-scale fisheries are often used interchangeably and also in this report, artisanal fisheries have generally been interpreted as being the same as small-scale fisheries.

A *subsistence fishery* is "a fishery where the fish caught are shared and consumed directly by the families and kins of the fishers rather than being bought by middle-(wo)men and sold at the next larger market" (FAO, no date). Pure subsistence fisheries are rare since excess production would be sold or exchanged for other products or services even in the smallest fishery; strictly speaking, all fisheries (except perhaps recreational are commercial. Still, when referring to subsistence fishing, a more household centred than commercial activity is implied. Subsistence fisheries are a subset of small-scale fisheries.

Small-scale fishing boats can be motorised or non-motorised. While traditional craft were often powered by wind or paddles, there has been an important increase in motorisation during the last few decades. It should also be noted that there are small-scale fisheries taking place without boats by using shorebased or handheld gear. In 2002, it was estimated that the world fishing fleet consisted of some 4 million vessels. About two-thirds of these were undecked (and generally less than 10 m) whereof 65 percent non-motorised, i.e. approximately 1. 8 million. Large vessels over 24 m (or larger than 100 GT) represent only about 1 percent of the total fishing fleet (FAO 2007).

Often the small-scale fishery classification criteria include a technical consideration, in particular the size of the vessel. Chuenpagdee *et al* (2006) found that this was the case in 65 percent of the 140 countries included in their study on marine small-scale fisheries. The gear type is another deciding factor. Fishing grounds and operational distance from shore could be other criteria, especially if there are different management regulations for the different fleet segments. It should be noted that many countries consider all inland water operations small-scale and that monitoring and management efforts also in the marine sector tend to be focused on the large-scale and marine fleet segments. In some countries, this constitutes an incentive for fishers to be considered as small-scale because there are less restrictions for this part of the fleet than for large-scale vessels (e.g. Nicaragua, see FAO/FishCode-STF, 2008). Moreover, the structure of the sub-sector and its ownership as well as conceptual considerations could be used as criteria. The following examples of criteria and characteristics were found in the developing country case studies (see also Table 27):

- **Technical criteria**: Vessels of less than 5 GT in Thailand and with an engine power of less than 50 HP in Cambodia. In Senegal, the vessel type is the decisive criterion and all canoes ("pirogues") are considered artisanal, i.e. small-scale.

- **Fishing ground and management factors**: In the Philippines, vessels smaller than 3 GT require registration at the municipal government level and are allowed to fish in the 0-15 km coastal area. They are called 'municipal fisheries' and considered small-scale.
- **Conceptual considerations**: According to the glossary of the *Indonesian National Act No. 31/2004 concerning the Fisheries*, small-scale fishers are defined as those who their livelihood do fishing for their daily life or daily necessity.

Table 27. Examples of definitions of small-scale marine fisheries from developing country case studies

Country (area)	*Size of vessel / engine*	*Other criteria*	*Sub-categories*	*No of vessels*
Brazil	< 18 m		"Small boats" < 12m (with and without engines); "middle-sized boats" 12-18 m.	99,100
Cambodia	< 10 HP	Largely subsistence fishing	Motorized; non-motorized	5,400
Ghana	Canoes	Low level of mechanization	According to gear types: Ali/Poli/Watsa; set net; hook and line; drift gillnet; beach seine.	11,200
India	Non-mechanized		Motorized; non-motorized, and type of boat: kattumarams; plank-built craft; FRP and other craft; ring seiners; dugouts.	179,000
Philippines	< 3 GT	Operating in coastal area < 15 km and under management of local municipalities	Motorized *bancas*; non-motorized *bancas*	469,800

Source: developing country case studies.

The exact criteria to use for defining fishery categories – and hence the subset of boats and operators that is included – should depend on the purpose for which the classification is made. The social and economic importance of the small-scale sector is often underestimated due to a lack of information. If the role of the small-scale fisheries in poverty reduction and food security is to be strengthened, more information may be needed on the socioeconomic characteristics of the sub-sector as well as on its overall development context in order for governments to formulate effective policies and actions. When defining the sub-sector, consideration may then need to be given to ownership structures and its importance to local economies. For resource management purposes, criteria related to fishing areas, target species and gear are likely to be relevant.

Links and interactions

The discussion above has focused on definitions of fishing operations, i.e. the actual act of catching fish at sea (or in a lake or river). However, a fishery consists of not only primary production but is a larger system including up and downstream activities among which fish processing and marketing are of major importance. Generally small-scale processing is labour intensive and uses a minimum of technology. In developing countries, the aim is commonly to preserve the fish and extend its shelf-life. Throughout the tropics, drying is widely practiced. Salting and fermenting are common in Asia, and smoking is mainly used in Africa. Large-scale processing can take place on board factory vessels or at shore-based plants. Freezing is globally the most common method of processing fish, followed by canning. Frozen fish is also the most common fish commodity for export from developing countries (FAO, 2007).

Box 5: Small-scale coastal fisheries in the EU

Within the European Union (EU) there has been no harmonised definition of small-scale fisheries although member countries do use the term generally to describe fleet segments of smaller boats fishing in national coastal waters. The sub-sector is overall considered of particular importance to employment and as having a lower impact on resources. Within the context of developing recommendations for the management of fisheries exploited by European small-scale coastal fleets, a recent study suggested that the EU bases its operational definition of small-scale fisheries on three criteria: vessel size, gear used and geographic range of activities. Accordingly, small-scale coastal fishing would generally include vessels of less than 12 meters – possibly up to 18 meters in certain areas with coastal fisheries by larger boats (the Mediterranean) – predominately using passive gear and operating in inshore areas. It was also noted that the importance of sub-sector, both in terms of production and employment, was often underestimated and that more knowledge on the structure and functioning of the sub-sector would be necessary for its efficient management (IFREMER, 2007).

As for fishing operations, the definition of what are small and large-scale land-based post-harvest activities is somewhat ambiguous. The picture is further complicated by the fact that small-scale fishers may supply fish to industrial processing plants and vice versa. For small-scale fishing communities, such arrangements can be both beneficial and unfavourable. Larger scale operators may have access to markets in a way that the small-scale fishers do not, and can in this way provide a lucrative distribution channel. In other situations, however, the situation may be different with large-scale fisheries competing with the small-scale sector for access and control over both resources and markets (FAO, 2003).

Vertical integration of large-scale fishing and processing industry, combined with important investments, has become common in many developed countries during the last few decades (e.g. Iceland, New Zealand – see Fishery Country Profiles (FAO , *No date c*). In the small-scale sector, vertical coordination is also common through, for example, fish traders pre-financing fishing trips or inputs in exchange for a guaranteed supply of fish. In Bangladesh, the *dadandar*, i.e. the fish trader cum money lender is the traditional source of credit for fishers. The credit conditions vary from location to another but generally the borrower – who may have taken a loan to finance fishing equipment – would be obliged to sell his fish to the *dadandar* at a price below the market price (NRI, 2003).

There are also interactions at the horizontal level between the small and large-scale fishery sub-sectors. In some countries, canoe fishers collect bycatch from industrial trawlers. In the Gambia, fishers who initially were disadvantaged and effectively displaced by the presence of shrimp trawlers worked out informal agreements with the crew and made a business of collecting bycatch and selling it through various outlets on shore (Clucas, 1997). This type of bycatch collection also takes place in a number of other countries.

Due to overfishing and increasingly scarce resources, the general competition for fishery resources has increased. While many countries reserve inshore marine areas and inland waters for small-scale operators, there are other situations where both fleet segments compete for the same fishery resources (FAO/RAP/FIPL, 2004; Jacquet and Pauly, 2008). Also, it is not unusual that, for example, industrial trawlers encroach on inshore fishing grounds. In addition to impacting on the resources available for the small-scale sector, this may increase the risk of accidents and collisions. In a study undertaken by the Programme for Integrated Development of Artisanal Fisheries in West Africa (IDAF) in seven West African countries in 1991-1994, incidents with industrial vessels getting their trawls entangled in fishing nets and dragging them away while canoes are fishing were among the main causes for accidents at sea (Gallène, 1995). Also ten years later, the Sustainable Fisheries Livelihoods Programme (SFLP) found through communications with fishing communities in Republic of the Congo, Guinea and Gabon that

infractions by larger vessels in the small-scale fishing area and safety at sea were major concerns among small-scale fishers (Njock, 2007).

Classifying diverse and complex fisheries

From the above discussion, it can be concluded that a fishery can be defined according to several different dimensions – biological, technological, economic, social, cultural and political – and that a multi-dimensional approach is needed for understanding the exact attributes of different small and large-scale fisheries and fishery systems. The following table gives an overview over some of the main characteristics and how they can schematically be described for small-scale – divided into subsistence and other – and large-scale fisheries. It should be remembered that the categories are not mutually exclusive; a specific fishery could fall into different categories depending on which characteristic is examined.

Table 28. Generic characteristics of categories of fisheries

Characteristics	Small-	scale	Large-scale
	Subsistence	Other small-scale	
Size of fishing craft/vessel and engine	Non or small (5-7 m; < 10 GT),often non-motorised	Small (< 24m; <50 GT)) with low power engine (<400 HP)	Large (>24m; >50 GT) with high power engine (>400 HP)
Type of craft/vessel	Canoe, dinghy, wooden boat, undecked vessels		Steel / GRP hulled vessel, trawlers, factory vessels
Fishing unit	Individuals, or family or community groups	Small groups, some specialisation and division of labour; importance of household and community	Smaller and larger groups; specialisation and division of labour
Ownership	Craft/gear owner-operated	Usually owned and operated by senior operator; some absentee ownership	Concentration of ownership, often by non-operators; cooperative ownership
Time commitment	Mostly parttime/occasional	Fulltime or parttime	Usually full time, or seasonal
Fishing grounds	Inshore or inland	Inshore/coastal; inland or marine	All marine areas, very few inland
Disposal of catch	Primarily household consumption but some local barter and sale	Sales to local, national and international markets; household consumption	Primarily sale to organised markets
Utilisation of catch	Fresh or traditionally processed for human consumption	Fresh or processed – generally traditionally – for human consumption.	Mostly processed; large share for reduction for non-food products
Knowledge and technology	Premium on skills and local knowledge; manual gear	High skills and knowledge needs; manual and mechanised gear; some electronic equipment	Skills and experience important but supported by technology; mechanised gear; automation and electronic equipment
Integration into economy	Informal, not integrated	Partially integrated	Formal, fully integrated
Base	Rural / peri-urban	rural	Urban/ corporate
Value added	Low/ local	Household/ local level	Throughout economy
Benefits	Direct consumption	Direct sale and employment	Some direct and through profits and taxes
Factors of production	Labor intensive	Labor intensive	Capital intensive

Source: Authors and adapted from Berkes et al, 2001; Chuenpagdee, 2006 and Johnson, 2006.

Moreover, it could be said that, generally in the world, there is a shift over time from the left to the right of table, i.e. from small-scale towards large-scale, but this trend is not linear or irreversible (Berkes *et al*, 2001; Johnson, 2006). Nevertheless, there appears to be sufficient

common features to allow for the use of small-scale and large-scale fisheries as two main distinguishable categories in global data and policy discussions (Chuenpagdee *et* al, 2006; Jacquet and Pauly, 2008).

6.1.1.2 Defining subsistence fisheries

The FAO (2010) proposed that a subsistence fishery is one in which:

> *'…fish caught are shared and consumed directly by the families and kin of the fishers rather than being bought by intermediaries and sold at the next larger market.'*

While covering essential ground in terms of the intent of subsistence fishing, this effectively leaves us with a static definition proposing 'subsistence fishing' as the antithesis of 'commercial fishing'. Under this definition, where fish are sold, fishing can no longer be deemed 'subsistence' in nature. This does not accommodate well the inherent variability in fish supply that moderates fishers disposal of catch. In practice, 'pure' non-commercial fishing as described here is rare. Instead fishers with limited resources remain opportunistic – where fish surplus to household requirements are captured (often during peak seasons) this catch is sold (See Box 2). Also, this definition, perhaps intentionally, leaves a 'grey' area; in being specific about market chains, instances where catch is sold directly by fishers or family members of fishers are neither included nor excluded from the proposed 'subsistence' group. Notably also, recreational fishers (with the exception of catch and releases fisheries) fall within this definition, as there is no concept of level of need amongst those engaged in fishing.

Box 2. Subsistence fishing in Bangladesh

"In the Bangladesh context, the term 'opportunistic' is perhaps the most appropriate synonym for subsistence. The patterns or activity by subsistence fishers are seen to be highly dependent on natural variability in available resource. Making meaningful distinctions between subsistence fishing and fishing for income can be a futile exercise. To some extent calling oneself a subsistence fisherman has become a matter of convenience. When people outside professional fishing communities want to minimise (downplay) the amount of fishing they do (because they are using illegal gear or think there may be some kind of access restriction) they describe it as fishing just for consumption, although they may well be using sizeable units of fishing gear. Children's fishing is almost always said to be 'just for consumption' even though many may sell some of their catch to supplement family income. The degree to which what is caught is sold for income also depends a great deal on seasonal fluctuations in the fish biomass of area water bodies. During the drawdown, for example, when fish are plentiful and concentrated in small areas where they are easily caught, a self-described subsistence fisherman can easily find himself with more fish than his family can consume. Subsistence fishermen are defined as those who fish for consumption and for whom any income from fishing is more a matter of chance than intent".

Source: FAP 17, 1994b

Other resource-based definitions found in technical literature refer to subsistence as:

> *'….a mode of production mainly geared towards home consumption and achieving a minimum standard of living'* (Sharif 1986).

> *'….those fishers who are poor, fish mainly for food and may exchange or sell surplus harvest to meet other basic needs'. (*Sowman 2006)

6.1.2 Disaggregating small-scale and large-scale fisheries

The information provided in the case studies is based on the latest available data and generally refers to a year during the period 2004-2007. However, for some values, older data have been used. The study has not attempted to adjust values from different years to standardize the values from the different country case studies to a base year. Rather, it has instead been assumed that the orders of magnitude of the calculated values and the relationships between different indicators are sufficiently precise given the level of aggregation and indicative nature of the study estimates. The results presented in this report are thus considered to refer to present-day (2008) values.

With regard to employment estimates, it should be noted that employment in fisheries takes many forms. The livelihoods of fishing communities often depend entirely on the fishery resources but there are also numerous part time and occasional fishers and fish workers. Some fish for subsistence, i.e. the catch is consumed directly by the household rather than being sold. Fishing is also a recreational activity, but this catch is often consumed and sometimes sold. Thus there is a spectrum of fishing activities which are often not readily distinguishable from one another. Conscious of this spectrum and the difficulties in categorizing these profiles the purposes of quantifying the fishing activities, the case studies followed the classification used by FAO:

- Fulltime fishers: receiving at least 90 percent of their livelihood or spending at least 90 percent of their working time from fishing.
- Part time fishers: fishers receiving at least 30 percent, but less than 90 percent of their livelihood from fishing or spending at least 30 percent but less than 90 percent of their working time in that occupation.
- Occasional fishers: those receiving less than 30 percent of their income from fishing or spending less than 30 percent of their working time on fishing.

While occasional fishing can make a major contribution to local food supplies and nutrition for communities living near inland and marine waters, this category of fishing was not explicitly covered in the case studies because data are generally not readily available. National population and economic census methods that are used in many countries only record primary occupational categories, not secondary or tertiary occupations, misrepresenting the nature of rural agricultural livelihoods combining many different income generating activities (Keskinen, 2003). Subsistence and occasional fishing is the subject of separate case studies (Mills 2010).

Likewise, employment in the auxiliary activities pose some problems with regard to definitions. The type of postharvest jobs included in the case study data are likely to be defined somewhat differently from one country to another but mainly refer to employment in fish processing and wholesale of fresh fish. Values could also include employment related not only to processing of fish from domestic capture fisheries but also of aquaculture production and imported fish. Employment in upstream and support activities (e.g. boat building, gear repair, provision of fuel) were estimated in some of the countries (see below) but these numbers were not included in the final compilation of data for the developing country case study.

The case studies relied to a large extent on secondary data in the form of official statistics, published data and "grey literature", e.g. information from project reports and studies. In some cases, this information was complemented and confirmed by primary data collection. This research took place via interviews with key informants (e.g. Cambodia, Ghana), focus group discussions or expert meetings (e.g. Brazil, Cambodia, China) and interviews with a sample of operators to collect vessel specific information (e.g. Bangladesh, China). In some of the countries

(Thailand, Vietnam), a reanalysis of existing household survey data (production or consumption) constituted an important input into the assessment of production and consumption.

Hence, there was not one approach followed in all countries but local circumstances and data availability decided how to obtain "best estimates" for the selected indicators. The following table gives some details on the approaches applied in a selection of the case study countries and more detailed information on how household survey data was used in some countries.

In spite of these efforts, for some of the case study countries, information was not available on all the selected indicators and existing data had to be extrapolated or assessed in other ways to complete the picture for the group of case study countries as a whole. At the time of compilation and analysis, case study results were hence sometimes further complemented and cross-checked with information available from other sources, in particular from the database of FAO Fishery Country Profiles. Estimates of discards were largely based on information from an FAO assessment of discards (Kelleher, 2005)[53].

Most efforts were vested in assessing employment numbers and production quantities and the share for local human consumption. Accordingly, data are most complete for these aspects and the indicators included in the developing country case study Thomson table presented in this report thus cover primary and postharvest employment by gender, share of production for domestic human consumption and discards (see table). One other aspect – fuel consumption – is discussed in the text (see section on 'fuel') but due to the small sample and apparent weaknesses of available estimates, no quantitative estimates have been included (see table).

While the focus of the indicators are on employment and local food supply, the fisheries sector also play an important role at the macroeconomic level – as a contributor to economic growth and as foreign exchange earner. These aspects were not explicitly covered by the developing country case studies. A separate study was undertaken with regard to the contribution of fisheries to GDP and related economic multiplier effects (Hoshino et al. 2010).

Summary tables of the information available on each case study country (and Lake Victoria) are available (FAO and WorldFish Center 2009).

[53] Full references of sources other than the case study report are given with the summary tables in the annex.

Box 6. Key features of the case study methods

China. Estimates were based on official fisheries statistics and frame survey results (2007) as well as interviews with wholesale markets managers and skippers in selected locations in three provinces: Guangdong and Zhejiang provinces for marine and Hubei province for inland. The results for the marine sector in Guangdong and Zhejiang provinces were extrapolated to the whole marine fisheries sector based on official landings data. The results for Hubei province were extrapolated to the rest of the country in consultation with local experts and using official statistics on fishing vessel and fishery resources distribution in inland waters as guidance.

Ghana. Estimates for the marine sector were based on data sourced from official fisheries statistics complemented by a questionnaire survey on auxiliary employment. Information on disposition (and on income/costs) was collected in semi-structured discussions with key informants.
Data on the inland sector were partly sourced from official statistics and project and research reports. In addition, a market survey was carried out and landings for Lake Volta were recalculated using market information from Yeji together with lakewide catch assessment data (from 2000) as a basis for extrapolation. Employment estimates were based on earlier (2007) survey data. For regions other than Lake Volta, data and estimates for Lake Volta were used, taking known differences between these other areas and Lake Volta into consideration. The number of fish processors was obtained from government officials in the different regions.

Indonesia. Aggregate data (separating marine and inland) were sourced from official estimates from different government agencies. Number of fishers by subsector (small-scale and large-scale) was estimated using a ratio derived from earlier sample surveys. Production by subsector (small-scale and large-scale) was calculated according to estimates by an expert panel. Information on the disposition of catches (e.g. share for domestic human consumption) was not available.

Philippines. Data were sourced from official fisheries statistics, censuses and research studies. The official information was classified according to environment – marine or inland – and scale: municipal (small-scale) and commercial (large-scale).
Information on the disposition of catches (e.g. share for domestic human consumption), separating the small and large-scale sectors, was not available.

Thailand. Estimates for the marine sector were based on data sourced from official fisheries statistics but production was recalculated assuming that:

- Large-scale catches included an additional 1 percent because of discards at sea;
- Small-scale catches included 1 additional kg (at USD 1 /kg) per fisher and day for own consumption;
- Only the large-scale sector produces for export.

Estimates of inland production and employment were made using census data (2003) giving an estimate of the total number of inland fishing households accompanied by survey data for 2 215 sampled households. Distinguishing between small, medium and commercial fishing, the survey results were extrapolated to all households according to the census data. Assumptions made included:

- Value of inland production : USD 1 / kg;
- 2.8 boats reduced by 50 percent per km^2 of water area.
- All inland production was assumed to be for domestic local consumption.

Vietnam. Data were mainly sourced from official statistics and project reports. Estimates of inland fisheries production were calculated reanalyzing existing household consumption survey data. Data sources and disaggregation definitions were discussed and validated with local officials and experts.

6.1.2.1 *The case for small-scale fisheries*

Box 7. the case for separate consideration of small-scale fisheries

- Small scale fisheries:
  - are often part of diverse and complex livelihoods nested in a local fishery economy that underpins the social, economic and cultural cohesion of isolated communities;
  - are essential for food security, poverty reduction, and as social safety nets;
  - are frequently dispersed over large areas with a multiple landing points
  - require different management approaches and knowledge pathways and more discursive than coercive enforcement;
  - are highly vulnerable to threats, including overfishing in inshore and inland areas, competition from large-scale fishing, and exposure to natural disasters such as typhoons and floods and
  - are subject to increased prevalence of HIV/AIDS particularly in fishing communities in Africa and Southeast Asia.
- Stakeholders in small-scale fisheries (in developing countries) generally have a weak political voice because they live in remote areas, in communities with low literacy that may be marginaliszed on the basis of race, tribe, caste or ethnicity.
- The production is caught for domestic use, or sold on beach directly to end consumers, the economic and nutritional contribution of small-scale fisheries inadequately captured in national accounts and food balance sheets
- Many small-scale fisheries are often effectively unregulated and poorly monitored, especially in developing countries and inland waters.

Sources: Béné *et al*, 2007; Garcia *et al*, 2008

Box 8: The Code of Conduct and small-scale fisheries

The Code of Conduct for Responsible Fisheries was adopted in 1995 by FAO members in response to the growing concerns regarding the sustainability of global fishery resources. The Code recognises the importance of small-scale fisheries in poverty alleviation and food security. One of the objectives of the Code is to "promote the contribution of fisheries to food security and food quality, giving priority to the nutritional needs of local communities" (Article 2 (f), FAO, 1995). It also acknowledges that the context of fisheries management includes "food security, poverty alleviation and sustainable development" (Article 6.2, FAO, 1995). Technical Guidelines to accompany the Code for "Increasing the contribution of small-scale fisheries to poverty alleviation and food security" are available (FAO, 2005). Direct reference is made in Article 6.18 to fishers and fish workers in the "subsistence, small-scale and artisanal fisheries" and their right to "a secure and just livelihood, as well as preferential access, where appropriate, to traditional fishing grounds and resources in the waters under their national jurisdiction" (FAO, 1995).

6.2 SUPPLEMENTARY DATA

6.2.1 Developing country case studies

6.2.1.1 Previous studies

The following table (adapted from Thompson 1980[54]) gives an overview of the marine capture fisheries in 1980. The study included global estimates of employment, catches and fuel consumption in small and large-scale marine fisheries. It argued for the relative importance of the small-scale sector and the need to protect inshore fishing grounds and support small-scale fishers.

The 'Thomson table' has been updated on several occasions (Lindquist, 1988; Berkes *et al*, 2001; Pauly, 2006) and the different versions are summarized below. Of these, only Berkes *et al* (2001) includes inland fisheries. The values in these tables have often been cited as representing 'global fisheries despite the omission of inland fisheries.

Table 29. A profile of world fisheries in 1980

	Large-scale Company owned	Small-scale Artisanal
Number of fishers employed	450,000	Over 8,000,000
Marine fish caught annually for human consumption (tons)	Around 24 million	Around 20 million
Capital cost of each job ($)	$10,000 - $100,000	$100 - $ 1,000
Marine fish caught for industrial reduction (fish meal and oil)	Around 19 million tons	Almost none
Fuel oil consumption (tons/ year)	10 – 14 million tons	1 – 2 million tons
Fish caught per ton of fuel consumed	2 – 5 tons	10 – 20 tons
Fishers employed for each $1 million invested	10 - 100	1,000 – 10, 000

Source: Thompson, 1980

Table 30. Comparative results of previous studies (millions)

Benefits	Thomson 1980		Lindquist 1988		Berkes et al 2001[55]		Pauly 2006	
	Small-scale	Large-scale	Small-scale	Large-scale	Small-scale	Large-scale	Small-scale	Large-scale
Annual catch for human consumption (tons)	20	24	24	29	20-30	15-40	About 30	about 30
Annual catch reduced to meals and oils (tons)	Almost none	About 19	Almost none	About 22			Almost none	20-30
Fish and other sealife discarded at sea (tons)			none	6-16			Very little	8-20 t
Number of fishers employed (million)	<8	About 0.450	>12	0.5	50	0.5	>12 s	About 0.5
Annual fuel consumption (tons)	1-2	10-14	1-2.5	14-19	1-2.5	14-19	About 5	About 37
Catch (tons) per ton of fuel consumed	10-20	2-5	10-20	2-5	10-20	2-5	4-8	1-2

Source: Authors

[54] David Thomson 'Conflict within the fishing industry' ICLARM Newsletter in July 1980.
[55] All versions refer only to the marine sector expect for Berkes *et al, 2001*, that incorporates both marine and inland fisheries.

All versions refer only to the marine sector expect for Berkes *et al, 2001*, that incorporates both marine and inland fisheries

6.2.2 Subsistence fisheries

Box 4. 'Subsistence fishing' in Thailand

As part of the Thai case-study for the study, a recalculation of inland capture fisheries production in Thailand was undertaken (Lymer et al. 2008). Datasets used in this analysis included the national Agricultural Census and the Gross Provincial Product (GPP) survey. Among those sampled in the GPP survey 2,215 households reporting fish production were identified and survey returns examined in detail. Of these, 75% of households reported production of less than 281 kg/yr, with a mean production of 102 kg/year. These households were designated to be low-production households. Remaining fishing households had an average catch of 1,306 kg/yr.

The national Agricultural Census identified 2,639,582 fishing households. Assuming a similar distribution of high-production and low-production fishing households as identified in the GPP survey, and attributing to these the average catches of such households as calculated in the GPP survey, total inland production was estimated at 1,062,696 t in 2005.

This figure represents around 5 times the official figure for inland capture fishery production for the same year. Official data is collected via the direct monitoring of landings at major landing sites in a number of larger reservoirs throughout Thailand.

Box 4. Use of the term 'hidden harvests'

The term 'hidden harvest' is not original. It has been used by several authors and for several different purposes. These are some examples.

- Employment. A produce recovery program that employs low income farm workers to "rescue" produce that is left behind in the fields and orchards after harvest. http://www.hiddenharvest.org/
- Food waste. A program that strives to alleviate hunger and end food waste in the Bay, Midland and Saginaw region by providing a safe and coordinated system of rescuing surplus food and redistributing it to feed people in need.
- Forests. Uncovering the Hidden Harvest: Valuation Methods for Woodland and Forest Resources (Earthscan People Plants International Conservation Series)
- Food policy. Pardey, Philip G. & Alston, Julian M. & Christian, Jason E. & Fan, Shenggen., 1996. "Hidden harvest," Food policy reports 6, International Food Policy Research Institute (IFPRI).
- Garments - Hidden Harvest garments philosophy is natural grown fabrics and personal identity.
- Poetry. Rodrigo Toscano, "Hidden Harvest" from *Platform*. 2003 by Rodrigo Toscano. Atelos publ.
- Integrated farming services. Pacific Ag Solutions (The Hidden Harvest™) provides a full range of integrated farming services.
- Wild foods. Scoones, I., Melnyk, M. and Pretty, J. N. 1992. The hidden harvest: wild foods and agricultural systems. A literature review and annotated bibliography. The Sustainable Agriculture Programme, International Institute of Environment and Development, London. 251 pp
- Wild resources. IIED 1997. Valuing the Hidden Harvest: Methodological Approaches for Local-Level Economic Analysis of Wild Resources. Sustainable Agriculture Programme Research Series 3:4. International Institute of Environment and Development, London. 73pp

6.2.3 Recreational fisheries

Table 31. Estimates of expenditures on fishing tackle in relation to total angler expenditures (ratio)

Location	Year	Ratio	Study
South Australia	2001	0.09	
Australia	2003	0.08	
USA	2001	0.06	
USA (L. Erie)		0.20	
USA	2006	0.10	ASA, Southwick Ass.
USA	2000	0.10	
USA	2007	0.06	
Canada	2007	0.17	
Canada	2007	0.08	
Washington (USA)	2006	0.15	
Washington (USA)	2008	0.22	Wash Dept Fish Wildlife
Germany	2000	0.38	Wedekind
Germany		0.03	Toivenen
England & Wales (inland)	2007	0.43	Radford et al
Austria	2000	0.25	
Ireland (indirect est.)	2003	0.24	Nat. Survey
Ireland (foreign)	2001	0.04	
Ireland (local)	2001	0.08	
Wales salmon /trout	1999	0.06	
Wales (trout)	2000	0.31	Nautilus
Scotland	2009	0.13	
Brazil (Pantanal)	1994	0.33	Ram, et al.
Mexico (Los Cabos)		0.02	Southwick
mean		0.16	
median		0.10	

Source: various studies

Box. Recreational fishing gear trade classification code

The NAICS code for fishing tackle and equipment is 3399201. It is for this definition of fishing tackle and equipment that the aggregate latent demand estimates are derived. “Fishing tackle and equipment” is specifically defined as follows:

3399201	Fishing tackle and equipment
33992011	Fishing tackle and equipment
3399201101	Fishing rods, excluding fishing rod and reel combinations
3399201106	Fishing reels, excluding fishing rod and reel combinations
3399201111	Fishing rod and reel combinations
3399201116	Fish hooks, including snelled hooks
3399201121	Artificial fishing bait, including flies, lures, casting plugs, spinners, and spoons
3399201126	Fishing tackle boxes
3399201131	Other fishing equipment, including bait and fish buckets, creels, floats, furnished lines, sinkers, and snap swivels

http://www.icongrouponline.com/codes/NAICS.html.

Table 32. Estimate of the global number of anglers (millions)

Country	Million anglers	Source
Australia	3.360	
Austria	0.410	EAA
Belgium	0.300	EAA
Brazil (Pantanal only)	0.059	
Bulgaria	0.180	EAA
Canada	2.800	
China	90.000	Min Guo
Cyprus	0.003	EAA
Czech Republic	0.263	EAA
Denmark	0.650	Roth
Estonia	0.050	EAA
Finland	1.900	
France	4.000	EAA
Germany	3.300	EAA
Hungary	0.325	EAA
Iceland	0.650	EAA
Ireland	0.200	EAA
Italy	0.900	EAA
Japan	10.200	*
Latvia (d)	0.200	EAA
Luxembourg	0.004	EAA
Macedonia	0.000	EAA
Netherlands	1.500	EAA
Norway	1.800	EAA
Poland	4.400	Bizacumen
Portugal	0.230	EAA
Rest of Asia & Latin America	41.800	**
Rumania	0.200	EAA
Russia	14.700	Bizacumen
Slovakia	0.069	EAA
South Africa (marine)	0.496	Griffith & Lambert
Spain (Mediterranean licenses only)	0.133	Franquesa
Sweden	2.500	EAA
Switzerland	0.350	EAA
Turkey	4.900	Bizacumen
UK (Eng & Wales)	4.200	Nautilus
USA	29.400	Bizacumen
Total number of anglers	**226.431**	

Sources: http://www.eaa-europe.org/index.php?id=14 and see table refs.. * Assuming Japan spends the same per person as other OECD. ** Assuming Rest of Asia and Latin America spend 75% of OECD anglers per person (includes Argentina with separate estimate of 3 million anglers).

Table 33. Percentages of global expenditures on recreational fishing tackle 2009

Region/Country	2009
US	29.13
Canada	2.41
Japan	9.02
Europe	39.17
Asia-Pacific	11.65
Latin America	8.62
Total	**100**

Source: Bizacumen

Table 34. Percentage breakdown of US expenditure on fishing equipment by type - 2006

Fishing Type	% Share
Freshwater	63.87
Saltwater	20.41
Nonspecific	15.72
Total	**100**

Source: Bizacumen

Table 35. Selected information sources for recreational fisheries contribution

Source	Countries	Data Source	Method	Issues/Notes
Steinback et al., 2004	U.S. excluding the states of Alaska, Texas, and Hawaii	A series of marine angler expenditure surveys in the coastal regions in 1998-2000. two-part survey involving a random sample of saltwater trips through an intercept creel survey and a random digit dial telephone survey of coastal households.	Input-output model "IMPLAN"	Value-added impacts not provided
Peterson	Hawaii, U.S.		Multipliers were generated using the RIMS II	
NMFS 2007	U.S.	No detail.	No detail on methods	This document is a national overview
Cowx, 1998	22 European countries	NA	NA	NA
Henry and Lyle, 2003	Australia	National recreational and indigenous fishing survey implemented in 2000. Used a remote (telephone/ diary) survey technique in conjunction with a number of validation/ calibration surveys to minimize non-response and behavioral biases.	Exploratory analysis of survey data. i.e. variance estimation.	IO analysis not provided
Fisheries and Oceans Canada, 2007	Canada	2005 survey on angler profiles, catch volumes and species, trip, and expenditure. Questionnaires were mailed to residents and non-residents.	major purchases or investments attributable to fishing activities; package deals purchased; and direct expenditures related to recreational fishing trip activities.	Value-added impacts not provided
Barnes et al., 2002	Namibia	A series of surveys were conducted in 1996-1997.	Expenditure, travel cost, and contingent valuation analysis	
McGrath et al.,1997; Brouwer et al., 1997	South Africa	Expenditure and income surveys in 1995-1996.	Input-output analysis	
Mike and Cowx, 1996	Trinidad	Socioeconomic survey in 1992.	Travel cost analysis	

Source: Hoshino, et al. 2010

6.2.4 GDP estimates and data sources

6.2.4.1 Classification of fisheries activities in the System of National Accounts

Fishing and aquaculture appears as a separate economic activity at the division level in the ISCI Rev. 4. However, processing and wholesale/ retail of fish and fishery products are located under Section C (manufacturing), Section G (Wholesale and retail trade), respectively. In addition to these three Divisions, fisheries related activities, such as recreational fishing, and subsistence goods producing (i.e. subsistence fishery for own consumption), also appear as a part of other Division or Classes.

Box 9.Classification of fisheries related activities in the System of National Accounts

Section A: Agriculture, Forestry, and Fishing
Division 03: Fishing and aquaculture
Group 031: Fishing
Class 0311: Marine fishing
Class 0312: Freshwater fishing

Section C: Manufacturing
Division 10: Manufacture of food products
Group 102: Processing and preserving of fish, crustaceans and molluscs
Class 1020: Processing and preserving of fish, crustaceans and molluscs
Division 33: Repair and installation of machinery and equipment
Group 331: Repair of fabricated metal products, machinery and equipment
Class 3315: Repair of transport equipment, except motor vehicles, includes repair and maintenance of ships and pleasure boats

Section G: Wholesale and retail trade; repair of motor vehicles and motorcycles
Division 46: Wholesale trade, except of motor vehicles and motorcycles
Group: 463: Wholesale of food, beverages and tobacco
Class 4630: Wholesale of food, includes egg, meat, fishery products etc.
Division 47: Retail trade, except of motor vehicles and motorcycles
Group: 472: Retail sale of food, beverages and tobacco in specialized stores
Class: 4721 - Retail sale of food in specialized stores, includes fish and seafood

Section R: Arts, entertainment and recreation
Division 93: Sports activities and amusement and recreation activities
Class 9319: Other sports activities, including operation of sport fishing

Section T: Activities of households as employers
Division 98: Undifferentiated goods- and services-producing activities of private households for own use
Group: 981: Undifferentiated goods-producing activities of private households for own use, includes hunting, gathering, and farming of goods produced by the household for its own subsistence.

Source: UN Online Statistical Database: Detail Structure and Explanatory Notes ISIC Rev.4. available at: http://unstats.un.org/unsd/cr/registry/regcst.asp?Cl=27

6.2.4.2 Sources for fisheries GDP data

Table 36. Summary of information sources for fisheries GDP

Source	Countries	Data Source	Method	Issues/Notes
FAO Fishery Country Profile	69 countries across all regions	In most cases the data source not specified.	In most cases the method not specified.	Appear to be fishing sector only. Aquaculture is included in some countries (not specified in most cases).
Gillett and Lightfoot, 2001	14 Pacific island countries (10 used in our analysis)	Published estimates of VAR; national accounts in various countries; reported income & expenditure data; personal contact with industry.	Used VAR to calculate various fishing subsector. For subsistence fishing, farm pricing method was used.	Fishing sector (catching, firming) only.
Gillett 2009	22 Pacific island countries and territories (19 countries available)	Various. See Appendix 1 for detail.	VAR	Catching & farming.
SFLP documents	15 West and Central African countries	Various, including official statistics, household surveys, and expert contacts.	Using a common method which follows SFLP Methodological Guidelines	sum of added values in the production, the processing and the marketing of fresh products and in the processing and marketing of processed products
Sugiyama et al., 2004	Bangladesh, China, Indonesia, Malaysia, Philippines, Lao PDR, Thailand, Vietnam	GDP values in 2001 calculated from the ESCAP official statistics.	Production values of capture fisheries and aquaculture. No further detail.	Figures are indicative, as the data to quantify the value of capture production is not readily available for many States.
Parvel Salz (Eurostat)	Netherlands, Italy, France, UK, Denmark, Spain, Ghana, Uganda	Data mainly from EUROSTAT data in 2006.		Eurostat data do not include marketing and other post-harvest activities other than processing. Aquaculture not included.
Expert contacts (case study coordinators)	Cambodia China Ghana	Various official statistics	Production and post-harvest sector included. Further detail not available.	
Individual county's reports	Canada, New Zealand, Japan, Iceland, Maldives, Seychelles	Official statistics.		Limited number of original documents accessed.

SFLP, Gillett and Lightfoot 2001, Gillett 2009.

Sugiyama et al.(2004)

The report contains crude estimation of capture production values, and aquaculture values as percentage of GDP. GDP values in 2001 calculated from the ESCAP official statistics except

Taiwan POC. The data of some States are from 2000. The report noted that "the data to quantify the value of capture production is not readily available for many States. As indicative figures, unit value of 0.8 US$ per kg was applied for this estimation of capture production value."

WB/ FAO consultant
The consultant has compiled the values of production and processing sector mainly from EUROSTAT data in 2006. EUROSTAT has data for value-added for "Processing and preserving of fish and fish products" for EU countries. However, the data do not include marketing and other post-harvest activities other than processing.

EU fleet performance and employment (except Spain), data 2006

- STECF-SGECA 02-08, Annual Economic Report 2008, Copenhagen, 21-25 April 2008
  - Employment is in full time equivalents, incl. self-employed

Spanish data on fleet performance, data 2006 (value and volume of catch, value added and employment)

- MAPYA (Ministerio de Agricultura, Pesca y Alimentación), Indicadores económicos de pesca marítima, Principales resultados, Ejercicio 2006

Employment in aquaculture, data 2005-6

- P. Salz et.al. (2008), Review of the EU aquaculture sector, Draft final report (under preparation), Project 'Definition of data collection needs for aquaculture' (FISH/2006/15 lot 6). Employment is in 'employed persons', incl. self-employed (NOT in full time equivalents)

Employment in fish processing

- EUROSTAT, data 2006. Employment is in full time equivalents

GDP and €/$ exchange rate

- EUROSTAT, data 2006. Contribution to GDP is only related to income created by the catching sector

Fuel prices

- B. van Marlen, P. Salz et.al., Energy savings in Fisheries, Draft final report (under preparation)

Specific indicators

Denmark – Inland - personal communication from FOI
France – Inland - European Fisheries Fund – National strategic programme 2007-2013
Denmark. Catch for non-human uses from Danish Min. of Agr. Fisheries Yearbook 2006, p.59.
Netherlands. Processing – J. Smit & C. Taal, Socio-economic indicators of the Dutch fisheries sector, LEI, 2007
Italy. Processing – source no. 7. (p.121), consistent with Italian NSP regarding situation in 2001

Expert contacts
The data were collected from the 17 case study coordinators via email (see section).

Information was compiled from existing secondary sources, complemented where possible by primary data collection or review. In some cases (for example, Thailand and Vietnam), catch

information was cross-checked and recalibrated by analysis of household consumption surveys. Fisheries GDP data were available for the following countries

Cambodia (David Thomson). Assumptions were made for production/post-harvest breakdown based on the government official figures of 10% fisheries GDP (capture 5.85%, 3.74% post-harvest, and rest is aquaculture). Value added for post-harvest includes smoking, drying, and making fish sauce and naim pickled fish.

China (Xie Yingliang) . Data Source: Chinese Fisheries Yearbook in 2004. The capture fisheries value accounted for about 1% of overall national GDP. The total value of capture fisheries and aquaculture accounted for about 2.4% of overall national GDP and the total value of capture fisheries, aquaculture, aquatic products processing, fishing boat building and fishery industry accounted for about 3% of the overall national GDP.

Country and regional sources available online

Canada. GDP contributions of Canadian fishing industry was divided into two groups: primary fisheries & mariculture; and processing. In addition, the contribution of the ocean transport industry (including marine shipping, ship & boat building and repair), ocean tourism industry (recreational fishing, coastal and cruise ship tourism), marine construction industry, ocean manufacturing and service industry, and government services in marine, were calculated separately. Source: Canada's Ocean Industries: Contribution to the economy 1988 – 2000. Prepared for Department of Fisheries and Ocean (DFO).

Denmark. Source: Statistics Denmark. http://www.statistikbanken.dk/statbank5a/default.asp?w=1280

Iceland. Sources:
Hall, Heidarsson and Saevaldsson, No date. Economy of Iceland, 2008[56]. The Central Bank of Iceland.
7% GDP value include fishing and fish processing.
Agnarsson and Árnason, 2003[57]. The Role of the Fishing Industry in the Icelandic Economy. A Historical Examination.

Japan. Source: Ministry of Agriculture, Forestry and Fisheries.
http://www.maff.go.jp/j/tokei/sihyo/index.html

Maldives. Source: U.S. Dept. of State Country Background Notes[58] . The fisheries industry, including fish processing, traditionally contributes about 7% of GDP, but it was only about 5% in 2007 due to a drastic drop in the fish catch. The website does not provide the data sources and method used.

Namibia. Source: Bank of Namibia Quarterly Report September 2007[59] . The table provides GDP by economic activities in 1995, including "fishing and fish processing on board" and "fishing processing on shore" but does not provide methodology or data sources.

[56] http://www.sedlabanki.is/lisalib/getfile.aspx?itemid=6372
[57] http://www.ioes.hi.is/publications/wp/w0307.pdf
[58] http://www.state.gov/r/pa/ei/bgn/5476.htm
[59] http://www.tradedirectory.com.na/documents/sbn5.pdf

New Zealand sources:
MAF 2006. http://www.maf.govt.nz/mafnet/new-zealand-fast-forward/oia/060831-b152-nzs-recent-growth-performance.pdf
McDermott Fairgray Group Ltd., 2000[60]. The report was prepared for the New Zealand Fishing Industry Council. The report includes the contribution of seafood industry by 3 customized subsectors: (1) ocean and coastal fishing and fishing consultants, (2) fishing in inland water and fish farming, and (3) fish and shellfish processing. The study found that the seafood industry had an annual output of about $1.8 billion in 1998. This directly adds around $541.5 million of value to the economy (0.6 percent of total GDP). Seafood processing comprises the larger part of the industry, accounting for almost 55 percent of the sector's value added. In addition to the direct impact, they also estimated indirect and induced impacts of the industry through the multipliers. Multipliers were estimated by input-output analysis. The results showed that indirect and induced value added impacts outweigh direct impacts by $641.0 million. This implies a value added multiplier of 3.17. The indirect and induced economic impacts of fish and shellfish processing were substantial, totaling $824.0 million value added or 0.8 percent of New Zealand's total GDP. This is larger than the total direct impact of the entire seafood industry of $541.5 million.

Seychelles. Source: Seychelles strategy 2007 (pers. com. K. Kelleher/ X. Vincent).

Tanzania. Source: Wilson 2004. The fisheries contribution to GDP was obtained from the Bank of Tanzania Economic Operations Report 2001. No detail on how GDP was calculated.
http://www.fao.org/docrep/007/j2760e/j2760e00.htm#Contents

Uganda. Source: Banks 2003, cited in
http://p15166578.pureserver.info/ilm/docs/finance/Fiscal%20Reforms%20in%20Fisheries%20in%20Uganda.pdf

Vietnam. Source: World Bank 2005.
http://siteresources.worldbank.org/INTVIETNAM/Resources/vn_fisheries-report-final.pdf

Scotland. http://www.scotland.gov.uk/Publications/2004/03/19079/34369

CRFM website.[61] Caribbean Regional Fisheries Mechanism (CRFM)'s website provides fisheries GDP figures for the member countries, but it does not provide the method of calculating GDP in detail. For some countries the data are quite old (early 1990s).

[60] An economic study commissioned by the New Zealand Seafood Fishing Industry Council. Available at: http://www.seafood.co.nz/f420,21397/21397_Economic_Impact_Assessment_NZ_Regions.pdf

[61] http://www.caricom-fisheries.com/members/antigua.asp

Table 37 Post harvest share of fisheries GDP for 21 sample countries (% of national GDP)

Country	Fishing GDP %	Post harvest GDP %	Fisheries GDP%	Post harvest share %	Year	Source
Benin	1.76%	1.24%	3.00%	41.3%	2002	Kébé & Tallec, 2006.
Burkina Faso	0.20%	0.10%	0.30%	33.3%	2002	Kébé & Tallec, 2006.
Cambodia	10.00%	6.00%	16.00%	37.5%	2003	BNP case study (David Thomson)
Cameroon	0.90%	0.80%	1.70%	47.1%	2002	Kébé & Tallec, 2006.
Canada	0.16%	0.12%	0.28%	42.9%	2000	Roger A. Stacey Consultants 2003
Cape Verde	1.28%	2.66%	3.94%	67.5%	2002	Kébé & Tallec, 2006.
Congo, Republic of	1.39%	1.36%	2.75%	49.5%	2003	FAO 2008
Côte d'Ivoire	0.76%	0.76%	1.52%	50.0%	2002	Kébé & Tallec, 2006.
Denmark	0.13%	0.22%	0.35%	62.3%	2005	Statistics Denmark
Finland	0.10%	0.02%	0.12%	16.7%	2000	Eurostat (Pavel Salz)
France	0.07%	0.04%	0.11%	36.4%	2003?	Lena's table
Gabon	0.76%	0.75%	1.51%	49.5%	2002	Kébé & Tallec, 2006.
Gambia	1.75%	3.95%	5.70%	69.3%	2002	Kébé & Tallec, 2006.
Ghana	8.00%	1.70%	9.70%	17.5%	2006	Eurostat (Pavel Salz)
Iceland	5.00%	2.00%	7.00%	28.6%	2007	Hall, Heidarsson and Saevaldsson, *No date*
Namibia	2.97%	0.83%	3.80%	21.8%	2006	Bank of Namibia Quarterly Report September 2007
Sao Tome and Principe	5.20%	0.60%	5.80%	10.3%	2002?	FAO 2008
Senegal	1.81%	2.29%	4.10%	55.9%	2003	FAO 2008
Sweden	0.02%	0.03%	0.06%	57.1%	na	Westlund pers. com.
Uganda	3.00%	9.00%	12.00%	75.0%	2002	Banks 2003, cited in
United States	0.30%	0.27%	0.57%	47.4%	2006	unstat.org

Sources:
Kébé & Tallec, 2006. includes marketing, processing, handling, sale and repair of canoes, etc.
ftp://ftp.fao.org/FI/DOCUMENT/sflp/SFLP_publications/French/Contribution_pecheSynth_fev_06.pdf
Roger A. Stacey Consultants 2003. Includes aquaculture
Eurostat (Pavel Salz). Processing included, but marketing and other post-harvest not included
Hall, Heidarsson and Saevaldsson, *No date.* Includes both fishing and fish processing
Statistics Denmark (http://www.statistikbanken.dk/statbank5a/default.asp?w=1280)
FAO 2008 – as Kebe & Tallec http://www.fao.org/fi/oldsite/eims_search/1_dett.asp?calling=simple_s_result&lang=en&pub_id=254204
Banks 2003, (cited in #). Includes trade sector. Official figure of 2.4% assumed
undervaluedhttp://p15166578.pureserver.info/ilm/docs/finance/Fiscal%20Reforms%20in%20Fisheries%20in%20Uganda.pdf
Statistics Denmark (http://www.statistikbanken.dk/statbank5a/default.asp?w=1280)
Bank of Namibia Quarterly Report September 2007 (http://www.tradedirectory.com.na/documents/sbn5.pdf)

Table 38. Calculation of mean and median fisheries sector GDPs based on 128 countries

	Fishing GDP		Fisheries GDP (based on **median** fishing GDP)			Fishing GDP (based on **mean** fishing GDP)		
	Median	Mean	Median	95% CI		Median	95% CI	
128 countries	1.29%	2.64%	2.20%	1.95%	2.52%	4.49%	3.98%	5.15%
Developed	0.19%	0.46%						
Developing	1.79%	3.23%						

($ million)

	GDP ($ million)	Fisheries GDP ($ million)			Fisheries GDP ($ million)		
128 countries	43,254,750	950,404	842,001	1,090,844	1,942,179	1,720,654	2,229,173
Developed	32,323,881	710,228	629,220	815,178	1,451,373	1,285,829	1,665,841
Developing	10,930,869	240,176	212,781	275,666	490,806	434,825	563,332

Source: Hoshino et al. 2010.

Table 39. Base data and data sources used to estimate extended fisheries sector GDP

Country	Fishing GDP	Post harvest GDP	Fisheries GDP	Aqua-culture included	Comment on fisheries GDP calculation	Year	Source
American Samoa	0.23			0.47	Commercial & subsistence fishing, aquaculture	2007	Gillett 2009
Angola	3.00				No detail on how fishery GDP was calculated	2006	SIFP 2008
Anguilla	2.60					?	UNLOS 2008
Antigua and Barbuda	1.48				No detail on how fishery GDP was calculated	2003	CRFM website
Bahamas	1.40				No detail on how fishery GDP was calculated	2004	CRFM website
Bangladesh	3.92				No detail on how fishery GDP was calculated	2009	FAO Country Profile
Barbados	1.00				No detail on how fishery GDP was calculated	2002	FAO Country Profile
Belgium	0.00				share in the national GDP and contribution to employment almost negligible	2003	FAO Country Profile
Belize	2.80			2.20	Includes aquaculture. It is not sure if processing etc included	2003	FAO Country Profile
Benin	1.76	1.24	3.00		including marketing, processing, handling, sale and repair of canoes etc.	2002	Kébé & Tallec, 2006.
Botswana	0.00				No detail on how fishery GDP was calculated	2002	FAO Country Profile
Brazil	0.40				No detail on how fishery GDP was calculated	2000	FAO Country Profile
British Virgin Islands	0.70					na	UNLOS 2008
Burkina Faso	0.20	0.10	0.30		including marketing, processing, handling, sale and repair of canoes etc.	2002	Kébé & Tallec, 2006.
Burundi	1.00				GDP contribution of 1% based on fish production only	2003	FAO Country Profile
Cambodia	10.00	6.00	16.00			2003	BNP case study (David Thomson)
Cameroon	0.90	0.80	1.70		including marketing, processing, handling, sale and repair of canoes etc.	2002	Kébé & Tallec, 2006.
Canada	0.16	0.12	0.28	0.05	Includes aquaculture	2000	Roger A. Stacey Consultants 2003
Cape Verde	1.28	2.66	3.94		including marketing, processing, handling, sale and repair of canoes etc.	2002	Kébé & Tallec, 2006.
Chad	1.30				No detail on how fishery GDP was calculated	2002	FAO Country Profile
China	2.40				GDP share based on gross value of fisheries output	2004	FAO Country Profile
Chile	1.50					1998	FAO Country Profile
Comoros	15.00				gross value of fisheries output as % of GDP	?	SWIOFC 2006
Congo, Republic of	1.39	1.36	2.75		SFLP method (see note)	2003 (?)	FAO 2008
Cook Islands	4.16			2.14	Commercial & subsistence fishing, aquaculture	2007	Gillett 2009
Costa Rica	0.32				No detail on how fishery GDP was calculated	2002	FAO Country Profile
Côte d'Ivoire	0.76	0.76	1.52		including marketing, processing, handling, sale and repair of canoes etc.	2002	Kébé & Tallec, 2006.
Croatia	0.23				Catch value only	2004	FAO Country Profile
Cyprus	0.24				No detail on how fishery GDP was calculated	2004	FAO Country Profile
Czech Republic	0.03				The role of fisheries is rather marginal. No info on how GDP calculated	2004	FAO Country Profile

Country	Fishing GDP	Post harvest GDP	Fisheries GDP	Aqua-culture included	Comment on fisheries GDP calculation	Year	Source
Denmark	0.13	0.22	0.35			2005	Statistics Denmark **
Djibouti	0.10				contribution of fisheries to GDP less than 0.1%	2001?	FAO Country Profile
Dominica	1.77				No detail on how fishery GDP was calculated	1994	CRFM website
Dominican Republic	0.01				No detail on how fishery GDP was calculated	2005	FAO Country Profile
Eritrea	2.30				GDP contribution includes value of production only	2002	WB 2004. Fisheries ESW
Ethiopia	0.00				The contribution of fisheries to GDP is marginal	2001	FAO Country Profile
Fiji Islands	1.38			0.02	Commercial & subsistence fishing, aquaculture	2007	Gillett 2009
Finland	0.10	0.02				2000	Eurostat (Pavel Salz)
France	0.07	0.04			NA	2003?	Westlund
French Polynesia	1.10				SFLP method (see note)	2001	SFLP
Gabon	0.76	0.75	1.51		including marketing, processing, handling, sale and repair of canoes etc.	2002	Kébé & Tallec, 2006.
Gambia	1.75	3.95	5.70		including marketing, processing, handling, sale and repair of canoes etc.	2002	Kébé & Tallec, 2006.
Georgia	1.10				No detail on how fishery GDP was calculated	2003	FAO Country Profile
Germany	0.02	0.02	0.04		Value of fishery production only	2005	Eurostat (Pavel Salz)
Ghana	8.00	1.70	9.70		Processing included, but marketing and other post-harvest not included	2006	Eurostat (Pavel Salz)
Greece	0.35	0.07	0.42		Value of primary production only. 0.42% from Eurostat (Pavel Salz)	2003	FAO Country Profile
Grenada	1.83				No detail on how fishery GDP was calculated	1994	CRFM website
Guinea	1.80				including marketing, processing, handling, sale and repair of canoes etc.	2002	Kébé & Tallec, 2006.
Guinea Bissau	3.70				No detail on how fishery GDP was calculated	1999	FAO Country Profile
Guyana	2.80				primary sector only	2004	FAO Country Profile
Haiti	2.50				No detail on how fishery GDP was calculated	?	UNLOS 2008
Iceland	5.00	2.00	7.00		Includes both fishing and fish processing	2007	Hall, Heidarsson and Saevaldsson, *No date*
India	1.07				GDP based on price of fish in 2003-04.	2003-04	FAO Country Profile
Indonesia	2.40				No detail on how fishery GDP was calculated	2004	FAO Country Profile
Iran (Islamic Rep. of)	0.23				No detail on how fishery GDP was calculated	2002	FAO Country Profile
Israel	0.06				No detail on how fishery GDP was calculated	2005	FAO Country Profile
Italy	0.10				Processing included, but marketing and other post-harvest not included		Eurostat (Pavel Salz)
Jamaica	0.50				No detail on how fishery GDP was calculated	2003?	FAO Country Profile
Japan	0.13			0.07	Value of fisheries production only. Includes aquaculture	2006	MAFF
Jordan	0.01				No detail on how fishery GDP was calculated	2001-02	FAO Country Profile
Kenya	0.50				Producion only. Not including VA from various supply chain	2005	FAO Country Profile
Kiribati	21.5					2000	FAO Country Profile*
Korea, Republic of	1.00				No detail on how fishery GDP was calculated	2000	FAO Country Profile
Kyrgyzstan	1.00				No detail on how fishery GDP was calculated	2006	FAO Country Profile
Laos.	6.80				No detail on how fishery GDP was calculated	2005	FAO Country Profile
Latvia	1.15				No detail on how fishery GDP was calculated	2003	FAO Country Profile

Country	Fishing GDP	Post harvest GDP	Fisheries GDP	Aqua-culture included	Comment on fisheries GDP calculation	Year	Source
Lesotho	0.00				Currently no significant economic role	2007	FAO Country Profile
Liberia	4.00				No detail on how fishery GDP was calculated	2005	FAO Country Profile
Madagascar	5.46			1.54	Including aquaculture. Unsure if processing and marketing included	2006?	FAO Country Profile
Malawi	4.00				No detail on how fishery GDP was calculated	2003	FAO Country Profile
Malaysia	1.73				GDP based on total value of fish landings in 2004	2004	FAO Country Profile
Maldives	4.50				including fish processing	2007	Global Edge
Mali	4.50				SFLP method (see note)	2002?	FAO 2008
Malta	0.16				Catch value only	2004	FAO Country Profile
Marshall Islands	26.65			0.05	Commercial & subsistence fishing, aquaculture	2007	Gillett 2009
Mauritania	4.50				SFLP method (see note)	2006?	FAO 2008
Mauritius	1.00				No detail on how fishery GDP was calculated	2004	FAO Country Profile
Mexico	0.80				No detail on how fishery GDP was calculated	2001	FAO Country Profile
Micronesia,Fed.States of	9.53	2.23	11.76	0.01	Commercial & subsistence fishing, aquaculture	2006	Gillett 2009
Morocco	2.50				No detail on how fishery GDP was calculated	2005	FAO Country Profile
Mozambique	4.00				No detail on how fishery GDP was calculated	2006	FAO Country Profile
Namibia	2.97	0.83	3.80		NA	2006	Bank of Namibia Qu. Rep. Sept. 2007 ***
Netherlands	0.07				Processing included, but marketing and other post-harvest not included	2006	Eurostat (Pavel Salz)
New Zealand	0.25				includes manufacturing, but excludes downstream	2006	MAF 2006
Nigeria	1.55				Capture and aquaculture production value only (00-05 average)	00-05	FAO Country Profile
Norway	0.30			0.10	Fishing and farming of all commercial fishing for fish, sharks, molluscs and crustaceans	2008	Statistics Norway
Oman	0.60				GDP based on total value of fish landings in 2004	2005	FAO Country Profile
Palau	6.08			0.02	Commercial & subsistence fishing, aquaculture	2006	Gillett 2009
PNG	3.09			0.01	Commercial & subsistence fishing, aquaculture	2006	Gillett 2009
Peru	1.98				No detail on how fishery GDP was calculated	2002	FAO Country Profile
Philippines	2.20				GDP based on total value of fish landings in 2003	2002	FAO Country Profile
Poland	0.01				Harvesting sector only. Share in national GDP is almost negligible	2005	FAO Country Profile
Portugal	0.22				Processing included, but marketing and other post-harvest not included	2006	Eurostat (Pavel Salz)
Qatar	0.10				No detail on how fishery GDP was calculated	2001-02	FAO Country Profile
Romania	0.00				Sector makes a marginal contribution to GDP	2002	FAO Country Profile
Russian Federation	0.30				Value of fishery production only	2006	FAO Country Profile
Rwanda	0.33				No detail on how fishery GDP was calculated	2004?	FAO Country Profile
Saint Kitts and Nevis	0.84				No detail on how fishery GDP was calculated	2005	FAO Country Profile
Saint Lucia	1.50				No detail on how fishery GDP was calculated	2001	CRFM website
St Vincent/ Grenadines	2.00				No detail on how fishery GDP was calculated	1999	FAO Country Profile
Samoa	6.20			0.00	Commercial & subsistence fishing, aquaculture	2007	Gillett 2009
Sao Tome and Principe	5.20	0.60	5.80		SFLP method (see note)	2002?	FAO 2008
Senegal	1.81	2.29	4.10		SFLP method (see note)	2003	FAO 2008

Country	Fishing GDP	Post harvest GDP	Fisheries GDP	Aqua-culture included	Comment on fisheries GDP calculation	Year	Source
Seychelles	30.00				NA	2005	Seychelles strategy 2007
Sierra Leone	9.40				No detail on how fishery GDP was calculated	2006	FAO Country Profile
Solomon Islands	6.19			0.01	Commercial & subsistence fishing, aquaculture	2007	Gillett 2009
Somalia	2.00				No detail on how fishery GDP was calculated	1990	FAO Country Profile
South Africa	1.00				No detail on how fishery GDP was calculated	2002	FAO Country Profile
Spain	0.17				Processing included, but marketing and other post-harvest not included	2006	Eurostat (Pavel Salz)
Sri Lanka	2.00				No detail on how fishery GDP was calculated	2004	FAO Country Profile
Sudan	0.00				The contribution of fisheries to GDP is marginal	2006	FAO Country Profile
Suriname	4.00				No detail on how fishery GDP was calculated	?	UNLOS 2008
Swaziland	0.00				Fishing does not play a significant economic role	2003	FAO Country Profile
Sweden	0.02	0.03	0.06		NA	?	? (Lena's table)
Tanzania	2.70				No detail on how fishery GDP was calculated	2000	Wilson 2004
Thailand	1.90				No detail on how fishery GDP was calculated	1996	FAO Country Profile
Taiwan	0.54				Overseas Fisheries Development Council Rep. of China	2003	
Togo	4.00				harvesting sector only	2005	FAO Country Profile
Tonga	5.10			0.00	Commercial & subsistence fishing, aquaculture	2005/06	Gillett 2009
Trinidad and Tobago	0.09				No detail on how fishery GDP was calculated	2005	FAO Country Profile
Turkey	0.22	0.06	0.40	0.08	Includes production, processing, aquaculture and support industries	2006	FAO Country Profile
Tuvalu	8.20	2.10	10.30		Commercial & subsistence fishing. No acuaculture	2002	Gillett 2009
Uganda	3.00	9.00	12.00		Including trade sector. Official figure of 2.4% assumed undervalued	2002	Banks 2003, cited in
U.K	0.04				Processing included, marketing and other post-harvest not included	2006	Eurostat (Pavel Salz)
United States	0.30	0.27	0.57		NA	2006	unstat.org
Vanuatu	1.67			0.03	Commercial & subsistence fishing, aquaculture	2007	Gillett 2009
Venezuela, Boliv Rep of	0.50				No detail on how fishery GDP was calculated	2002	FAO Country Profile
Viet Nam	4.00			5.78	Direct production value only	2005	Van Trong
Zambia	0.42				GDP based on contribution from capture fishery alone	2005	FAO Country Profile
Zimbabwe	0.00				Fish production is not a major contributor to GDP	2004	FAO Country Profile

* Westlund pers. com.

** (http://www.statistikbanken.dk/statbank5a/default.asp?w=1280)

*** (http://www.tradedirectory.com.na/documents/sbn5.pdf)

Note: unadjusted values with respect to the economic contribution of aquaculture

Table 40. Table Estimates of country by country extended fisheries sector GDP (proportion and $ thousands)

Country	Harvest	Post-harvest	GDP	1.765
American_Samoa	0.0023			0
Angola	0.03		58547	3100
Anguilla	0.026		109	5
Antigua_Barbuda	0.0148		1026	27
Bahamas	0.014		6586	163
Bangladesh	0.039		67694	4660
Barbados	0.01		3430	61
Belgium	0		448560	0
Belize	0.028		1274	63
Benin	0.0176	0.0124	5428	163
Botswana	0		11781	0
Brazil	0.004		1314170	9278
British_VI	0.007			0
Burkina Faso	0.002	0.001	6767	20
Burundi	0.01		974	17
Cambodia	0.1	0.06	8628	1380
Cameroon	0.009	0.008	20644	351
Canada	0.0016	0.0012	1326376	3714
Cape_Verde	0.0128	0.0266	1434	56
Chad	0.013		7085	163
China	0.024		3280053	138943
Chile	0.015		169458	4486
Comoros	0.15		449	119
Congo_R	0.0139	0.0136	7646	210
Cook_Islands	0.0416		183	13
Costa_Rica	0.0032		25225	142
Cote_dIvoire	0.0076	0.0076	19570	297
Croatia	0.0023		51277	208
Cyprus	0.0024		21277	90
Czech_Republic	0		168142	0
Denmark	0.0013	0.0022	308093	1078
Djibouti	0.001		830	1
Dominica	0.0177		328	10
Dominican_Republic	0.0001		36686	6
Eritrea	0.02		1201	42
Ethiopia	0		19395	0
Fiji	0.0138		3433	84
Finland	0.001		246020	434

Country	Harvest	Post-harvest	GDP	1.765
France	0.0007		2562288	3166
French_Polynesia	0.011		5300	103
Gabon	0.0076	0.0075	10654	161
Gambia	0.0175	0.0395	643	37
Georgia	0.011		10176	198
Germany	0.0002		3297233	1164
Ghana	0.08	0.017	15246	1479
Greece	0.0035	0.0007	360031	1512
Grenada	0.0183		554	18
Guinea	0.018		4564	145
Guinea_Bissau	0.037		357	23
Guyana	0.028		1044	52
Haiti	0.025		6137	271
Iceland	0.05	0.02	19510	1366
India	0.0107		1170968	22114
Indonesia	0.024		432817	18334
Iran	0.0023		270937	1100
Israel	0.0006		161822	171
Italy	0.001		2107481	3720
Jamaica	0.005		10739	95
Japan	0.0013		43767	100
Jordan	0.0001		15832	3
Kenya	0.005		29509	260
Kiribati	0.534		87	82
Korea_R	0.01		969795	17117
Kyrgyzstan	0.01		3505	62
Lao	0.068		4008	481
Latvia	0.0115		27154	551
Lesotho	0		1600	0
Liberia	0.04		725	51
Madagascar	0.0546		7326	706
Malawi	0.04		3552	251
Malaysia	0.0173		180714	5518
Maldives	0.045		1049	83
Mali	0.045		6863	545
Malta	0.0016		6375	18
Marshall_Islands	0.2665		163	77
Mauritania	0.045		2644	210

Country	Harvest	Post-harvest	GDP	1.765
Mauritius	0.01		6363	112
Mexico	0.008		893364	12614
Micronesia	0.0935	0.0223	257	30
Morocco	0.025		73275	3233
Mozambique	0.04		7752	547
Namibia	0.0297	0.0083	6740	256
Nauru	0.0212		28	1
Netherlands	0.0007		754203	932
New_Zealand	0.0025		129372	571
Nigeria	0.0155		165690	4533
Niue	0.042			0
Norway	0.003		381951	2022
Oman	0.006		35729	378
Palau	0.0608		164	18
PNG	0.0309		6261	341
Peru	0.0198		109088	3812
Philippines	0.0218		144129	5546
Poland	0		420321	0
Portugal	0.0022			0
Qatar	0.001		42463	75
Romania	0		165980	0
Russia	0.003		1291011	6836
Rwanda	0.0033		3320	19
Saint_Kitts	0.0084		527	8
Saint Lucia	0.015		958	25
Saint_Vincent	0.02		553	20
Samoa	0.062		482	53
SaoTome_Principe	0.052	0.006	145	8
Senegal	0.0229	0.0259	11151	544
Seychelles	0.3		728	385
SierraLeone	0.094		1672	277
SolomonIslands	0.0619		369	40
Somalia	0.02		2532	89
SouthAfrica	0.01		277581	4899
Spain	0.0017		1429226	4288
SriLanka	0.02		32354	1142
Sudan	0		47632	0
Suriname	0.04		2241	158
Swaziland	0		2942	0
Sweden	0.0002	0.0003	444443	222
Tanzania	0.027		16181	771
Thailand	0.014		245818	6074
Togo	0.04		2493	176
Tonga	0.051		231	21
TrinidadTobago	0.0009		19982	32
Turkey	0.0022		657091	2551
Tuvalu	0.082		26.7	4
Uganda	0.03	0.09	11214	1346
UK	0.0004		2727806	1926
USA	0.003	0.0027		0
Vanuatu	0.0167		452	13
Venezuela	0.005		228071	2013
Viet Nam	0.04		71216	5028
Zambia	0.0042		11363	84
Zimbabwe	0		3418	0
TOTAL				**324807**

Source: Hoshino et al.

Note: This table shows unadjusted values with respect to the economic contribution of aquaculture. The values used to estimate the global extended capture fisheries GDP were adjusted by reducing the harvest level GDP by the proportion of the harvest represented by recorded aquaculture production.

6.2.4.3 Fisheries sector multipliers

Table 41. Fisheries sector multipliers

Country	Sources	Year	Marine Industry	Output		Employment		Value Added		Income	
			Multiplier type (I/II)	I	II	I	II	I	II	I	II
Australia	Allen Consulting	1996-97	Marine tourism	2.50		2.37					
Australia	Allen Consulting	1996-97	Fisheries and seafood	2.27		2.19					
Queensland	KPMG Consulting	1994-95	Commercial Fishing	1.60		1.74					
Queensland	KPMG Consulting	1994-95	Recreational fishing /boating	2.10		1.74					
Canada	Fisheries Ocean Canada	2006	Traditional fishery						0.66		
Canada	Fisheries Ocean Canada	2006	Fish processing						0.79		
Canada	Fisheries Ocean Canada	2006	Ocean related tourism						0.83		
Newfoundland/Labrador	Pinfold	2006	Fishing			5.71	7.10	0.55	0.67		
Newfoundland/Labrador	Pinfold	2006	Fish processing			9.94	12.03	0.58	0.61		
Newfoundland/Labrador	Pinfold	2006	Marine tourism			17.00	20.57	0.70	0.85		
Nova Scotia	Pinfold	2006	Fishing			9.23	11.54	0.64	0.81		
Nova Scotia	Pinfold	2006	Fish processing			12.50	15.63	0.53	0.67		
Nova Scotia	Pinfold	2006	Marine tourism			19.00	23.75	0.67	0.84		
New Brunswick	Pinfold	2006	Fishing			11.74	14.79	0.78	0.96		
New Brunswick	Pinfold	2006	Fish processing			6.36	8.01	0.33	0.40		
New Brunswick	Pinfold	2006	Marine tourism			21.00	26.72	0.60	0.74		
Prince Edward Island	Pinfold	2006	Fishing			7.64	9.70	0.69	0.83		
Prince Edward Island	Pinfold	2006	Fish processing			14.46	18.36	0.45	0.54		
Prince Edward Island	Pinfold	2006	Marine tourism			15.00	19.05	0.58	0.70		
Québec	Pinfold	2006	Fishing			7.80	10.69	0.73	0.98		
Québec	Pinfold	2006	Fish processing			5.27	7.22	0.43	0.58		
Québec	Pinfold	2006	Marine tourism			20.00	27.40	0.86	1.15		
British Columbia	Pinfold	2006	Fishing			3.49	4.57	0.61	0.82		
British Columbia	Pinfold	2006	Fish processing			8.36	10.95	0.50	0.67		
British Columbia	Pinfold	2006	Marine tourism			15.00	19.65	0.73	0.98		
Canada	GPOR and SGA	2006	Recreational fishing/ boating		2.76						
UK	Greig	>1999	Catching	1.82		1.44					
UK	Greig	>1999	Processing	2.14		2.72					
England	Seafish	2007	Demersal fishing	2.17	3.35	1.52	2.13	3.16	5.50		
England	Seafish	2007	Sellfish fishing	2.39	3.83	1.32	1.59	6.50	12.34		
England	Seafish	2007	Pelagic fishing	2.35	3.38	2.81	4.32	1.89	2.97		
England	Seafish	2007	Fish processing	2.08	3.65	3.33	6.89	2.39	4.78		
Scotland	Greig	>1999	Catching	1.65		1.50					
Scotland	Greig	>1999	Processing	2.26		2.64					

Country	Sources	Year	Marine Industry	Output		Employment		Value Added		Income	
			Multiplier type (I/II)	I	II	I	II	I	II	I	II
Scotland	Robert et al.	1999	Sea fishing	1.66							
Scotland	Robert et al.	1999	Finfish farming	1.17							
Scotland	Robert et al.	1999	Fish processing	1.72							
USA (Pensilvania)	Murray and Shields	2004	Steelhead fishery	1.56		1.29		1.60			
USA (Hawaii)	Peterson	1997	Swordfish longline	1.44	1.84	14.64	19.34				
USA (Hawaii)	Peterson	1997	Small commercial boat	1.49	2.16	49.69	57.39				
USA (Tennessee)	O'Bara	1997	Recreational Walleye fishery	2.08							
SE Asia	Chua and Garces	1992	Fishing					1.50			
Bangladesh	Macfadyen and Thomas	>2001	Shrimp farming	2.15							
New Zealand	McDermott Fairgray	1998	Ocean/Coastal fishing	1.97							
New Zealand		1998	Inland fishing and fish farming	4.52							
New Zealand		1998	Fish and shellfish processing	3.02							
Taranaki	BERL	2006	Commercial fishing	1.37	1.52	1.45	1.67	1.50	1.76		
Taranaki	BERL	2006	Seafood processing	1.35	1.45	1.68	1.89	1.46	1.64		
Africa	Dyck and Sumaila	2003	Ocean fishing	2.12	3.88					0.3	0.57
Asia	Dyck and Sumaila	2003	Ocean fishing	1.81	3.33					0.27	0.47
Europe	Dyck and Sumaila	2003	Ocean fishing	2.72	5.65					0.37	0.81
Latin America & Caribbean	Dyck and Sumaila	2003	Ocean fishing	1.84	3.21					0.25	0.45
North America	Dyck and Sumaila	2003	Ocean fishing	3.38	7.98					0.49	1.27
Oceania	Dyck and Sumaila	2003	Ocean fishing	2.68	4.99					0.34	0.67

Table 42. Supply-driven multipliers

Country	Year	Marine Industry	Output		Employment	
			Upstream	Downstream	Upstream	Downstream
Finland	2003	Fishing	1.6	3.0	1.3	1.7
Finland	2003	Aquaculture	2.2	2.3	2.9	2.5
Finland	2003	Fish processing	2.8	2.1	5.3	2.7
Finland	2003	Fish wholesalling	2.4	2.5	6.2	7.3
USA (Hawaii)	1997	Tuna longline	1.4	1.0		
USA (Hawaii)	1997	Swordfish longline	1.4	1.3		
USA (Hawaii)	1997	Small commercial	1.5	1.3		
USA (Hawaii)	1997	Charter boats	1.5	1.0		
USA (Hawaii)	1997	Recreation boats	2.2	1.0		
USA (Hawaii)	1997	Expense boats	2.3	1.3		

Sources: Finland: Virtinen e
t al. USA: Cai et al.

6.2.5 Approaches to calculation of fisheries GDP

The published values for "fisheries GDP" are commonly created through national accounts in accordance with the international standard for Systems of National Accounts (SNA) and the International Standard Industrial Classification of All Industrial Activities (ISIC)[62] that the SNA follows. SNA is based on a set of internationally agreed concepts, definitions, classifications and accounting rules. It defines some major statistics that are widely used as indicators of economic activity, including GDP. There are three main methods of calculating GDP (see Box 1). Among these three, the production approach (also called value-added or output approach), which calculates GDP by taking the value of goods and services produced (gross output), less the cost of goods and services used in the production process (intermediate consumption), is the most common approach used to calculate fisheries GDP.

Box 10. The Calculation of GDP

According to the Handbook of National Accounting (UN, 1999), there are three approaches to calculate GDP:

1) Total value-added generated by all producers (production approach);
2) Sum of private and government consumption, capital formation and net exports (expenditure approach); and
3) Sum of compensation of employees, taxes on production and imports, consumption of fixed capital and the operating surplus (cost or income approach)

Ideally, the three approaches described above should be used simultaneously and independently from each other, so that the data resulting from each approach can be used as checks to evaluate the data obtained from the other two approaches. In practice, however, this ideal situation is rarely encountered: Some countries do not reconcile their estimates at all, and statistical discrepancies remain in the published results. Other countries do not use the three approaches independently.

Countries often estimate GDP using only one or two approaches. Most often, GDP is estimated by the production approach. In most cases, the income approach is missing as it is generally regarded to be the most difficult to implement.

Source: UN 1999

In most countries, macroeconomic statistics such as GDP are compiled by national statistical offices rather than the fisheries agency. Sector-specific data is most often compiled by the relevant ministries,

[62] http://unstats.un.org/unsd/cr/registry/regct.asp?Lg=1

i.e. the Ministry of Agriculture or the Ministry of Fisheries, and fisheries related statistics are sent to national statistical offices. National statistical offices then compile GDP statistics based on the data provided by these line ministries and agencies.

In order to produce internationally comparable statistics, most countries adopt ISIC classification systems and the Central Product Classification (CPC) , both developed by the UN, although some countries have developed their own classification systems or have adopted regional systems. ISIC classifications are structured according to the type of economic activity rather than the type of product produced by each sector. The current ISIC (Revision 4.0, released on 11 August 2008) has four levels: Sections, Divisions, Groups, and Classes. Sections are used to group together similar activities and are identified by a letter. The Division is represented by a 2-digit code and further sub-divided into Groups (3 digit code) and Classes (4-digit code). The locations of the classification for major fisheries related activities in ISIC are given in Annex 1.

If a particular sector is economically of a great importance, the relevant part of the classification can be further disaggregated, while if a sector is still undeveloped or unimportant the relevant part of the classification can be treated at a more aggregated level (United Nations, 2008). Ideally, a country would be able to provide data at all levels of ISIC classification, but in reality not all detailed categories of the classification are reported. In fact, fisheries related activities are most often reported at an aggregated level under "Agriculture, forestry, and fishing" and it is not possible to isolate the economic values of "fishing" activities from the other agricultural subsectors.

In most countries where disaggregated data is available, fisheries related activities are often reported under the category "Fishing and aquaculture[63]." This means that the values of capture fishing and fish farming to the point of first sale – the harvest subsector- are included, whereas the economic contributions of related or dependent activities such as fish processing and marketing or fishing vessel construction are not included, but are counted under manufacturing and other sectors in the national accounts (See Annex 1). Most commonly, countries do not report these connected activities in detail or information is lumped under a general category such as "food processing." Thus, the fisheries GDP values generally only include value-added created in primary production activities, such as the catching and farming of fish.

6.2.5.1 Alternative approaches

A large body of recent work underlines the high potential of small-scale fishing activities for economic development but systematically highlights how poorly the true economic value of this sector is reflected in official statistics and discussions of food security and livelihoods (Cowx, et al., 2004). Some studies have attempted to re-calculate fisheries GDP considering the wider social and economic contributions of the sector.

SFLP approach

For instance, the Sustainable Fisheries Livelihoods Programme in west and central Africa (SFLP) developed a methodology that considered a wider range of economic and social impacts of the fisheries sector through case studies in 15 participating countries[64]. Their approach in calculating fisheries GDP included the whole fish value chain, i.e. from fishing through to trade and retail marketing. The value added created by the various elements of the fisheries system were aggregated into a revised GDP measurement including (i) actual fishing or fish production, (ii) trade of fresh fish products, (iii)

[63] Under the most recent revision (ISIC Rev. 4), officially released on 11 August 2008. In the previous revision (ISIC Rev.3.1), fishery is classified under the category "Fishing, operation of fish hatcheries and fish farms."

[64] Benin, Burkina Faso, Côte d'Ivoire, Ghana, Mali, Congo, Gabon, Guinea, Mauritania, Cameroon, Chad, Gambia, Senegal, Cape Verde and Sao Tome & Principe

processing of fresh fish products, and (iv) trade of processed fish products. In addition to the GDP figure, two other indicators, namely an annual investment in fisheries, and the contribution of the sector to national budgets, were used as a proxy for national wealth created by the fisheries sector.

It was found that that the value added generated by the fish harvesting or production subsector alone (that is to the point of first sale) represents on average only 60 to 70 percent of the total value generated by the sector (Kébé, 2008). The remaining 30 to 40 percent is generated by the secondary and tertiary sectors. The study also found that the small-scale fisheries represent the most important fractions of the value added created by the sector in most of these countries. For instance, in Mauritania about 45 percent of the overall value added is attributed to the small-scale fisheries. In Senegal, the small-scale fisheries subsector generates 80 percent of total landings and 60 percent of the export volume.

Value Added Ratios (VAR)

Another example is the study commissioned by the Asian Development Bank (ADB) for Pacific Island countries, which highlighted a large contribution from small-scale subsistence fisheries, although their approach focused on "fishing" activities rather than the "fisheries" sector as a whole, thus the post-harvest sector was not included. With this study Gillett and Lightfoot (2001) used value-added ratios (VARs) to estimate the relative contribution of the different fishing subsectors, including large scale offshore fishing, small-scale commercial fishing, non-commercial subsistence fishing (here defined by fishing for a variety of products for own consumption), and others, including aquarium fish and related products, diving, seaweed culture and collection. VARs are the proportion of the gross output attributable to value-added. The value-added of fishing subsector was estimated by multiplying the value of production (gross output) by the VARs. The study showed that their re-estimated average fishing GDP for the region was approximately 30% higher than the official figure (7.0% vs. 5.4% across all countries). The differences in estimates were primarily due to the omission of non-commercial subsistence fishing as well as the differences in the estimate of production and the method used to calculate the GDP contribution. This study was recently updated by Gillett (2009) for 22 Pacific Island countries and territories, using more detailed value added ratios (Table 2). The study found that in most locations the re-estimated GDP ranged between 4.5% (Niue) and 63% (Palau) higher than the official figure.

> *"The main lesson learned is that, in the countries where the estimates are markedly different, the process of preparing the national accounts tends to rely on outdated surveys, inappropriate indicators, and/or poorly understood methods. In most of these cases, the compilers of national accounts do not appear to have consulted the relevant fisheries agencies or the industry when preparing their estimates."*
>
> *Gillett and Lightfoot, 2001*

VARs used in these studies are given in Table 1 and Table 2. VARs in Table 1 were derived based on (i) published estimates of value-added ratios, (ii) the ratios used in calculating national accounts in various countries, (iii) reported income and expenditure data for some activities, (iv) discussions with people involved in the industry, and (v) their own knowledge and experience. The revised version (Table 2) has more detailed information on small-scale fishing and aquaculture.

Table 43. Value-added ratios (VARs) for fisheries subsectors in developing countries in the Pacific (%)

Subsector	*VAR (%)*
Large-scale offshore fishing	40-55
Small-scale commercial fishing	55-70
Subsistence fishing: motorized	65-75
Subsistence fishing: non-motorized	90

Source: Gillett and Lightfoot, 2001.

Input / Output analyses

This approach has been used to estimate the contribution of ocean fish to the global economy at $380 billion (Dyke and Sumaila, 2009)

Verification of results

These alternative approaches could be used to cross check the results of the method used in this study. For example, the economic impacts arising from the fisheries production and recreational fisheries could be estimated through a meta-analysis on multipliers, such as output, value-added and employment multipliers obtained from the existing input-output analyses in fisheries.

By structuring the available data into groups with similar multipliers (based on defined criteria) it would be possible to estimate wider economic contributions (rather than harvest and post-harvest subsectors alone) to global economy and understand any inter-group differences quantitatively. However, it is recognized that multiplier benefits are subject to double counting as an initial increase in output flows through the output-chain is subsequently re-counted in the estimation of multipliers.

Another possible complementally approach is to use VARs in conjunction with the landed value of capture and aquaculture production to determine the contributions of fisheries sector to national GDP. Currently VARs for fisheries are only available for limited geographic areas (i.e. Pacific Island countries), so it is not possible to use these VARs to estimate global figure at this point. More regional case studies similar to the Pacific Island countries case studies are needed to estimate global level GDP impacts from the sector.