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ECONOMIC AND SECTOR WORK

HIDDEN HARVEST

The Global Contribution of Capture Fisheries

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ABBREVIATIONS AND ACRONYMS

DANIDA	Danish International Development Agency
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
GPP	Gross provincial product
GT	Gross tonnage
HIES	Household Income and Expenditure Survey
HP	Horsepower
IFAD	International Fund for Agricultural Development
IFREMER	L'Institut Français de Recherche pour l'Exploitation de la Mer
ISIC	International Standard Industrial Classification of All Industrial Activities
IUU	Illegal, unreported and unregulated (fishing)
MRC	Mekong River Commission
NAS	National Accounts Statistics
NMFS	National Marine Fisheries Service
NZ	New Zealand
OECD	Organization for Economic Cooperation and Development
PROFISH	Global Partnership on Fisheries
SFLP	Sustainable Fisheries Livelihoods Programme
SINTEF	*Stiftelsen for industriell og teknisk forskning;* The Norwegian Foundation for Scientific and Industrial Research
SNA	Systems of National Accounts
SUMA	Support for Brackish Water and Marine Aquaculture project (DANIDA, Vietnam)
UK	United Kingdom
UN	United Nations
U.S.	United States of America
VAR	Value-added ratio

UNITS OF MEASURE

$	U.S. dollar
NOK	Norwegian kroner
ton(s)	metric ton(s)
TT$	Trinidad dollar

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 of people and is essential to the diet of the poor in many countries. About half of those working in the fisheries sector are women, mostly engaged in marketing and processing. However, the 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 focuses 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 of those workers, 97 percent, live in developing countries. 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 their 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 and 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 report compiles information from case studies on countries representing over half of the world's fish workers 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 the gross domestic product, including recreational fishing and postharvest activities, and highlights the importance of subsistence fishing.

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

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

Lena Westlund (World Bank and Food and Agriculture Organization of the United Nations [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 team, prepared the background study on subsistence fisheries and coordinated the country case studies prepared by WorldFish, 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* (publications are available at http://www.worldbank.org/fish). A background study for this report was also prepared to inform policymakers and decision makers participating in the 28th Session of the FAO Committee on Fisheries.

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

- Employment and food recovery. Hidden Harvest is a produce recovery program in Coachella Valley, California, 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 rescue. Hidden Harvest is a surplus food rescue program that strives to alleviate hunger and end food waste in the Bay, Midland, and Saginaw, Michigan, regions by providing a safe and coordinated system of rescuing surplus food and redistributing it to feed people in need (http://www.hiddenharvest.com)
- Food policy report. *Hidden Harvest: U.S. Benefits from International Research Aid*, Philip G. Pardey, Julian M. Alston, Jason E. Christian, and Shenggen Fan (Washington, DC: International Food Policy Research Institute, 1996)
- Integrated farming services. Pacific Ag Solutions (The Hidden Harvest™) provides a full range of integrated farming services (http://www.pacagsol.com)
- Forests. *Uncovering the Hidden Harvest: Valuation Methods for Woodland and Forest Resources*, B. M. Campbell and Martin Karl Luckert (London: Earthscan Publications, 2001)
- Wild foods. *The Hidden Harvest: Wild Foods and Agricultural Systems: A Literature Review and Annotated Bibliography*, Ian Scoones, Mary Melnyk, and Jules N. Pretty (London; Sustainable Agriculture Programme, International Institute for Environment and Development, 1992)
- Wild resources. *Valuing the Hidden Harvest: Methodological Approaches for Local-Level Economic Analysis of Wild Resources*, International Institute for Environment and Development (London: Sustainable Agriculture Programme Research Series 3:4. International Institute of Environment and Development, 1997)
- Garments. The Swedish company, Our Legacy's SS10, Hidden Harvest collection features garments of naturally grown fabrics and "personal identity"
- Poetry. "Hidden Harvest," in *Platform*, Rodrigo Toscano (Berkeley, CA: Atelos, 2003)

1 The preliminary report of "Small-Scale Capture Fisheries: A Global Overview with Emphasis on Developing Countries" is available at http://www.4ssf.org.

2 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 the International Union for Conservation of Nature.

TERMINOLOGY AS USED IN THIS REPORT

Commercial includes both large- and small-scale fisheries subsectors aimed at generating cash revenues.

The ***fisheries sector*** includes all stakeholders and economic activities associated with the capture fisheries value chain, including preharvest and postharvest. Industrial, commercial, inland, recreational, small-scale, large-scale, and artisanal are subsectors. Except in the case of recreational fisheries for which fishing equipment data were available, preharvest inputs to other subsectors are not included in calculations due to lack of disaggregated data.

The ***footprint*** of an activity is the collective economic, social, and environmental impacts of its undertaking.

Full-time fishers receive at least 90 percent of their livelihood from or spend at least 90 percent of their working time at fishing. ***Part-time fishers*** receive at least 30 percent, but less than 90 percent, of their livelihood from fishing or spend at least 30 percent, but less than 90 percent, of their working time in that occupation. ***Occasional fishers*** receive less than 30 percent of their income from fishing or spend less than 30 percent of their working time at fishing.

Industrial represents the large-scale, commercial fishery subsector most often conducted from motorized vessels greater than 20 meters in length operating inshore and/or on open oceans.

Inland fisheries are operated in (mostly) freshwater marshes, swamps, rivers, lakes, and reservoirs.

Postharvest activities take place after the capture and landing of fish and include cleaning, storing, wholesaling, retailing, and other processing before consumption.

Recreational fishers in both high- and low-income countries catch fish for pleasure and home consumption. Few, if any, of the fish are sold.

Small scale generally refers to the commercial fishery subsector conducted without boats and/or from motorized or nonmotorized vessels of less than 20 meters in length. The concept of *small scale* is discussed in greater detail in the text. In this report, ***artisanal*** is the same as small scale.

Subsistence fisheries comprise the subsector in which the majority of fishers are poor and captures are primarily consumed by local households without entering the value chain. Only surpluses are sold.

The ***value chain*** comprises all economic activities and subsectors that directly or indirectly contribute to capture and postharvest processing and marketing of fish. In this report, the value chain does not include activities that occur before fish capture, such as boatbuilding and net fabrication.

EXECUTIVE SUMMARY

This study provides a disaggregated profile of the world's small- and large-scale fisheries and an estimate of their direct and indirect contributions to the gross domestic product (GDP), food security, and rural livelihoods. The study is directed at decision makers, the development community, and professionals to uncover the hidden importance of the fisheries sector with a view to increasing its economic and environmental contributions in a sustainable manner.

APPROACH

Key indicators on production, employment, productivity, and economic contributions were compiled from 17 developing country[3] and region case studies supplemented with recent sector studies from other developing countries and published information from Organization for Economic Cooperation and Development (OECD) member states. Case study data were compiled and extrapolated to the global level using available global fisheries statistical information. The primary raising factors were statistical information, most importantly from the national catch reports submitted to the Food and Agriculture Organization of the United Nations (FAO). Developing and developed countries and marine and inland fisheries were treated separately. Rather than being a random sample, the case study countries ensure coverage of countries where approximately 80 percent of the world's fishers live.

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

Estimates of recreational fisheries' contribution to GDP and estimates of numbers of recreational fishers (anglers) were compiled from the published literature. Because most countries report the value of recreational fishing tackle sold but do not report the number of anglers and their other nontackle expenses (such as for licenses, ice, bait, accommodation, boat hire, travel costs, etc.), the percentage of expenditures attributable to fishing equipment in the (mostly OECD) countries that do disaggregate these data was used to ascertain the aggregate value of expenditures made by anglers globally. Most studies acknowledge some overlap and possible double accounting with the tourism sector.

Available national fisheries sector GDP estimates were compiled and examined to ensure consistency and to establish whether postharvest or aquaculture segments were included or excluded. For most countries, postharvest economic activities are considered as "manufacturing" under the System of National Accounts and generally are not included in reported GDP contribution of the fisheries sector. However, recent studies of some countries in West Africa, the Pacific Islands, and OECD member states have included disaggregated estimates of the postharvest contribution of fisheries to GDP where available. This sample was used to correct estimated GDP from fishing alone (available for more than 120 countries) to include the postharvest value chain. Available data did not permit the disaggregation and/or extrapolation of the preharvest value chain contributions to GDP.

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

Methodological Issues

No standard definition allows for easy disaggregation of small- and large-scale fishery subsectors from national capture fishery reports. Many countries do not even report these subsectors as separate economic activities. To the extent possible in this analysis, the definitions of *small scale* and *large scale* used by each case study country was respected. Consequently, at the aggregate or global level, the dividing line between small and large scale is inevitably blurred, as are distinctions among commercial, recreational, and subsistence fishing.

The lack of data for some countries, or the lack of disaggregated data, required assumptions to fill these data gaps. The major gaps encountered related to (1) deficiencies in the official records of the numbers and production of small-scale fishers, particularly in inland fisheries; (2) records or estimates of postharvest labor in small-scale fisheries; (3) information to assess the scale and importance of subsistence fisheries; and (4) the basis for national fisheries GDP estimates.

The nonrandomness of the case study samples improved overall data richness but created problems for accurate extrapolation. 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 postharvest GDP contribution is extrapolated on the basis of the limited number of GDP estimates, which disaggregate aquaculture, capture fisheries harvesting, and capture fisheries postharvesting activities.

Because of these issues, the results should be treated with due caution and critically evaluated in light of new information or additional precision obtained from further studies.

KEY FINDINGS

- Approximately 120 million full-time and part-time workers are directly dependent on commercial capture fisheries value chains for their livelihoods.
- Ninety-seven percent (116 million) of these people live in developing countries. Among them,
  - more than 90 percent (including almost 32 million fishers) work in the small-scale fisheries subsector,
  - 47 percent of the total workforce is women, which in developing countries equates to 56 million jobs,
  - over half (60 million) of those employed in fisheries value chains in developing countries work in small-scale inland fisheries, and
  - 73 percent (approximately 23 million) of developing country fishers and fish workers live in Asia.
- Over half of the catch in developing countries is produced by the small-scale subsector, and 90 to 95 percent of the small-scale landings are destined for local human consumption.
- Commercial capture fisheries, including postharvest activities, are conservatively estimated to have contributed $274 billion to the global GDP in 2007. This is slightly less than 1 percent of the total global GDP.
- The preharvest value chain (including such activities as boatbuilding and equipment manufacture and sale) may add a further $160 billion to the GDP estimate.
- Global estimated expenditures by approximately 220 million recreational fishers are about $190 billion annually. Recreational fisheries can be of greater economic importance than commercial fisheries in some countries, and they contribute about $70 billion to global GDP.
- An estimated 5.8 million fishers in the world earn less than $1 per day.
- Fish is a vital source of nutrition and feeds more than 1 billion consumers to whom fish is a key component of their diets.
- Subsistence fisheries are a large economic activity and livelihood component of rural communities, but the numbers of subsistence fishers at the global level and the importance of fish to such households are poorly quantified.
- The role of women in fisheries is not limited to processing and marketing; women are also investors, sources of credit, managers of household fishing receipts, and consumers who make important decisions on family nutrition.
- Small-scale fishing communities are among the poorest and most afflicted with social ills and may be further marginalized by a failure to recognize the importance of fisheries.

- Large-scale fisheries land more fish, but small-scale fisheries produce more fish for domestic human consumption.
- National reported capture fisheries production statistics seem to underestimate overall commercial catches by about 10 percent and small-scale inland captures by as much as 70 percent.
- Employment in small-scale fisheries is several times higher per ton of harvest than in large-scale fisheries.
- Small-scale fisheries generate less waste in the form of discards (unwanted catch dumped at sea).
- Like other primary production sectors, fisheries tend to be more important in developing economies than in developed economies.

CONCLUSIONS

The study compiles estimates for key indicators and highlights numerous limitations at local, national, and global levels regarding data availability, data use, and data interpretation. The study reveals serious information deficiencies that undermine decision makers' understanding 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, such as their importance for employment and food supply, their role in poverty reduction, and as a source of wealth and economic growth.

The economic and social importance of the capture fisheries value chain is frequently underappreciated, and the contribution of small-scale and inland fisheries to livelihoods and food security is often poorly recognized. Undervaluation of this sector is both a cause and a result of having weak data on how fisheries interact with the greater society and economy. These knowledge gaps may in part explain why policymakers tend to neglect comprehensive efforts to manage this complex and politically sensitive sector.

What little is known about the contribution of fisheries focuses on the industrial subsector, partly because it is urban based and produces the bulk of the fish entering international trade and because data from this sector are easier to collect. Even in the case of large-scale fisheries, however, available information rarely identifies key trends in profitability and sustainability.

The case studies show that standard fishery production statistics frequently fail to consider employment and other socioeconomic contributions of small-scale, subsistence, and recreational fisheries. As a result, the real economic importance of these fisheries often remains hidden, the pressure on fish resources is often underestimated, and the sector is often neglected in national, regional, and local policies and plans.

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 to contribute to employment and food security. An increase in fisheries GDP may simply mean increased costs of fishing rather than increased productivity, or net benefits. Consequently, increases in sector GDP or employment need to be complemented by 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.[4]

There is a general understanding that capture fisheries need to be broadly reformed to optimize their economic performance and environmental sustainability. Such an overhaul will require an inventory of users and use patterns. National and regional fisheries policy and planning need to be informed by an accurate characterization of the economic performance of fisheries, their social contribution, and their sustainability.

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- 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 they are highly vulnerable to external and internal threats. Accurately characterizing their role and contribution is a first step toward improved management of these fisheries and building political will for reform.

4 See, for example, the World Bank's reports *The Sunken Billions* and *Rising to Depletion?* and its Worldwide Governance Indicators project (http://info.worldbank.org).

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

Recommendations

1. Critically review the results presented here with a view to improving the underlying data, rendering definitions and data sets more compatible, and enhancing the basis for assessing the economic contribution of capture fisheries with the overall objective of improving fisheries management and laying a robust foundation for reform.
2. National and international fisheries agencies and nongovernmental organizations should alert policymakers and decision makers to the value of capture fisheries as a primary industry that underpins the economic activities of an extended value chain and can make an economic contribution several times the landed value of the catch.
3. National fisheries authorities, specialists, and statistics agencies should collaborate to improve estimates of the fisheries sector's contribution to GDP, including the entire value chain. GDP estimates need to be complemented with disaggregated social and environmental indicators reflecting employment, direct contributions to poverty reduction and food security, and trends in the economic performance and environmental sustainability of the various capture fisheries subsectors.
4. The development community should consider collaboration in the following:
    - Elaboration of 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
    - Development of procedures to estimate the extended GDP of the fisheries sector (consistent with existing United Nations guidance [UN and FAO 2004]), including a typology of sector-specific multipliers and value chain analyses, especially for developing countries
    - Building consensus on the preparation of estimates of economic rents and associated indicators of fisheries sector performance (Anderson and Anderson 2010)
    - Improving human resource and other capacity in fisheries data collection, analysis, and management
    - Further development of fisheries governance indicators.
5. Work with the formal mechanisms of the FAO[5] to improve collection and interpretation of statistical data on fisheries at national, regional, and global levels, including validation and improvement of the results presented, and enhance linkages between fisheries data sets and social and economic data sets.

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

Chapter 1: INTRODUCTION

The importance of fisheries as a source of nutrition, employment, and income for many of the world's coastal and rural poor is often not fully appreciated by policymakers. In particular, the contributions of small-scale fishing to the livelihood strategies of millions of households in coastal and rural communities in developing countries and the role they play in food security and poverty alleviation are often ignored in fisheries planning. The growing threat to sustainable fisheries represented by overcapitalization, overfishing, and environmental degradation is often a matter of survival for the many millions of workers in the capture fishery value chain.

Disaggregated information and separate analysis of large-scale, small-scale, artisanal, recreational, marine, and inland fisheries creates a better understanding of their respective roles and social and economic importance. The analysis can inform the trade-offs between objectives—between poverty reduction and employment, foreign exchange and food supply—and it can inform the policies underpinning effective fisheries management. A disaggregated analysis can underpin investment in reforms and in the capacity to develop and implement governance systems adapted to the local context of small-scale fisheries. It can also help build political will for reforms founded on a greater understanding of the social, economic, nutritional, and cultural importance of these different sector segments. The diversity within each subsector, or industry segment, is enormous, with multiple areas of overlap between the subsectors providing a continuum, or spectrum, of production and marketing systems from shoreline collection of shellfish to electronic auctions and recreational fisheries.

Unfortunately, disaggregated data showing the characteristics of the various capture fisheries subsectors are generally lacking. Sector profiles distinguishing between marine and inland fisheries, harvest and postharvest employment, and their respective economic contributions seldom exist. Because of this lack of data, the relative contributions of the different fisheries subsectors, both harvest and postharvest, have not been systematically appraised to inform policy and management.

This data deficit can be attributed to several causes. 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 at point of harvest or first sale present substantial technical problems (such as shell on/off, gutted, whole, dried, or salted). Illegal and deliberately unreported fishing is ubiquitous. Waste and discarding can account for over half of a catch. The relationships between catches and economic returns are nonlinear and complex. Although difficult to collect, these basic production and economic information requirements are essential for policy and planning. The deficiencies are an important contributor to underinvestment in management and policy support to, especially small-scale and subsistence fisheries.

This study attempts to address these critical knowledge gaps with a focus on small-scale fisheries in developing countries to direct the efforts by policymakers 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.

The specific objectives of the study are the following:

- To provide a disaggregated profile of the world's small- and large-scale fisheries, including subsistence and recreational subsectors
- To provide an estimate of the national and global economic importance of the fisheries sector and value chains.

Chapter 2: ESTIMATING THE ECONOMIC CONTRIBUTION OF GLOBAL CAPTURE FISHERIES

This study addresses the knowledge gaps in our understanding of the importance of the various capture fisheries subsectors. The characteristics and contributions of the small- and large-scale commercial capture fisheries are compared and contrasted with a *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 people who are related to the fishing industry. This information is supplemented with additional data drawn from recently completed reviews of the sector. Analyses of fisheries in developed countries are then compared with the developing country profiles to build a global picture of small- and large-scale fisheries. Overall, the sample of developing and developed countries accounts for 88 percent of reported marine catches and 74 percent of reported inland catches.

The fundamental differences between large-scale and small-scale fisheries call for different approaches and perhaps different values to be applied in these coupled segments of a primary industry. In this report, fisheries are disaggregated as commercial, subsistence, and recreational. Commercial fisheries are further disaggregated according to scale. Fisheries that target species that will be rendered for fishmeal or fish oil, often called industrial or reduction fisheries,[6] are not included in this analysis.

2.1 DISAGGREGATING SMALL- AND LARGE-SCALE COMMERCIAL CAPTURE FISHERIES

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

Within this great diversity are vast differences in scale. Commonly, the sector is divided into small-scale fisheries and large-scale fisheries, but the respective definitions differ greatly among countries. Nevertheless, several general attributes distinguish them. Large-scale fisheries are often associated with high capital costs and sophisticated technologies. 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 through profit distribution and taxation.

Small-scale fishing uses smaller (or no) fishing vessels and relatively low-technology fishing methods. Small-scale fisheries tend to be more labor intensive. Small-scale fisheries are often seen as an activity of low productivity, with low yield rates and low-value products directed mainly to local consumption. However, modern small-scale fisheries can be economically efficient and produce high-value products for international markets. Technological developments—particularly motorization, modern navigation, and communication equipment; globalization; and food safety requirements—have changed the way many small-scale fisheries operate.

2.1.1 What Are Small-Scale Fisheries?

Many countries classify their small-scale fisheries as a distinct category. However, the terminology varies and can include a wider range of categories such as artisanal, traditional, subsistence, or recreational. Some countries, such as Norway, use the category "coastal fisheries," implying fishing closer to the shore and with relatively small boats.

Artisanal fishery commonly describes a traditional fishery. *Artisanal* implies a simple, individual (self-employed) or family type of enterprise most often operated by the owner. It also implies the use of low levels of technology rather than describing the scale of the activity. However, *artisanal fisheries* and *small-scale fisheries* are often used interchangeably, and in this report, artisanal fisheries is used synonymously with small-scale fisheries.

6 In particular, the Coordinating Working Party on Fishery Statistics.

TABLE 2.1: Example Definitions of Small-Scale Marine Fisheries from Developing Country Case Studies

COUNTRY (AREA)	SIZE OF VESSEL/ ENGINE	OTHER CRITERIA	SUBCATEGORIES	NO. OF VESSELS
Brazil	<18 m		"Small boats" <12 m (with and without engines); "middle-sized boats" 12–18 m	99,100
Cambodia	<10 HP	Largely subsistence fishing	Motorized; nonmotorized	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	Nonmechanized		Motorized; nonmotorized and type of boat: catamarans, plank-built craft, fiber-reinforced polymer and other craft, ring seiners, dugouts	179,000
Philippines	<3 GT	Operating in coastal area <15 km and under management of local municipalities	Motorized and nonmotorized *bancas* (an outrigger boat)	469,800

Source: Developing country case studies.
Notes: HP = horsepower; GT = gross tonnage.

Small-scale fisheries are often classified on the basis of technical attributes (table 2.1). Chuenpagdee *et al.* (2006) found that vessel size was the key criterion in marine small-scale fisheries in 65 percent of 140 countries studied. In 2002, the world fishing fleet consisted of about 4 million vessels. Large-scale vessels over 24 meters (or larger than 100 gross tons) represent only about 1 percent of the total fishing fleet (FAO 2007a). About two-thirds of the fleet were undecked (and generally less than 10 meters), of which 65 percent, or approximately 1.8 million, were nonmotorized vessels operated by small-scale fishers.

The type of fishing gear type is another important determinant, and fishing grounds and operational distance from shore can be a criterion, especially where different management regulations apply for the different subsectors. Many countries consider all inland water fishing operations to be small-scale. The large-scale fisheries tend to be the primary focus of monitoring and management efforts, and because fewer restrictions generally are placed on small-scale fishing, operators of relatively large vessels may be motivated to try to remain classified as small scale, as reported in Nicaragua (FAO/FishCode-STF 2008). The following examples of criteria and characteristics for small-scale fisheries were found in the developing country case studies:

- Technical criteria: Vessels of less than 5 gross tons in Thailand and less than 50 horsepower in Cambodia are classified as small scale. In Senegal, the vessel type is the decisive criterion, and all canoes, or *pirogues*, are considered to be artisanal, although some can be over 15 meters with more than 20 crew
- Fishing ground and management responsibility: In the Philippines, vessels smaller than 3 gross tons require registration at the municipal government level and are allowed to fish in the 0- to 15-kilometer coastal area. They are called *municipal fisheries* and are considered small scale, and management responsibility is devolved to the municipality level
- Conceptual considerations: According to the Indonesian National Act No. 31/2004 concerning fisheries, small-scale fishers are defined as those who do fishing for their daily life or daily necessity.

The European Union (EU) has no harmonized definition of small-scale fisheries, although member countries use the term generally to describe fleet segments of smaller boats fishing in national coastal waters. Small-scale fisheries are considered particularly important to employment and as having a relatively lower impact on resources. A 2007 study coordinated by the French Research Institute for Exploration of the Sea (IFREMER) suggests 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 but possibly up to 18 meters for vessels using predominately passive gear and operating in inshore areas. The study concludes that the importance of this industry segment, in terms of both production and employment, is often underestimated and that more knowledge on the structure and functioning of the small-scale fisheries is necessary for its efficient management (IFREMER 2007).

The FAO Working Group on Small-Scale Fisheries concluded that it is not possible or useful to formulate a universal definition of small-scale fisheries considering their diversity and dynamism. Accordingly, the following description of small-scale fisheries 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 subsector, conducted full-time or part-time, 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 subsector, 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/Advisory Committee on Fisheries Research 2004, p. 2).

The diversity of attributes in small-scale fisheries suggests that a multidimensional approach is required to categorize small- and large-scale fisheries and fishery systems. Table 2.2 gives an overview of some of these attributes.

A general evolution from small scale toward large scale is taking place, but this trend is neither linear nor irreversible (Berkes *et al.* 2001; Johnson 2006). Béné, Macfadyen, and Allison (2007) make a case for the separate consideration of small-scale fisheries (box 2.1), and small-scale fisheries is now a permanent agenda item on the FAO Committee on Fisheries agenda. In conclusion, their differentiating

TABLE 2.2: Generic Characteristics of Categories of Fisheries

CHARACTERISTICS	SMALL-SCALE		LARGE-SCALE
	SUBSISTENCE	OTHER	
Size of fishing vessel and engine	Nonmotorized or small (5–7 m, <10 GT	Small (<24 m, <50 GT) with low-power engine (<400 HP)	Large (>24m, >50 GT) with high-power engine (>400 HP)
Type of craft/vessel	Canoes, dinghies, wooden boats, undecked vessels		Steel/glass-reinforced plastic–hulled vessel, trawlers, factory vessels
Fishing unit	Individuals or family or community groups	Small groups; some specialization and division of labor; importance of household and community	Smaller and larger groups; specialization and division of labor
Ownership	Craft/gear owner operated	Usually owned and operated by senior operator; some absentee ownership	Concentration of ownership, often by nonoperators; some cooperative ownership
Time commitment	Mostly part time/occasional	Full time or part time	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 organized markets
Utilization of catch	Fresh or traditionally processed for human consumption	Fresh or processed, often traditionally, for human consumption	Mostly processed; large share for reduction to fishmeal
Knowledge and technology	Premium on skills and local knowledge; manual gear	High skills and knowledge needs; manual and mechanized gear; some electronic equipment	Skills and experience important but supported by technology; mechanized gear; automation and electronic equipment
Integration into economy	Informal, not integrated	Partially integrated	Formal, fully integrated
Base	Rural/periurban	Rural/periurban	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; adapted from Berkes *et al.* 2001; Chuenpagdee *et al.* 2006; Johnson 2006.

BOX 2.1: 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 and as social safety nets; are frequently dispersed over large areas with 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 marginalized on the basis of race, tribe, caste, or ethnicity.

Because the production is caught for domestic use or sold onshore directly to end consumers, the economic and nutritional contribution of small-scale fisheries is inadequately captured in national accounts and food balance sheets.

Many small-scale fisheries are effectively unregulated and poorly monitored, especially in developing countries and inland waters.

Source: Béné *et al.* 2007; Garcia *et al.* 2008.

attributes are sufficient to treat small- and large-scale fisheries as two distinct categories in global data and policy discussions (Chuenpagdee *et al.* 2006; Jacquet and Pauly 2008).

2.1.2 The Small-Scale Fisheries Value Chain

Fishing operations are part of an extended value chain in which fish processing and marketing are of major importance. In general, small-scale processing is labor intensive and uses a minimum of technology to preserve the fish, extend its shelf life, or add value. Drying, salting, fermenting, and smoking are extensively used. In large-scale fisheries, processing takes place at sea and/or at shore-based plants. Freezing and canning are the most important methods of processing. Frozen fish is the most common fish commodity exported from developing countries (FAO 2007a).

The dividing line between small- and large-scale land-based postharvest activities may be blurred. Small-scale fishers may supply fish to industrial processing plants, allowing them to indirectly participate in markets to which they might not otherwise have access. In some countries, canoe fishers collect and market bycatch from industrial trawlers. For example, in the Gambia, fishers who were effectively displaced by shrimp trawlers worked out informal agreements and made a business of collecting and marketing bycatch (Clucas 1997). However, large- and small-scale fishers often compete directly for access and control over fish resources and markets (FAO 2003).

Vertical integration of the large-scale fishing and processing industry has become common during the last few decades in many countries, such as Iceland, New Zealand, Namibia, and Peru (FAO 2011). In small-scale fisheries, vertical organization tends to be informal; for example, fish traders finance fishing operations in exchange for a guaranteed supply of fish. In Bangladesh, the *dadandar*, or the fish trader/money lender, is the traditional source of credit for fishers. The credit conditions vary from one location to another, but generally, the borrower is obliged to sell his fish to the *dadandar* at a price below the market price (Kleih *et al.* 2003).

While many countries reserve inshore marine areas and inland waters for small-scale operators, in many fisheries, both fleet segments compete for the same fishery resources (FAO/RAP/FIPL 2004; Jacquet and Pauly 2008), and industrial trawlers frequently encroach on reserved inshore fishing grounds (Kelleher 2002). In addition to affecting the resource base available for small-scale fisheries, encroachment on inshore fishing grounds may increase the risk of accidents and collisions. Incidents of large-scale vessels getting their trawls entangled in small-scale fishing nets and dragging them away were among the main causes for accidents at sea in seven West African countries (Gallène 1995). In the Republic of the Congo, Guinea, and Gabon, infractions by larger vessels in areas reserved for small-scale fishers and safety at sea were major concerns among small-scale fishers (Njock 2007). The FAO Code of Conduct calls for preferential treatment of small-scale fisheries (box 2.2).

2.2 CASE STUDY METHODS

Case studies on 17 developing countries formed the quantitative basis for the developing country part of the global study. The case studies were executed in full collaboration with the national authorities with a view to progressively securing greater inclusion of previously unaccounted fishing activities. The selected countries were not a random sample

BOX 2.2: 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 recognizes 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" (FAO 1995a, Article 2[f]). It also acknowledges that the context of fisheries management includes "food security, poverty alleviation and sustainable development" (Article 6.2). The Code directly references 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" (Article 6.18). The FAO (2005) also issued technical guidelines for "increasing the contribution of small-scale fisheries to poverty alleviation and food security" to accompany the Code.

but included countries home to 70 percent of the world's fish workers and that account for 40 percent of the global and 56 percent of developing countries' reported catches.[7] The group of case study countries did not include any of the major fishmeal-producing countries in Latin America, which 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). The case studies were undertaken on the following developing countries:

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

7 Calculated using averages of 2004–06 based on data from FAO FishStat Plus. The *developing countries* grouping is defined as listed in FAO FishStat Plus (FAO 2008a) with one exception: Cyprus has been removed from developing countries (and now belongs to developed countries in Europe).

Information of the fisheries was compiled on the following characteristics:

1. Production
   - Catch
   - Catch for human consumption
   - Waste and discards
2. Employment
   - Numbers of harvesters
   - Numbers of postharvest workers by gender
3. Employment per ton of catch
4. Efficiency
   - Catch per fisher
   - Catch per ton of fuel
5. Economic contribution
   - Harvest GDP
   - Postharvest GDP
   - Recreational GDP.

The information provided in the case studies is based on the latest available data and generally refers to a year during the period 2004 through 2007, although for some values, older data have been used. This study does not standardize the values from the different country case studies to a base year. Rather, it assumes 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 case studies relied to a large extent on secondary data in the form of official statistics, published data, and "gray literature" (such as information from project reports and studies). In some cases, this information was complemented and confirmed by primary data collection. This primary research took place via interviews with key informants in Cambodia and Ghana; through focus group discussions or expert meetings in Brazil, Cambodia, and China; and through interviews with a sample of operators to collect vessel-specific information in Bangladesh and China. The reanalysis of existing household survey data constitutes an important input into the assessment of production and consumption in Thailand and Vietnam.

Although every effort was made to standardize in the case study approaches, each was tuned to local circumstances and data availability to obtain best estimates for the selected indicators. Box 2.3 provides further details of the approaches. Data are most complete for employment, production quantities, and the share for local human consumption. For some of the case study countries, information was

not available on all the selected indicators, and available information was used as a basis for extrapolation to complete the analyses. Case study results were also complemented and cross-checked with information available from other sources, particularly from the database of FAO Fishery Country Profiles (FCPs). Summary tables of the information available on each case study country (and Lake Victoria) are available (FAO and WorldFish Center 2009). Macroeconomic aspects were not explicitly addressed in the developing country case studies, but a separate study was undertaken by a team led by Eriko Hoshino on the contribution of fisheries to GDP and related economic multiplier effects.

BOX 2.3: Key Features of Case Study Methods

China: Estimates were based on official fisheries statistics and an unpublished frame survey conducted in 2007 and on interviews with wholesale markets' managers and vessel captains in selected locations in Guangdong and Zhejiang provinces for marine fisheries and in Hubei province for inland fisheries. The results for the marine subsector in Guangdong and Zhejiang provinces were extrapolated to the entire marine fisheries 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 to guide the raising factors.

Ghana: Estimates for the *marine* fisheries were based on data sourced from official fisheries statistics complemented by a questionnaire survey on auxiliary employment. Information on cost and earnings was collected in semistructured discussions with key informants. Data on the *inland fisheries* were partly sourced from official statistics and project and research reports. In addition, a market survey was conducted, 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 from inland fisheries were sourced from official estimates from different government agencies. The numbers of small- and large-scale fishers was estimated using a ratio derived from earlier sample surveys. Small- and large-scale production was calculated according to estimates by an expert panel. Information on the disposition of catches (such as the share for domestic human consumption) was not available.

Philippines: Data were sourced from official fisheries statistics, censuses, and research studies. The official information was disaggregated into marine or inland and municipal (small scale) and commercial (large scale). Information on the share for domestic human consumption, separated into small- and large-scale production, was not available.

Thailand: Estimates for the *marine* subsector were based on data sourced from official fisheries statistics. Production was recalculated assuming the following:

- Large-scale catches included an additional 1 percent because of discards at sea.
- Small-scale catches included 1 additional kilogram (at $1/kg) per fisher and day for own consumption.
- Only the large-scale fisheries produce for export.
- Estimates of inland production and employment were made using 2003 census data 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 that inland production was valued at $1 per kilogram, the number of boats was 1.4 per square kilometer of water area, and all inland production was for domestic local consumption.

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

Source: Authors.

2.2.1 Developed Country Sample

The quantified profile of large- and small-scale fisheries from the developing country case studies was complemented with existing information from OECD countries and others where recent studies have been executed, such as for the Pacific Islands. 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.[8] These countries included eight EU members (Denmark, France, Greece, Italy, the Netherlands, Portugal, Spain, and the United Kingdom) and Canada, Japan, and Norway. 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 were used as necessary.

An approach similar to that used for the developing country case studies was applied to the definitions of small- and large-scale fisheries in developed countries. However, information on the share of the catch for domestic human consumption and on discards was not available by subsector in the sample countries. Most of the information on fisher and postharvest employment was expressed in full-time equivalents. The postharvest jobs referred mainly to employment in fish processing and include employment related to processing of fish originating not only from domestic capture fisheries, but also from aquaculture production and imported fish. In general, jobs in marketing and sales, particularly at the retail level, are not captured in the analysis. Employment in upstream and support activities (such as boatbuilding, gear repair, and fuel provision) is likewise not included.

2.2.2 Use of Statistical Data

The developing and developed country data were disaggregated to separate small- 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 postharvest 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 these case studies. However, no attempt was made to harmonize the definition of small-scale and large-scale fisheries across countries (see Annex for more a detailed discussion of 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. Quantities of all aquatic animals are given as *live weight equivalents*, which is the weight of the catch before 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 region means the catch of the fleets registered in that country or region rather than the catch taken from its waters. Catches from recreational fisheries are generally not included in the disaggregated profiles because the estimates represent only commercial fisheries and include subsistence and recreational fisheries only to the extent that they are included in official fisheries statistics.

2.2.3 Extrapolating the Sample Data to the Global Level

2.2.3.1 Developing Countries

The results of the case studies were used to estimate key indicators for all developing countries as a group. Because important fishmeal-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. Estimates of discards in the developing country case studies were largely based on ancillary information, so no attempt was made to assess discards on the basis of those estimates.

To obtain the aggregate employment values, the number of fishers and fish workers by subsector, or industry segment, in case study countries was included as per-case-study estimates. For non–case study countries, the case studies' average catch-per-fisher ratio and reestimated catch quantities were used to calculate the number of fishers in each subsector. Catches were reestimated on the basis of the difference between case study data on catches by subsector and marine and inland production averages for 2004 to 2006 from FAO FishStat Plus data (2008a). For all case study countries excluding China,[9] the case study data showed, on average, catches to be 10 percent higher in the marine subsector and

8 (http://www.fao.org/fishery/cwp/en) with strengthened links to the Global Strategy to Improve Agricultural and Rural Statistics.

9 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 China, it was deemed incorrect to allow this particular case to influence the reestimation of catches for other countries.

70 percent higher for inland fisheries, reflecting assumed underreporting. The production of all other developing countries was raised proportionately, dividing the difference 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 based on complementary data (e.g., FAO FCPs) were made for known anomalies. By dividing these reestimated catch quantities by 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.

Postharvest 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.

2.2.3.2 Developed Countries

To arrive at employment numbers for developed countries as a group, the same principles and methods were used to extrapolate sample country data as were used for developing countries. The number of fishers by subsector, or segment, in the non-EU sample countries was included as given. For the 25 member states of the EU, data were available on total full-time and part-time employment.[10] 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 reestimate of catches, data from the sample of developed countries were combined with FAO FishStat Plus data (averages of catches for 2004 to 2006 in marine and inland waters) for nonsampled countries to provide totals for marine and inland catches by all developed countries. Using the findings from the developing country case studies and considering estimates of illegal, unreported, and unregulated (IUU) fishing (Agnew *et al.* 2008), the total marine production was then raised by 10 percent overall and that of the large-scale marine fisheries by another 5 percent, resulting in a reestimate of the total marine catch at 13 percent higher than reported catches according to the FAO FishStat Plus data.[11] Comprehensive information on inland fisheries was not available for most of the sample of 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. On this basis, 23 percent of marine catches were assessed as small-scale production. All inland catches were considered to be small scale. The reestimated catches were divided by the average catch-per-fisher values obtained from the sample of developed countries to derive at an aggregate number of fishers for all developed countries.

2.2.4 Assumptions and Issues

Despite the global diversity of fisheries and fishery systems, there are sufficient common features to distinguish small- and large-scale fisheries as two principal segments for the purposes of global policy discussions or country-level monitoring efforts. The definitions of large- 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. Summing these categories across countries presents certain difficulties, and every effort was 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. Because of 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.

Because 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 nonexistent.

The sample data are extrapolated to the global level using a variety of multipliers, the most important of which is the

10 From Salz *et al.* 2006. Unlike the information in the sample country data compilation that was generally expressed as full-time equivalents, employment information in Salz *et al.* is presented in total full-time and part-time employment figures. These data were adjusted for assumed decreases in employment from the year of the study (2005) to present-day (2008) levels (based on personal communication, P. Salz).

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

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, although some inland waters, such as the Caspian Sea and North America's Great Lakes, are known to have significant large-scale fisheries. It is assumed that the sample reflects the global disaggregation of small- and large-scale fisheries.

Disparities exist between official statistics (such as numbers of fishers) and the values obtained through the case studies. Consequently, a global estimate, such as global catch, based on the case study results is higher than that estimated by FAO on the basis of the aggregate of the 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 directed to resolve the differences and that such resources are justified given that the contribution of capture fisheries to economies is considerably greater than portrayed by the official statistics. The study complements official statistics, allowing for a better understanding of the contributions and roles of small- 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 results can be considered as best estimates to which future studies can add precision.

There is a spectrum of fishing activities that are often not readily distinguishable from one another. Conscious of this spectrum for the purposes of quantifying the fishing activities, the case studies followed the classification used by FAO:

- Full-time fishers, receiving at least 90 percent of their livelihood from or spending at least 90 percent of their working time fishing
- Part-time 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, receiving less than 30 percent of their income from fishing or spending less than 30 percent of their working time fishing.

Occasional fishing can make a major contribution to local food supplies and nutrition for communities living near inland and marine waters. However, this category of fishing was not used in the case studies because separate data were generally not readily available. Census or national employment surveys often record only primary occupational categories, not secondary or tertiary occupations, misrepresenting the diversity of rural livelihoods that combine many income-generating activities (Keskinen 2003). Subsistence and occasional fishing is the subject of separate case studies (Mills 2010).

Employment in postharvest and auxiliary fisheries activities also raises issues about definitions. These employment values in the case studies refer mostly to postharvest processing and include marketing jobs. Employment values could also include employment related to processing of imported fish and fish from aquaculture, as employment data generally do not distinguish between the sources of fish supply. Employment in upstream and support activities, such as boatbuilding, gear repair, and provision of fuel, were estimated in some of the countries, but these values were not included in the final compilation of data for the developing country case studies.

2.3 UNCOVERING THE HIDDEN HARVESTS OF SUBSISTENCE FISHERIES

A *subsistence fishery* is "a fishery where the 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" (FAO n.d.[c]). Pure subsistence fisheries are rare because excess production is sold or exchanged for other products or services even in the smallest fishery. In this respect, subsistence fisheries are partly a component of small-scale commercial fisheries. With the possible exception of recreational fisheries, all fisheries are likely to have some commercial component. Recreational, subsistence, and commercial fisheries may overlap. Nevertheless, subsistence fishing implies a more household-centered than commercial activity.

Under the FAO definition, where fish are sold, fishing can no longer be deemed subsistence, which does not accommodate well the inherent variability in fish supply that moderates fishers' disposal of catch. In practice, "pure" noncommercial fishing as described here is rare, and fishers remain opportunistic, so where fish surplus to household requirements are captured, often during peak seasons, this catch is sold (box 2.4). This definition also leaves a gray area where catch sold directly by fishers or family members of fishers is neither included nor excluded from the proposed subsistence group. Recreational fisheries, with the exception of catch-and-release fisheries, also fall within this definition.

BOX 2.4: Subsistence Fishing in Bangladesh

Subsistence fishers are those who fish for consumption and for whom any income from fishing is more a matter of chance than intent. *Opportunistic* is perhaps the most appropriate descriptor for subsistence fishing in Bangladesh. The patterns of activity by subsistence fishers are seen to be highly dependent on natural variability in available resources, and making meaningful distinctions between subsistence fishing and fishing for income can be a futile exercise. The designation of subsistence fisher may largely be a matter of convenience. When fishers outside professional fishing communities want to understate the level of fishing, it is often described as fishing for consumption, although they may be fishing at commercial scale. 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 varies in accordance with seasonal fluctuations in the fish biomass and the area of water bodies. When fish are plentiful and concentrated in small areas where they are easily caught, self-described subsistence fishers can catch more fish than the family can consume.

Source: FAP 1994.

The process of preparing the developing country case studies indicated that the contribution of subsistence fisheries was considerably more important than anticipated. Consequently, detailed studies on subsistence fisheries were undertaken for Bangladesh, Vietnam, and the Philippines, in each case using available data (that is, no field surveys were undertaken).

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 period as part of the Flood Action Plan, were reanalyzed. The outputs from 34 districts were extrapolated to the national level using a neighbor-influence model and updated using the 2001 population census values. The Compartmentalization Pilot Project 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 were used in a production balance sheet to reassess the likely magnitude of capture fishery activities, including 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, and the Vietnam results are considered to provide reasonable estimates given the weakness of the underlying data. The data gaps mean that the Vietnam estimates do not include the marine sector for which additional fieldwork would be of benefit. Additional details of the case study analyses are provided in the Annex.

2.4 ESTIMATING THE ECONOMIC CONTRIBUTION OF RECREATIONAL FISHERIES

Recreational fisheries may be considered a special form of small-scale fisheries. To some extent, they overlap with subsistence fisheries because part of the catch is consumed by the fisher, the fisher's family, or associates. In some cases, some or all of the catch may be sold to offset the costs of 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 fisheries requires alternative approaches to valuation. The approach taken in available national assessments is to estimate either 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. For example, 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; that is, 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, estimates of recreational fisheries' 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 (tables 2.3 through 2.8), 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 were estimated in the same manner.

TABLE 2.3: Estimated Expenditures on Fishing Tackle in Relation to Total Angler Expenditures

LOCATION	YEAR	RATIO	STUDY
South Australia	2000	0.09	Jones and Doonan 2005
Australia	2003	0.08	Henry and Lyle 2003
United States	2001	0.06	Dean 2007
United States (Lake Erie)	2003	0.20	Murray and Shields 2004
United States	2006	0.10	Southwick Associates 2007
United States	2008	0.10	ASA 2002
United States	2004	0.10	Steinback, Gentner, and Castle 2004
United States (Washington)	2006	0.15	TCW Economics 2008
United States (Washington)	2008	0.22	Washington Department of Fish and Wildlife
Canada	2005	0.08	DFO 2007
Germany	2000	0.38	Hilge 1998; Wedekind, Hilge, and Steffens 2001
Germany	—	0.03	Toivonen 2004
England and Wales (inland)	2007	0.43	Radford, Riddington, and Gibson 2009
Austria	2000	0.25	Kohl 2000
Ireland (indirect est.)	2003	0.24	The Marine Institute 2004
Ireland (foreign)	2001	0.04	Indecon 2003
Ireland (local)	2001	0.08	Indecon 2003
Wales (salmon/trout)	1999	0.06	Radford *et al.* 2009
Wales (trout)	2000	0.31	Nautilus 2000
Scotland	2009	0.13	Glasgow Caledonian University 2009
Brazil (Pantanal)	1994	0.33	Moraes and Seidl 2000
Mexico (Los Cabos)	2007/08	0.02	Southwick *et al.* 2008
Mean		0.16	
Median		0.10	

Source: Findings of the authors' review of the studies listed on the right.

TABLE 2.4: Recreational Fishing Gear Trade Classification Code

THE NORTH AMERICAN INDUSTRY CLASSIFICATION SYSTEM CODE FOR FISHING TACKLE AND EQUIPMENT IS 3399201. THE AGGREGATE LATENT DEMAND ESTIMATES ARE DERIVED FOR THIS DEFINITION OF FISHING TACKLE AND EQUIPMENT. "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

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

TABLE 2.5: Estimated Global Number of Anglers

COUNTRY	ANGLERS (MILLIONS)	SOURCE
Australia	3.360	
Austria	0.410	EAA 2003
Belgium	0.300	EAA 2003
Brazil (Pantanal only)	0.059	Shrestha, Seidl, and Moraes 2002
Bulgaria	0.180	EAA 2003
Canada	2.800	Fisheries and Oceans Canada 2005
China	90.000	Min 2006
Cyprus	0.003	EAA 2003
Czech Republic	0.263	EAA 2003
Denmark	0.650	Roth and Jensen 2003
Estonia	0.050	EAA 2003
Finland	1.900	Finnish Game and Fisheries Research Institute 2009
France	4.000	EAA 2003
Germany	3.300	EAA 2003
Hungary	0.325	EAA 2003
Iceland	0.650	EAA 2003
Ireland	0.200	EAA 2003
Italy	0.900	EAA 2003
Japan[a]	10.200	
Latvia	0.200	EAA 2003
Luxembourg	0.004	EAA 2003
Macedonia	0.000	EAA 2003
Netherlands	1.500	EAA 2003
Norway	1.800	EAA 2003
Poland	4.400	BizAcumen 2009
Portugal	0.230	EAA 2003
Rest of Asia and Latin America[b]	41.800	
Rumania	0.200	EAA 2003
Russia	14.700	BizAcumen 2009
Slovakia	0.069	EAA 2003
South Africa (marine)	0.496	Griffith and Lamberth 2002
Spain (Mediterranean licenses only)	0.133	Franquesa *et al.* 2004
Sweden	2.500	EAA 2003
Switzerland	0.350	EAA 2003
Turkey	4.900	BizAcumen 2009
England and Wales	4.200	Nautilus 2000
United States	29.400	BizAcumen 2009
Total number of anglers	226.431	

Sources: http://www.eaa-europe.org/index.php?id=14 and see table references.
[a] Assuming Japan spends the same per person as other OECD countries spend.
[b] Assuming the rest of Asia and Latin America spend 75 percent of what OECD countries spend per person (includes Argentina with separate estimate of 3 million anglers). Note that if these anglers spend less than 75 percent of what OECD anglers spend, the number of anglers rises proportionately.

TABLE 2.6: Global Expenditures on Recreational Fishing Tackle

REGION/COUNTRY	2009
United States	29.13%
Canada	2.41%
Japan	9.02%
Europe	39.17%
Asia-Pacific	11.65%
Latin America	8.62%
Total	100%

Source: BizAcumen 2009.

TABLE 2.7: U.S. Expenditures on Fishing Equipment by Type, 2006

FISHING TYPE	SHARE
Freshwater	63.87%
Saltwater	20.41%
Nonspecific	15.72%
Total	100%

Source: BizAcumen 2009.

TABLE 2.8: Selected Information Sources for Recreational Fisheries Contribution

SOURCE	COUNTRIES/ REGIONS	DATA SOURCE	METHOD
Steinback *et al.* 2004	United States, excluding 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 MPLAN; value-added impacts not provided
Peterson 2005	Hawaii	Surveys	Multipliers generated using RIMS II
NMFS 2007	United States	No detail; this document is a national overview	No detail on methods
Cowx 1998	22 European countries	n.a.	n.a.
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 nonresponse and behavioral biases	Exploratory analysis of survey data (i.e., variance estimation); input-output analysis not provided
Canada 2007	Canada	2005 survey on angler profiles, catch volumes and species, trip, and expenditure; questionnaires were mailed to residents and nonresidents	Major purchases or investments attributable to fishing activities; value added impacts not provided
Barnes *et al.* 2002	Namibia	Series of surveys 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: Authors.

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

This part of the study provides an estimate of the commercial capture fisheries sector's contribution to global GDP. A country's GDP is a key indicator of the role of fisheries in the national economy and complements the estimates of capture fisheries employment addressed in a previous part of the study. Fisheries sector trade balance,[12] rents, and other important economic 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, and there may be overlap with these segments.

2.5.1 Approaches to the 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

12 The global supply and demand for fish is being addressed in a separate study.

BOX 2.5: Calculation of GDP

According to the *Handbook of National Accounting*, 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)
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 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 not used because it is generally regarded to be the most difficult to implement.

Source: UN 1999.

Activities (ISIC)[13] followed by the SNA. The 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. Three main methods are used to calculate GDP (box 2.5). 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.

In most countries, macroeconomic statistics such as GDP are compiled by national statistical offices rather than the fisheries agency. Fisheries sector–specific data are most often compiled by the relevant ministries, such as the Ministry of Fisheries, and the required 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.

To produce internationally comparable statistics, most countries adopt International Standard Industrial Classification (ISIC) of all industrial activities classification systems and the Central Product Classification, both developed by the UN, although some countries have developed their own classification systems or 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 August 11, 2008) has four levels: sections, divisions, groups, and classes. Sections are used to group similar activities and are identified by a letter. The division is represented by a two-digit code and further subdivided into groups (three-digit code) and classes (four-digit code).

If a particular sector is economically of great importance, the relevant part of the classification can be further disaggregated, and less economically important activities can be treated at a more aggregated level (UN 2008). Ideally, a country can provide data at all levels of ISIC classification, but in reality, not all detailed categories of the classification are reported. Fisheries-related activities are most often reported at an aggregated level under "Agriculture, forestry, and fishing," and it is often not possible to isolate the economic values of fishing activities from the other agricultural subsectors.

In most countries where disaggregated data are available, fisheries-related activities are often reported under "Fishing and aquaculture."[14] 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 or other sectors in the national accounts. Countries usually do not report these connected activities in detail, or they lump information under a general category such as food processing. Thus, the fisheries GDP values generally include only value added created in primary production activities—the catching and farming of fish.

2.5.1.1 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 ISIC Rev. 4 (box 2.6).

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

14 In the previous revision (ISIC Rev.3.1), fishing is classified under "Fishing, operation of fish hatcheries and fish farms."

BOX 2.6: 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. http://unstats.un.org/unsd/cr/registry/regcst.asp?Cl=27.

However, processing and marketing of fish and fishery products are located under Section C, Manufacturing, and Section G, Wholesale and retail trade, respectively. In addition to these divisions, fisheries-related activities, such as recreational fishing and subsistence goods producing (such as subsistence fishery for own consumption), also appear as a part of other divisions or classes.

Within the SNA, 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. This study considers not only the economic activities to the point of first sale but also the downstream economic activities in the estimate of the global economic contribution of capture fisheries,

This metric is called the *extended GDP contribution* and was estimated as follows (details of the data sources are provided in the Annex).

1. Available GDP estimates were compiled for 129 countries, for 26 of which GDP information disaggregated into harvest and postharvest subsectors was available.
2. A GDP postharvest multiplier (ratio of harvest-to-postharvest GDP) was derived based on these 26 countries (value = 1.76, with a range of 1.55 to 2.04).
3. The GDP postharvest multiplier was applied to the reported harvest GDP for those countries for which postharvest GDP was not available (103 countries).
4. The percentage contribution of both harvest and postharvest subsectors to total national GDP for each of the 129 countries was calculated.
5. The percentage contribution was converted into monetary value, using the reported national GDP data[15] (measured in current U.S. dollars in 2007) from

15 http://siteresources.worldbank.org/DATASTATISTICS/Resources/GDP.pdf.

the World Development Indicator database (World Bank 2011).

6. The extended global GDP contribution of commercial capture fisheries is the sum of these monetary values.
7. Lack of GDP data, weak specification, or disaggregation of the available GDP data precluded isolation of the aquaculture subsector (aquaculture GDP data were available for only 18 countries, representing 7 percent of global production) and of the upstream economic activities (such as fishing vessel construction).

Based on available literature and online sources, efforts were made to separate the contribution of the capture from the culture subsectors for these 18 countries. In the absence of evidence to the contrary, the GDP values for other countries were assumed to include aquaculture and were adjusted using the proportion of the harvest contributed by aquaculture as per the FAO FishStat (n.d.[a]) production values.

2.5.1.2 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 recalculate fisheries GDP considering the wider social and economic contributions of the sector; for example, input-output analysis has been used to estimate the contribution of ocean fish to the global economy at $380 billion (Dyke and Sumaila 2009).

The Sustainable Fisheries Livelihoods Programme (SFLP) considered a wider range of economic and social impacts in case studies in 15 participating countries.[16] The GDP estimates included the whole fish value chain, from fishing and fish farming to trade and retail marketing. Two other indicators, 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. The results showed that the value added generated by the fish harvesting operations to the point of first sale represented, on average, 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 small-scale fisheries made the most important contribution to the value added created along the value chain in most of these countries: in Mauritania, about 45 percent of the overall value added is attributed to the small-scale fisheries; in Senegal, 80 percent of total landings and 60 percent of the export volume are attributed to small-scale fisheries.

Value-added ratios (VARs) were used in a study on Pacific Island countries, which focused on harvesting operations rather than on the entire value chain. VARs are the proportion of the gross output attributable to value added. The VARs were based on (1) published estimates of VARs, (2) the ratios used in calculating national accounts in various countries, (3) reported income and expenditure data for some activities, (4) discussions with people involved in the industry, and (5) author knowledge and experience. The value added was estimated by multiplying the value of production (gross output) by the VARs. The study showed that their reestimated average fishing GDP for the region was approximately 30 percent higher than the official figure, or 7.0 percent compared to 5.4 percent of GDP across all countries. The increased estimates were primarily attributable to the omission of noncommercial subsistence fishing, differences in the estimate of production, and differences in the method used to calculate the GDP contribution. An updated study (Gillett 2009) on 22 Pacific Island countries and territories found that GDP ranged between 4.5 percent (Niue) and 63 percent (Palau) higher than the official figure.

These alternative approaches can be used to cross-check the results presented 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 postharvest subsectors alone) to global economy and understand any intergroup differences quantitatively. However, multiplier benefits may be subject to double counting. Another possible approach is to use VARs in conjunction with the landed value of capture and aquaculture production to determine the contributions of the fisheries sector to national GDP. Currently, VARs for fisheries are available for only a limited number of countries, and improved estimates of the contribution of fisheries to GDP

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

will benefit from additional case studies such as those for the Pacific Islands.

2.5.2 Methodological Challenges

Several issues and challenges were identified during the estimation exercise.

1. Many countries do not publish these GDP estimates or statistics on value added in the fishery sector. Where such data exist, the basis for the estimates is often insufficiently clear to enable the values to be compared or compiled across countries.
2. 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 fully captured in available estimates of GDP.
3. Other important economic activities that 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.
4. "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 2002).
5. 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).
6. Where there is extensive vertical integration in the fishing industry (for example, if the first sale is by a processing plant that owns a fishing fleet), primary production (harvesting) may not be fully reflected in the harvest-level GDP estimates.
7. 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-postharvest ratio derived from the 26 sample countries represents the universe of harvest-postharvest GDP ratios. However, the extended GDP estimate can clearly be improved when more comprehensive, clearly specified, and disaggregated fisheries sector GDP data become available.

2.5.3 Information Sources

The NAS compiled each year by the 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 solely by drawing on relatively consistent data such as those in the NAS.

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 (2011), 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, the data were assumed to 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; for more information, see http://www.fao.org/fishery/en) are notable exceptions, stating clearly how the values were obtained and the economic activities included in the estimates.

2.5.4 GDP Data Sources

Table 2.9 summarizes the data sources used for the GDP data. Tables A.1 through A.6 (in the Annex) display the data upon which the estimates were based.

TABLE 2.9: Summary of Information Sources for Fisheries GDP

SOURCE	COUNTRIES	DATA SOURCE	METHOD	ISSUES/NOTES
FAO 2011	69 countries across all regions	In most cases, the data source is not specified	In most cases, the method is not specified	Appear to be fishing activities 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 and expenditure data; personal contact with industry	Used VAR to estimate different fishing activities; for subsistence fishing, farm pricing method was used	Harvest activities only (fishing and farming)
Gillett 2009	22 Pacific Island countries and territories (19 countries available)	Various; see annex for detail	VAR	Catching and farming
SFLP documents (http://www.fao.org/fishery/en)	15 West and Central African countries	Various, including official statistics, household surveys, and expert contacts	Using a common method that follows SFLP Methodological Guidelines	Sum of added values in production, processing, and marketing of fresh products and in processing and marketing of processed products
Sugiyama, Staples, and Funge-Smith 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
Salz *et al.* 2006; Eurostat 2006	Netherlands, Italy, France, United Kingdom, Denmark, Spain, Ghana, Uganda	Data mainly from Eurostat data in 2006		Eurostat data do not include marketing and other postharvest activities other than processing; aquaculture not included
Expert contacts (case study coordinators)	Cambodia, China, Ghana	Various official statistics	Production and postharvest included; further detail not available	
Individual country reports	Canada, New Zealand, Japan, Iceland, Maldives, Seychelles	Official statistics		Limited number of original documents accessed

Source: SFLP (http://www.fao.org/fishery/en); Gillett and Lightfoot 2001; Gillett 2009.

Chapter 3: RESULTS

The results are presented in the following order:

1. The global profiles of small- and large-scale commercial fisheries
2. Results of the developing country case studies and sampled developed countries
3. Results of the subsistence fisheries case studies
4. Estimate of economic importance of recreational fisheries
5. Estimate of the contribution of commercial capture fisheries to global GDP.

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

The sample of developing and developed country fisheries profiles were extrapolated to the global level. Tables 3.1, 3.2, and 3.3 quantify selected characteristics of the global capture fisheries. Key points include the following:

- An estimated 35 million commercial fishers are engaged in harvesting operations in developing and developed countries combined.
- Adding employment in the postharvest subsector brings the total fisheries workforce to approximately 119 million people who are directly dependent on capture fisheries for their livelihoods as full-time or part-time workers.
- Ninety-six percent of these people live in developing countries (116 million).
- Over 90 percent of fishers and fish workers are employed in small-scale fisheries.
- 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 countries.
- Large-scale fisheries land more fish in total, but small-scale fisheries produce more fish for domestic human consumption.
- Almost half of the fisheries value chain workforce is female.
- Almost half of the workforce is employed in inland fisheries.
- Small-scale fisheries generate less wastage in the form of discards; that is, catch that is not landed but disposed of at sea.

If the level of engagement of government in fisheries management reflects the perceived importance of this subsector to national economies, 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.

Fish is the world's most traded food—about 37 percent of reported production is traded (FAO 2006). Large-scale fisheries account for a substantial proportion of the trade in capture fishery products. In many countries, large-scale fisheries provide important foreign exchange earnings. Trade in the products of large-scale fisheries (particularly small pelagic fish such as sardines and mackerel) is 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.

Tables 3.1 through 3.4 summarize the profiles of small- and large-scale fisheries at the global level and in developing and developed countries. The tables are based on developing country case studies and the sample of developed countries and raised to the global level as described in the methodology.

In the developing country case studies, small-scale fisheries land more fish than large-scale fisheries, but at the global level—when taking developed countries and major fishmeal producers into account—large-scale fisheries account for the majority of the landings. However, small-scale fisheries

TABLE 3.1: Global Profile of Small- 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)	34	14	48	56	1	57	105
Value (billions)	$37	$9	$46	$49	$0	$50	$96
Discards (% of total catch)[a]	4%	0%	3%	13%	3%	13%	8%
Employment (full time and part time)							
Number of fishers (millions)	14	18	32	2	1	3	35
Number of postharvest jobs (millions)	38	38	76	7	0.5	8	84
Total workforce (millions)	52	56	108	9	2	11	119
Women in total workforce (%)	36%	54%	46%	64%	28%	60%	47%
Efficiency							
Catch per fisher (tons)	2.5	0.8	1.5	25.7	0.6	18.3	3.0
Catch per ton of fuel (tons)	1–3	n.a.	n.a.	1–4	n.a.	n.a.	n.a.

Source: Authors.
Notes: [a] Refers to catch that does not go to nonfood uses or that is exported.

TABLE 3.2: Small- and Large-Scale Fisheries in Developing Countries

	SMALL-SCALE FISHERIES			LARGE-SCALE FISHERIES			TOTAL
	MARINE	INLAND	TOTAL	MARINE	INLAND	TOTAL	
Production and utilization							
Total annual catch (million tons)	28	13	41	34	0.5	35	76
Value of catch (billions)	$28	$8	$37	$35	$0.5	$35	$72
Discards (% of total catch)	1%	0%	1%	5%	2%	5%	3%
Employment							
Number of fishers (millions)	13	18	31	2	1	3	34
Number of jobs in postharvest (millions)	37	38	75	7	0.5	7.5	82.5
Total workforce	50	56	106	9	1.5	10.5	116.5
Women in total workforce (%)	36%	54%	46%	66%	28%	62%	47%
Efficiency							
Catch per fisher (tons)	2.1	0.7	1.3	18.3	0.6	13.4	2.2
Catch per ton of fuel (tons)	0.5–4	n.a.	n.a.	1–5	n.a.	n.a.	n.a.

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

produce more fish for domestic human consumption, and in developing countries, over half of the catch for domestic human consumption is produced by the small-scale fisheries.

Based on the developing country case studies, inland fisheries account for 23 percent of the total catch, and about 90 percent of this production is used for domestic human consumption (table 3.6). In developed countries, inland fisheries are far less important, and accurate data on catches, including recreational and subsistence fishing, are often deficient.

The following sections provide additional details of these profiles.

TABLE 3.3: Small- and Large-Scale Fisheries in Developed Countries

	SMALL-SCALE FISHERIES			LARGE-SCALE FISHERIES			
	MARINE	INLAND	TOTAL	MARINE	INLAND	TOTAL	TOTAL
Production and utilization							
Total annual catch (million tons)	6	1	7	22	<1	22	29
Value of catch (billions)	$9	$0.5	$9	$15	<1	$15	$24
Discards (% of total catch)	15%	1%	13%	25%	n.a.	25%	22%
Employment							
Number of fishers (millions)	1	<1	1	0.5	<1	0.5	1.5
Number of jobs in postharvest (millions)	1	<1	1	0.5	<1	0.5	1.5
Total workforce (millions)	2	<1	2	1	<1	1	3
Women in total workforce (%)	43%	44%	43%	38%	n.a.	38%	42%
Efficiency							
Catch per fisher (tons)	9.5	8.6	9.4	67.8	n.a.	67.5	26.9
Catch per ton of fuel (tons)	1–2	n.a.	n.a.	2–4	n.a.	n.a.	n.a.

Source: Authors.

TABLE 3.4: Employment in Capture Fisheries in Developing Countries, by Continent (thousands)

CONTINENT	SMALL-SCALE FISHERS	TOTAL FISHERS	POSTHARVEST 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%

Source: Authors.

3.1.1 Employment

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

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 (including aquaculture). Because those employed generally provide for dependents and household members, the fisheries sector may support over half a billion people, or almost 8 percent of the world's population (FAO 2009b). This figure does not include all those who depend on fishing and related activities as an occasional or complementary source of food and income along with other livelihood strategies.

In developed countries, employment in fisheries has generally declined (FAO 2009b). Employment in the sector still totals about 3 million—about 1 million in harvest and 2 million in postharvest activities. The small-scale fisheries account for 74 percent of all jobs and are the most important employer (table 3.5).

3.1.2 Production and Utilization

At the global level, large-scale fisheries produce about 11 million tons more than small-scale fisheries, though it should be noted that global fishmeal supply is based largely on harvests of about 17 million tons by industrial reduction fisheries.

In the developing country case studies, small-scale fisheries land more than large-scale fisheries, and

TABLE 3.5: Results from Developed Countries (thousands)

	SMALL-SCALE FISHERIES			LARGE-SCALE FISHERIES			
	MARINE	INLAND	TOTAL	MARINE	INLAND	TOTAL	TOTAL
Number of fishers	663	98	761	326	2	328	1,089
Postharvest employment	1,259	206	1,465	457	1	458	1,923
Total employment	1,922	304	2,226	783	3	786	3,012
Women in total workforce	43%	44%	43%	38%	29%	38%	41%

Source: Authors.

TABLE 3.6: Catch Used for Local Human Consumption

	SMALL-SCALE FISHERIES			LARGE-SCALE FISHERIES			
REGION/COUNTRY	MARINE	INLAND	TOTAL	MARINE	INLAND	TOTAL	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: Authors; case studies.

TABLE 3.7: Discard Rates in Developing and Developed Countries

	SMALL-SCALE FISHERIES			LARGE-SCALE FISHERIES			
	MARINE	INLAND	TOTAL	MARINE	INLAND	TOTAL	TOTAL
Developing countries							
Catch (tons)	30	12	42	34	—	34	76
Discard rate (%)	1%	0%	0.8%	5%	2%	5%	3%
Developed countries							
Catch (tons)	6	1	7	22	0	22	29
Discard rate (%)	15%	1%	13%	25%	25%	25%	22%
Total tons	36	13	49	56	0	56	105
%	3%	0%	3%	13%	25%	13%	8%

Source: Authors; case studies; Kelleher 2005.
Note: Rates according to case studies and Kelleher (2005) and adjusted to match total estimates made in Kelleher—namely, discards are 8% of the global marine catch and 3.7% of small-scale marine catches. The sample of fisheries in Kelleher is biased toward fisheries with high discard rates, which tends to increase the discard rate for small-scale fisheries in developed countries.

small-scale fisheries generally produce more fish for domestic human consumption. In developing countries, it is estimated that over half of the catch for domestic human consumption is produced by the small-scale fisheries. In the developing country case studies, inland fisheries account for 23 percent of the total catch, and about 90 percent of this production is used for domestic human consumption.

The total annual capture fisheries production of the 11 developed sample countries amounts to 11.8 million tons. Small-scale fisheries account for 24 percent of this production. Officially reported catches from inland fisheries represent less than 1 percent of the total.[17]

The case study information on the percentage of the catch used for direct local consumption (not used for animal feed or exported) is summarized in table 3.6. Although it is not possible to extrapolate the case studies to the global level, the available data suggest that about 45 percent of the global

17 With a few exceptions, inland fisheries' catch quantities for the sample countries were compiled from FAO FishStat Plus (2008a) averages for 2004–06.

TABLE 3.8: Summary of Developing Country Case Studies

DEVELOPING COUNTRY FISHERIES	SMALL-SCALE FISHERIES		LARGE-SCALE FISHERIES		TOTAL
	MARINE	INLAND	MARINE	INLAND	
Number of fishers (million tons)	23.3		1.5		24.7
(percentage of total)	40%	54%	4%	2%	
Postharvest employment (millions)	56.1		3.6		59.7
Total employment (millions)	79.3		5.1		84.4
(percentage of total)	45%	49%	5%	1%	
Number of women in total workforce (millions)	36.6		3.1		39.7
(percentage of total)	36%	55%	67%	31%	47%
Total catch (million tons)	28.9		11.4		40.3
(percentage of total)	50%	22%	27%	1%	
Catch for domestic human consumption (million tons)	23.5		6.2		29.7
(percentage of total)	77%	91%	56%	n.a.	74%
Discards (% of total catch)	0.5%		5%		2%
	0.5%	0	5%	2%	

Source: Authors; case studies; Kelleher 2005.

catch may be used for direct local human consumption. The discard rates shown in table 3.7 should be interpreted with caution because the source data (Kelleher 2005) were compiled on the basis of fishing gears and not with a view to disaggregating small- and large-scale fisheries.

3.2 SMALL- AND LARGE-SCALE FISHERIES IN THE SAMPLED COUNTRIES

The results of the developing country case studies are summarized in table 3.8 and of the developed country samples in table 3.9. The tables divide fisheries into quadrants: small-scale and large-scale fisheries in marine waters and in inland waters. In summary:

- Almost 25 million fishers are represented in the case study countries. Including postharvest activities, there are over 84 million full-time and part-time fishers and fish workers.[18]
- Forty-seven percent of the total workforce is women.
- The vast majority of fishers and fish workers are employed in small-scale fisheries; 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 do 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, or catch that is not landed but disposed of at sea (expressed as a proportion to landed catch).

The following sections further explore these results and discuss related issues, including 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 studies, close to 25 million fishers are represented. However, while fishing itself is clearly an important source for employment, the bulk of fisheries employment is in the postharvest subsector such as fish processing and marketing. The case studies indicate that for each person employed as a fisher, on average, between two to three people are employed in postharvest activities. When postharvest activities are included, over 84 million full-time and part-time fishers and fish workers are represented in the case study countries. Over 90 percent of this total workforce is employed in the small-scale fisheries, and over half work

18 For Kenya, Tanzania, and Uganda, only employment on and around Lake Victoria is included.

TABLE 3.9: Summary of Developed Country Sample

	SMALL-SCALE FISHERIES			LARGE-SCALE FISHERIES			
	MARINE	INLAND	TOTAL	MARINE	INLAND	TOTAL	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[a]	763,301	21,745	785,046	350,537	1,710	352,247	1,137,293
Women in workforce[a]	324,721	9,479	334,200	134,135	504	134,639	468,839
Women[a] (%)	43%	44%	43%	38%	29%	38%	41%
Production and utilization							
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[b]							12%
% of catch used for local human consumption[c]	75%	92%	75%	58%	58%	58%	62%
Catch per fisher (tons)	10.2	11.5	10.3	60.6	18.8	60.3	27.9
Catch per ton of fuel[d]	1.9		1.9	3.5		3.5	3.3
Discards (% landings)[e]							11.1%

Source: Authors; sample country studies.
[a] Excluding Norway.
[b] Only EU countries excluding France and the United Kingdom.
[c] Same proportions among subsectors as in developing countries assumed.
[d] Marine fisheries in EU countries only.
[e] Only Norway, Canada, Japan, and France

in inland waters such as lake, river, flood plain, and wetland fisheries (see table 3.10 and box 3.1). 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 3.4).

The sector also generates employment upstream, supplying inputs such as boatbuilding and engine and gear manufacturing and providing various support services in harbors, at landing sites, and in dry docks and repair and maintenance workshops. These jobs are not as numerous as in the postharvest subsector, but these workers still constitute a substantial workforce. Case study information from Ghana and Senegal indicate that employment in these backward linkages add another 5 to 10 percent to the total number of full-time and part-time people employed in fisheries.

3.2.1.2 Developed Countries

Although employment in fisheries has generally declined in developed countries (FAO 2009b), the sector still provides about 3 million jobs (table 3.11). About 1 million are fishers, and the remaining two-thirds are employed in postharvest activities. Seventy-four percent of all jobs are in small-scale activities.

While employment in developed country fisheries may appear relatively low, especially compared with the developing country estimates, fisheries can be far more important at the local level than national aggregate employment values may indicate. In addition, the employment figures for many developed countries are expressed in a full-time equivalent, so the actual number of people receiving income from fisheries is considerably higher. Moreover, employment multiplier

TABLE 3.10: Full- 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	1,000	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[a,b]
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[c]	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: Authors; developing country case studies.
[a] Includes fishers and fish workers in the large-scale fisheries.
[b] Fishers only.
[c] See section 3.4 on subsistence fisheries.

BOX 3.1: 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 nonmotorized small vessels or no boats, and operating in flood plains or rice fields. Fishing and related activities are generally integrated with other livelihood activities. An estimated 496,000 full-time and part-time inland fishers, some of whom are subsistence fishers, operate in Cambodia. In addition, more than 920,000 people are involved in small-scale processing of inland catches. This activity takes place during the peak fishing period after the rainy season, and employment is mainly part time and often organized on a household basis.

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

effects can be important. Estimates from the United States indicate an employment multiplier of up to 27 percent. That means that if output increased so that 100 new jobs were created in commercial fishing, 27 jobs would also be generated in other sectors supplying inputs (U.S. BEA 2008). In the United Kingdom, a multiplier analysis, encompassing both indirect and induced impacts,[19] estimated that the removal of sea fishing and fish processing, which account for direct employment of about 22,000, would result in the loss of 138,000 U.K. jobs (Seafish 2007).[20]

19 An employment multiplier indicates these direct and indirect effects. An induced effect occurs because employees get wages that they spend, thereby increasing demand for other products and services and requiring additional employment in the sectors producing these goods (Scottish Government 2008).

20 Full-time equivalent (sample country table for the United Kingdom).

TABLE 3.11: Estimated Employment in Developed Countries (thousands)

	SMALL-SCALE FISHERIES			LARGE-SCALE FISHERIES			
	MARINE	INLAND	TOTAL	MARINE	INLAND	TOTAL	TOTAL
Number of fishers	663	98	761	326	2	328	1,089
Postharvest employment	1,259	206	1,465	457	1	458	1,923
Total employment	1,922	304	2,226	783	3	786	3,012
Women in total workforce (%)	43%	44%	43%	38%	29%	38%	41%

Source: Authors; compiled from sample of developed countries.

3.2.2 The Role of Women

Women account for 47 percent of the workforce, indicating that about 56 million jobs in the harvest and postharvest subsectors are held by women. The World Bank, FAO, and International Fund for Agricultural Development (IFAD) have already addressed this gender in fisheries and aquaculture, but considerable additional efforts are required, including on empowerment, health, education and access to finance (World Bank, FAO, and IFAD 2007).

Gender roles in fisheries commonly portray 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, an 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 2009a). In Bangladesh, fishing is traditionally a low-caste Hindu occupation, and only men in fishing communities normally engage in catching fish. Although 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 regardless 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 (table 3.12). On average, however, almost as many women as men are employed in the fisheries sector when postharvest activities are included. If China is excluded, the average proportion of women fishers and fish workers approaches 60 percent. This is true both for the small- and large-scale fisheries but with somewhat higher numbers of women in marine than in the inland fisheries. 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 3.12: Women in Fisheries Workforce in Developing Countries

COUNTRY/CASE STUDY	TOTAL WORKFORCE (THOUSANDS)*	PERCENTAGE WOMEN
Nigeria	6,500	73%
India	10,316	72%
Cambodia	1,624	57%
Ghana	372	40%
Senegal	129	32%
Brazil	493	30%
China	12,078	19%
Bangladesh	3,253	5%
Mozambique	265	4%

Source: Authors; Developing country case studies.
* Full- and part-time; fishing and postharvest activities

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 about 400,000 people (full and part time), although important differences exist among countries (Salz *et al.* 2006). In the sample, in developed countries, women represented an average of 41 percent of the total employment, mostly employed in the fish-processing industry (table 3.13).

TABLE 3.13: Women in Fisheries Workforce in Developed Countries

COUNTRY/CASE STUDY	TOTAL WORKFORCE (THOUSANDS)*	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.
* Full- and part-time; fishing and postharvest activities.

TABLE 3.14: 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: Authors; FAO 2008 (FISHSTAT Plus, average 2004 to 2006); developing country case studies.

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 to 2006 (FAO 2008a), but the Ghana case study estimated catches from Lake Volta alone to be 346,000 tons on the basis of information from Yeji fish market surveys. The most important cases of underreported inland water catches described in the developing country case studies are summarized in table 3.14.[21] 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.[22]

The total annual production by capture fisheries in the 11 developed countries in the sample is 11.8 million tons (table 3.15). Small-scale fisheries account for 24 percent of this production. Officially reported catches[23] from inland fisheries represent less than 1 percent of the total.[24]

3.2.4 Utilization of Catches

3.2.4.1 Fish Consumption

Based on the FAO Food Balance Sheets derived from data officially reported by member countries (FAO 2009b), the average global apparent per capita fish consumption was 16.7 kilograms in 2006.[25] For 2005, the average reported per capita fish consumption in all developing countries as a group was estimated at 14.4 kilograms per person, compared to 23.9 kilograms in developed countries (Laurenti 2007).

The Food Balance Sheets show great variations among countries. For example, apparent per capita consumption in developing country case studies ranged from 4.6 kilograms

21 The table includes all case study countries showing a difference greater than 10 percent (smaller differences may be due to differences in reporting years). The China case study indicated inland catches to be 10 percent less than the officially reported figure (not included in the table).

22 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 is not notable for the marine sector.

23 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).

24 With a few exceptions, inland fisheries catch quantities for the sample countries were compiled from FAO FishStat Plus averages for 2004–06 (FAO 2008a).

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

TABLE 3.15: Fish Production in the Sampled Countries (million tons)

	SMALL-SCALE FISHERIES			LARGE-SCALE FISHERIES			
	MARINE	INLAND	TOTAL	MARINE	INLAND	TOTAL	TOTAL
Developed countries	2.747	0.082	2.829	8.989	0.023	9.012	11.841
Developing countries	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: Authors; case studies.

TABLE 3.16: 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 2003–05)	23.4	18.7	32.6	25.4	27.7

Sources: Authors; Hortle 2007; Laurenti 2007; Lymer *et al.* 2008; Nguyen, Bach, and Mills 2008; case studies for Thailand and Vietnam.

in Mozambique to 32.6 kilograms in the Philippines (in 2005) (Laurenti 2007). In-country variations are not reflected in these national averages, and fish consumption is 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, particularly 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) is about 50 kilograms (Hortle 2007). This contrasts with a value of 28 kilograms, the total average apparent per capita fish consumption for the four countries concerned, as calculated in the Food Balance Sheets (Laurenti 2007). However, these numbers are not entirely comparable because 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 section 3.3. The apparent per capita fish consumption derived from the Food Balance Sheets for Thailand and Vietnam was recalculated using the higher catch estimates provided in case studies. Per capita consumption figures for Cambodia and Lao PDR are included in table 3.16 (as estimated by Hortle 2007) because 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 Sheets estimates are considerable (table 3.16). It should be noted, however, that the Mekong River Commission (MRC) consumption study includes some supply from subsistence fisheries.

Even relatively low annual fish consumption levels can be of vital importance for nutrition and health. Because of its high nutritional content—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 is 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 2009b). 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 2007a; Laurenti 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 to 80 percent of animal protein consumption in the four countries (Hortle 2007).

3.2.4.2 Different Uses of Small- 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 important differences exist 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 small-scale than of large-scale marine production is used for direct domestic human consumption. In other words, it is not exported or used for reduction into fishmeal 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 fishmeal and other nonfood purposes, whereas only 18 percent of the catch of the small-scale fisheries is used for animal feed. In Thailand and Vietnam, 20 to 30 percent of the total fish production is destined for nonfood uses (Laurenti 2007; Xie 2008; Lymer *et al.* 2008; Nguyen *et al.* 2008).

3.2.4.3 Trade

Fish and fishery products are among the world's most traded food products—37 percent of the total production enters international trade (FAO 2009b). About 25 percent of this quantity is produced through aquaculture, and the rest, about 40 million tons,[26] is capture fisheries production. 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.[27] 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 (Menezes 2008; Thuok *et al.* 2008; van der Knaap 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 because 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, and small-scale producers are heavily affected 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 the global food supply system to trade disruption pose additional threats (Kelleher 2008). High export prices are beneficial for fishers, but if sustainable resource management practices are absent, international market demand may foster overexploitation (FAO 2005; Kurien 2005).

26 Live weight equivalent (FAO 2009b).

27 In 2004; including aquaculture products (FAO 2007).

3.2.5 Fueling Fisheries

Fish-catching operations are heavily dependent on fossil fuel. The global fishing fleet consumes 42 to 45 million tons of fuel per year (Tyedmers 2004; Tyedmers, Watson, and Pauly 2005), which means that, on average, the fleet catches somewhat less than 2 tons of fish per ton of fuel consumed (based on catches reported to FAO).[28] Active demersal fishing activities, such as dredging, bottom trawling, beam trawling, and Danish seining, represent energy-intense fishing methods, whereas passive fishing (such as using hook and line, gill nets, or raps) requires less energy. Active pelagic fishing with, for example, midwater trawls, purse seines, and ring nets tends to be moderately energy intense.

Large-scale marine fisheries use about 10 times more fuel per ton of catch than do small-scale fisheries (table 3.17). Developing country fisheries and small-scale fisheries show significantly greater fuel efficiency, largely because many small-scale and inland fisheries in developing countries do not use motorized vessels. The poor fuel efficiency in the large-scale marine fisheries in developing countries is partly attributable to aging and poorly maintained fleets, widespread tropic shrimp trawl fisheries with a low retained catch per unit of fuel, and fleet overcapacity.

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 wide diversity in fishing operations, the average estimated fuel-efficiency rates calculated from the developing countries case studies[29] varied greatly (table 3.18) 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 are particularly limited.[30]

Nonmotorized vessels are an important part of the small-scale fisheries, and fishing with nonmotorized craft or with handheld gear is obviously fuel efficient. However, vessels

28 Based on catches from 2000, the estimation is 80.4 million tons. Only direct fuel consumption (i.e., not accounting for indirect energy use related to input supplies, boat building, etc.) and reported marine fishing (freshwater fisheries and IUU fishing) are not considered (Tyedmers *et al.* 2005).

29 Data on selected fleet segments were provided in the Big Numbers Project case studies from Ghana, Bangladesh, Cambodia, China, and Senegal.

30 The China case study gave an average of 10.9 tons caught per ton of fuel consumed in inland waters of Hubei province. In Lake Volta in Ghana, the average rate was 6.1 tons of fish per ton of fuel.

TABLE 3.17: Catch per Ton of Fuel

	SMALL-SCALE FISHERIES			LARGE-SCALE FISHERIES			
	MARINE	INLAND	TOTAL	MARINE	INLAND	TOTAL	TOTAL (TONS)
Developing countries	2.2	0.7	1.3	18.3	0.6	13.0	2.2
Developed countries	1.9			3.5			3.2

Source: Authors.

TABLE 3.18: Fuel Efficiency Estimates: Examples from Developing Country Marine Fisheries

COUNTRY	TYPE OF VESSEL/FISHING	FISH CATCH (TONS) PER TON OF FUEL
Senegal	Small-scale: Average pirogues, different gear	4.2
Cambodia	Small-scale: <10 HP	3.1
Ghana	Small-scale: Ali/poli/watsa	1.4
China	Small-scale: Gillnetters and stow boats in East 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: Offshore tuna	3.9
China	Large-scale: Purse seiners, trawlers, and hooking boats in East China Sea (Zhejiang province)	1.7
Bangladesh	Large-scale: Vessels <150 GT	1.4
Cambodia	Large-scale: Average trawlers, seiners, and other offshore boats	1.2

Source: Authors; developing country case studies.

fishing in inland waters in Cambodia and 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.

3.2.5.2 Developed Countries

Data from the EU sample countries showed that large-scale vessels were more fuel efficient than the small-scale fleet—3.5 tons of fish per ton of fuel consumed compared to 1.9 tons of fish per ton of fuel, respectively. Based on observer data, however, fisheries in the northeast United States show greater differences in fuel efficiency between gear types than between vessel sizes. Overall, large vessels (longer than 24 meters) appeared twice as fuel efficient as medium (12 to 24 meters) and small (less than 12 meters) vessels. However, if midwater 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 did medium and large boats (table 3.19). This finding is consistent with other observations that purse seine fisheries for small pelagic species often destined for reduction (fishmeal and oil) are more fuel efficient than fishing for high-value (food) fish (Tyedmers *et al.* 2005). Otter and scallop trawling are by far the least fuel-efficient fishing methods both for small and large vessels with average catches of 1.5 tons per ton of fuel consumed.

3.2.5.3 Historical Trends in Fuel Use

Evidence shows that some fisheries are using an increasing quantity of fuel to catch the same amount of fish because of the declining state of many fish stocks, an expanding fleet, and increasing vessel horsepower driven by the "race to fish" (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 to 20 tons per ton of fuel, and large-scale fisheries, 2 to 5 tons. By 2006, these values had decreased to 4 to 8 tons and 1 to 2 tons for small- and large-scale fishing, respectively (see Annex).

The historical trend suggests a likely continued decline in fuel efficiency in small-scale fisheries. The available data do not show small-scale fisheries to be more fuel efficient than their large-scale counterparts. However, these estimates are based on a limited sample, particularly for developing countries, and this conclusion refers only to motorized fishing because fishing from nonmotorized boats or by handheld gear is not included in the sample.

TABLE 3.19: Catch per Ton of Fuel Consumed in Fisheries in the Northeast United States

FLEET SEGMENTS/ GEAR TYPES	GILLNET	LONG-LINE	OTTER TRAWL	MIDWATER 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; A. Kitts (personal communication).

3.2.5.4 Fuel as a Proportion of Total Harvesting Costs

The price of fuel for fishing generally does not vary among countries as much as it varies for the transport sector because taxes on fuel for fishing tend to be lower. However, studies on the economic performance of marine capture fishery fleets[31] show that fishing vessels in developing countries have relatively higher fuel costs than do vessels in developed countries (Le Rey, Prado, and Tietze 1999; Tietze *et al.* 2001; Tietze *et al.* 2005; FAO 2007a).[32] 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 countries. This difference was even more pronounced for vessels using passive gear; the studies showed that developing country fishers using passive gear spend three times as much as their counterparts in developed countries spend on fuel. The cost differential may be largely attributable to the extensive use of outboard motors in the canoe fisheries. Overall, the relative importance of fuel costs has increased and is estimated to represent 37 percent of gross revenues globally and 20 percent and 43 percent in developed and developing countries, respectively (table 3.20).

TABLE 3.20: 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 2007a.

The developing country case studies also provided information on the relative weight of fuel in the cost structure of fishing. Although the data are insufficient for calculating exact proportions, the studies indicate that fuel represents a larger percentage of gross revenues in marine small-scale 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.

31 See Le Rey *et al.* 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 were surveyed.

32 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 2007a).

BOX 3.2: 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). More commonly, bycatch is the total catch of nontarget 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" (Kelleher 2005).

"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 because target species may be discarded as well (Kelleher 2005).

Source: Eayrs 2007; Kelleher 2005.

3.2.6 Bycatch and Discards

Globally, the quantity of fish discarded at sea (box 3.2) has declined in recent years. Increased utilization of bycatch (particularly in Asia), use of more selective gear, reduced fishing if there are high levels of unwanted bycatch, and more efficient bycatch management have all contributed to reduced discards. However, global discards are around 7 million tons annually—effectively 8 percent of catch is dumped before landing. Tropical shrimp trawl fisheries have the highest discard rates, followed by other shrimp and finfish trawl fisheries. Small-scale fisheries tend to have lower discard rates than large-scale fisheries. Purse seine, handline, jig, trap, and pot fisheries have relatively low discard rates (Kelleher 2005).

The developing country case studies countries showed low discard rates—an estimated average of 0.5 percent in the small-scale fisheries and 5 percent for large-scale fisheries (Kelleher 2005).[33] Small-scale inland fisheries showed almost no discards, but tropical shrimp-trawl fisheries in some countries (such as Indonesia, Mozambique (box 3.3), Nigeria, and Senegal) influenced the higher discard rates noted for the large-scale fisheries in general. In Asia, including China, discards are negligible because bycatch is used either for human consumption or as animal feed. Bycatch collection at sea by small-scale operators takes place in many countries, such as Ghana, India, Mozambique, Nigeria, Senegal, and Thailand (Béné *et al*. 2007).

33 Based on case study data and the FAO discards database (Kelleher 2005).

BOX 3.3: Bycatch Collection in Mozambique

In Mozambique, artisanal fishers have collected bycatch from shrimp trawlers since the 1970s. In Nampula and Zambezia provinces, 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 SUPPLEMENTARY DATA

Table 3.21, adapted from Thomson (1980), gives an overview of the marine capture fisheries in 1980. Thomson's study included global estimates of employment, catches, and fuel consumption in small- and large-scale marine fisheries. It argued for the relative importance of small-scale fisheries 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 in tables 3.21 and 3.22. Of these, only Berkes *et al*. (2001) includes inland fisheries. The values in these tables are often cited as representing global fisheries despite the omission of inland fisheries.

TABLE 3.21: Profile of World Fisheries in 1980: The Thomson Table

	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)	~24 million	~20 million
Capital cost of each job ($)	$10,000–100,000	$100–1,000
Marine fish caught for industrial reduction (fishmeal and oil)	~19 million tons	..
Fuel oil consumption (tons/year)	10–14 million	1–2 million
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: Adapted from Thomson 1980.

TABLE 3.22: Comparative Results of Previous Studies

BENEFITS	THOMSON 1980		LINDQUIST 1988		BERKES *ET AL.* 2001		PAULY 2006	
	SMALL-SCALE	LARGE-SCALE	SMALL-SCALE	LARGE-SCALE	SMALL-SCALE	LARGE-SCALE	SMALL-SCALE	LARGE-SCALE
Annual catch for human consumption (million tons)	20	24	24	29	20–30	15–40	~30	~30
Annual catch reduced to meals/oils (million tons)	..	~19	n.a.	~22	n.a.	n.a.	..	20–30
Fish and other sea life discarded at sea (million tons)	n.a.	n.a.	0	6–16	n.a.	n.a.	..	8–20
Number of fishers employed (million)	<8	~0.45	>12	0.5	50	0.5	>12	~0.5
Annual fuel consumption (tons)	1–2	10–14	1–2.5	14–19	1–2.5	14–19	~5	~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: Compiled from cited sources.
Note: All studies refer to marine fisheries only except Berkes *et al.* 2001, which includes both marine and inland fisheries.

3.4 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 studies on subsistence fisheries were commissioned—on Vietnam, Bangladesh, and the Philippines (Mills 2010). The results of two of these studies follow. In the case of the Philippines, subsistence fishing could not be satisfactorily disaggregated from small-scale commercial fishing.

The subsistence fishing case studies present a complex picture of an activity that is only partially captured in official fisheries or household survey statistics (box 3.4). A number of key points emerge:

- If production is primarily for household consumption, production volumes per household are low, as 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.
- Subsistence fishing is difficult to define 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 up to 83 percent 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 percent of the rural population engage in fishing activities (Shams 2007; Sjorslev 2000). Households switch from no-fishing to subsistence fishing to commercial fishing in accordance with the

BOX 3.4: Subsistence Fishing in Thailand

The Thai case study included a recalculation of inland capture fisheries production. Datasets used included the National Agricultural Census and the Gross Provincial Product (GPP) survey. In the GPP survey, 2,215 households reporting fish production were identified, and survey returns were examined in detail. Of these, 75 percent of households reported production of less than 281 kilograms per year, with a mean production of 102 kilograms per year. These households were designated to be low-production households. Remaining fishing households had an average catch of 1,306 kilograms per year.

The National Agricultural Census identified 2,639,582 fishing households. Assuming a distribution of high-production and low-production fishing households similar to that 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 tons in 2005.

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

Source: Lymer *et al.* 2008.

seasonality of livelihood opportunities and household division of labor.

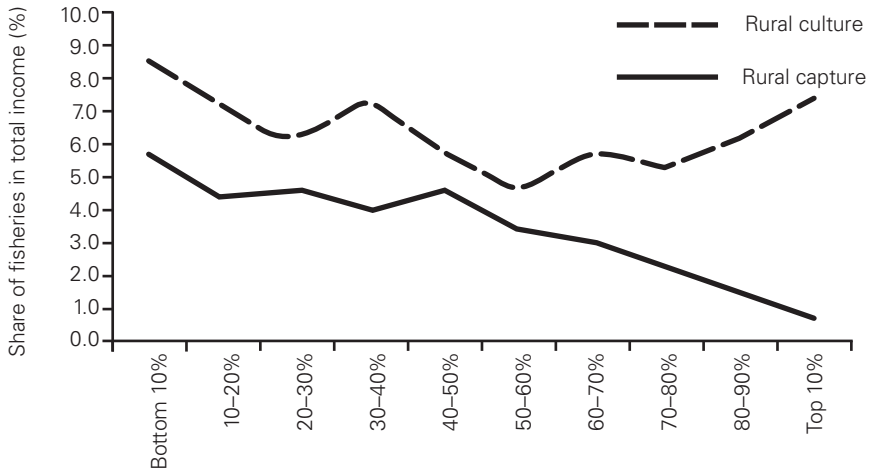
- Conventional fisheries statistics do not capture the extent or importance of subsistence fisheries, and household income and expenditure surveys may not capture its importance if conducted in a nonfishing season.
- Food consumption surveys and food balance sheets can indicate a substantially greater level of dependence on subsistence fisheries than is shown by the other approaches. However, the design of the survey requires some sensitivity to the nature of subsistence fisheries.

3.4.1 Bangladesh

The following are some key findings of the Bangladesh study:

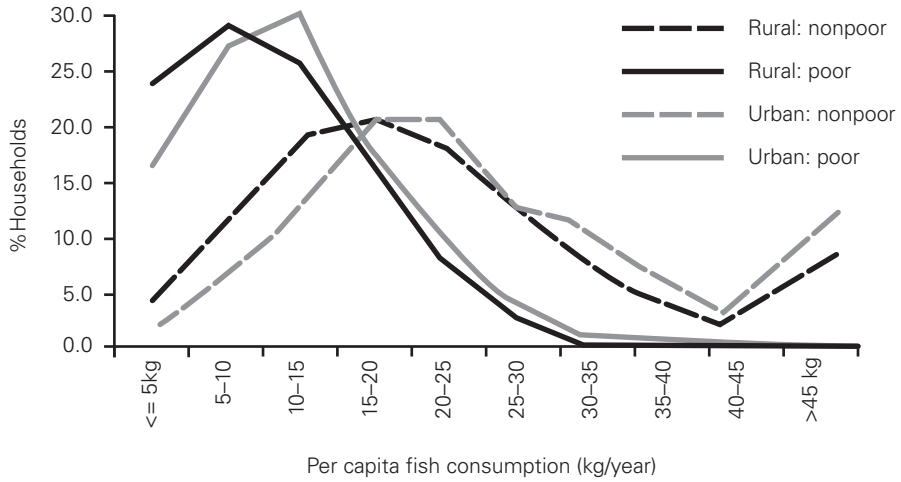
- Reanalysis of data collected from the 1980s and 1990s indicated up to 15.2 million households (inhabited by 68 million people) directly engaged in capture fishery activities at a subsistence or commercial level for at least part of the year.
- The more recent Household Income and Expenditure Survey (HIES) from 2005 provides an estimate of 13 million households (inhabited by 63 million people) involved in fish production, both fisheries and aquaculture subsectors.
- Direct questions in the HIES regarding household fish production underestimated by a minimum of 40 percent the number of people engaged in fish production.
- Capture fisheries constitute a greater proportion of household income for poor than for nonpoor households (see figures 3.1 and 3.2).
- Seasonality and interannual 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.
- The discrepancy between estimates from these two data systems relates at least in part to the changing nature of fish production in Bangladesh as well as to a mismatch between temporal and spatial scales of sampling in the HIES and the nonrandom temporal and spatial distribution of fishing activities.
- 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.
- The relative importance of subsistence and commercial fishing at a district level cannot be predicted on the basis of yield estimates, nor can the amount of subsistence fishing be determined on the basis of commercial fishing estimates. A far more complex set of drivers, including geography and hydrology, urbanization, and social issues, act to negate simple

FIGURE 3.1: Income from Fisheries in Bangladesh by Income Group



Source: HIES 2005.

FIGURE 3.2: Bangladesh Fish Consumption by Rural and Urban Poor and Nonpoor



Source: HIES 2005.

correlation. Therefore, data on commercial fishing, which dominates fisheries data systems, are often a poor indicator of the importance of fishing at a district and ultimately at a national level.

3.4.2 Vietnam

The following are some key findings of the Vietnam study:

- 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.
- Alternative estimates of both inland and marine capture fisheries suggest national supply of fish per capita may be as high as 40 kilograms per year (table 3.16). This is about 40 percent higher than the official estimate for fish consumption.
- 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 because key characteristics of fisheries differ among regions.
- 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.
- 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 are largely absent. Fish consumption studies were of considerable value in detecting fish production not captured by direct sampling methods.
- 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.
- Studies of inland provinces tended to provide detailed statistics on participation in fisheries by the general population, and 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 (1) the official production and consumption estimates with (2) results of the first case study (which had the objective of disaggregating small- and large-scale fisheries) and (3) the second case study (which focused on subsistence fisheries) is presented in tables 3.23 and 3.24. The comparison illustrates that the official values may underestimate fish production and consumption by about 40 percent.

TABLE 3.23: Comparison of Vietnam Fish Production Case Studies (million tons)

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

Source: Mills 2010.

TABLE 3.24: Estimated Participation in Vietnam Inland Fisheries under Alternative Scenarios (millions)

SCENARIO/ASSUMPTIONS	INLAND FISHING HOUSEHOLDS	INLAND FISHERS	TOTAL FISHERS	HOUSEHOLD MEMBERS
1. Same catch for non-Mekong households	2,820	4,090	4,720	14,450
2. Half catch for non-Mekong households	4,990	7,240	7,910	23,910
3. Thirty percent of rural households outside Mekong Delta fish	4,970	7,200	7,880	23,810

Source: Mills 2010.
Note: Scenario 1 is based on an assumption that households 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 conservative assumption that households outside this highly productive area catch, on average, half the quantity of fish of those within the study area. Scenario 3 is based on a similar conservative assumption that 30 percent of rural households outside of the study area are engaged in fishing.

3.5 RECREATIONAL FISHERIES

There is no standard method of estimating the value of recreational fishing. The wide variety of studies often target either inland or marine angling but rarely both. Different studies include or exclude different costs, such as exclusion of capital costs, which may also exclude fishing tackle.

The subsector 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 because many "weekend anglers" fish expressly to provide food. The activity is also closely linked to marine and aquatic recreation. Neither of these activities is addressed in this study.

There are an estimated 225 million recreational fishers, or anglers, worldwide—almost twice the numbers of commercial fishers (see Annex). In the United States, 18 out 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 1/35 of the value of a salmon netted in an angling fishery ($600–1,000 per angled salmon) (Isaksson and Oskarsson 2002). The employment generated by recreational fishing is significant, almost three times the number employed in commercial fisheries in the United States, and the economic contribution of angling in Wales is more than twice that of commercial fishing and aquaculture combined (Nautilus 2007). China has an estimated 90 million recreational fishers. Angling is promoted as part of the National Healthy Exercise Plan, and based on an annual per capita consumption of $35 per recreational angler, the Chinese market for recreational fishing is about $3.5 billion (Min Guo 2006).

The total annual expenditure on recreational fisheries is conservatively estimated at over $190 billion (table 3.25). The estimated annual global demand for recreational fishing equipment is $15.66 billion (BizAcumen 2009). A number of studies

TABLE 3.25: Estimated 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	
United Kingdom	1,122	0.075	14,960	£2.89 billion
Spain	162	0.075	2,161	
Russia	245	0.1	2,448	
Rest of Europe	2,554	0.1	25,540	
United States	4,532	0.075	60,423	$82 billion
Canada	376	0.075	5,008	
Japan	1,403	0.075	18,711	
Australia	146	0.075	1,947	A$1.9 billion
China	n.a.	n.a.	n.a.	$3.5 billion
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 2009; authors.

of expenditures on recreational fishing (Annex, table 2.8) indicate that 10 percent (median value; average 12 percent) of expenditures can be attributed to fishing equipment. The value of $190 billion is derived on the basis of a conservative assumption that 7 percent of angler expenditure is used for equipment in developed countries and 10 percent is used in developing countries. The higher proportion for developing countries is based on the perception that a greater proportion of developing country angler expenditure is on equipment.

The different approaches used in the available recreational fisheries case studies complicate estimates of average value added and multipliers. Studies from the United States and the United Kingdom both indicate that income value added is about 0.37 percent for each unit of angler expenditure, so total value added would be in excess of this value. If total value added is assumed to be 40 percent, the contribution of recreational fisheries to GDP is about $70 billion annually. This value is a conservative estimate because recreational fisheries in seven countries contribute an estimated $74 billion per year to the global economy when direct and indirect impacts are taken into account.

The impact of recreational fishing on fish stocks can be considerable. In France, sea angling (including collection of shellfish) is estimated to harvest 30,000 tons annually (Fremer and BVA 2002). 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 Lambeth 2002).

3.6 THE CONTRIBUTION OF COMMERCIAL FISHERIES TO GDP

The contribution of a sector to national 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 as one of many indicators, not only to monitor the progress of sustainable resource management, but also to gain the attention of decision makers and to highlight the contribution of the sector to poverty alleviation (FAO 2004b).

The total fisheries sector's contribution, including the marine, inland, and postharvest subsectors, to the global economy was estimated at $274 billion in 2007, with a 95-percent confidence interval of between $252 and 303 billion. If a conservative upstream multiplier of 1.3 is applied (a limited number of studies suggest a multiplier of 1.6), there is an additional contribution to GDP of about $90 billion.

The global capture fisheries GDP estimate is based on information from 129 countries for which further details of the estimate are itemized in table A.3. The estimates included only the direct impacts from commercial fisheries (primary production of harvest and postharvest subsectors). Indirect, induced economic impacts were not included, nor was the aquaculture subsector. The available GDP values underestimate the economic contribution from subsistence fisheries because 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. Future analyses can significantly improve the accuracy of the estimate when further country-level postharvest GDP values become available.

3.6.1 Summary Statistics

3.6.1.1 Harvest Subsector

Out of 129 countries where the fisheries-related GDP data were available, the contribution from the harvest (catching) subsector was identified for 111 countries (see table 3.26). The remaining 18 countries reported the combined contribution of catching and farming (aquaculture) of fishery products (primary production) to national GDP.

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

3.6.1.2 Postharvest and Nonharvest Subsectors

Out of 129 countries, the contributions of the postharvest and nonharvest subsectors were identified for 26 countries.

TABLE 3.26: Contribution from the Fisheries Harvest Subsector to National GDP (%)

	RANGE	AVERAGE	MEDIAN
Global	0–30	2.8	1.3
Developing countries		3.5	1.8
Developed countries		0.4	0.2
Oceania		8.5	4.6

Source: Gillett 2010; Kébé 2008.

Of these, 10 countries used estimates prepared by the SFLP for sub-Saharan countries (see Annex), which included not only the postharvest subsector (marketing, processing, fish handling), but also the sale and repair of fishing boats and equipment. For the remaining 11 countries, the precise activities included in the nonharvest subsector were not fully specified.

In the 26 countries, the nonharvest 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 half of the actual contribution from the fisheries sector. The contribution of nonharvest 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 nonharvest share of total fisheries GDP is not significantly correlated with other factors, such as country economic status, fish production, or the species composition (demersal, shellfish, pelagic, and freshwater) of landings. The postharvest contribution tends to have a lower share of GDP in European countries, whereas the postharvest 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 the recreational fisheries subsector, including marine and inland tourism, was compiled for seven countries (Australia, Belize, Canada, Namibia, New Zealand, Northwest Trinidad, and the United States). Together, these countries directly contributed approximately $49 billion per year to the global economy and, if indirect impacts are included, about $74 billion per year.

3.6.2 VARs, Value Chain Analyses, and Input-Output Analyses

Studies in 15 sub-Saharan countries show that the harvest subsector accounts for 60 to 70 percent of the value generated by the sector (table 3.27). The remaining 30 to 40 percent is generated largely by postharvest marketing and processing activities (Kébé 2008). Studies using a VAR approach in Pacific Island developing economies estimate the revised fisheries sector GDP (including nonharvest activities) to be from 4 percent to 63 percent higher than the "official" estimates, which generally refer to the harvest subsector only, and on average 30 percent higher (Gillet 2009, Gillett and Lightfoot 2002). Other studies in the U.S. Pacific Territories

TABLE 3.27. 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: nonmotorized	90
Nonvessel fishing	89–92
Aquaculture	21–72

Source: Gillett and Lightfoot 2002.

TABLE 3.28: Value Chain Analysis for Lake Victoria Nile Perch

	EURO/KG	% OF VALUE
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: Authors; case studies.

and in Uganda indicate that revised fisheries sector GDP is about twice the official estimates (Yaron and Moyini 2004; Zeller, Booth and Pauly 2006).

The distribution of value added along the value chain varies widely. A value chain study from Nigeria indicates that approximately three times the farm gate value of farmed catfish is generated postharvest in marketing and specialized fish restaurants. Approximately 80 percent of the export value of processed Indonesian blue swimming crab is generated postharvest. Other studies report value added at the harvesting level accounted for between 4 percent (Moroccan anchovy fishery) and 18 percent (Icelandic cod) of the retail value, and the retail sector captured about 60 percent of the retail value (Gudmundsson, Asche, and Nielsen 2006). Nile perch fishers in Lake Victoria receive less than 10 percent of the retail value, and about 60 percent of the retail value is captured in the European market (table 3.28).

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 analysis (table 3.28). This is 4.5 times greater than the first sale value of the fish produced (Dyck and Sumaila 2009).

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 spin-off (secondary) activities, generating a household income of approximately US$2.2 billion,in 2006 (Pinfold 2009). The GDP impact of the sector was estimated at $3.7 billion when direct plus secondary activities were accounted for, and the final product value of the seafood industry overall was just under $4.8 billion. A 2008 study in Norway[34] showed that the fishing and aquaculture industry in Norway contributed NOK38.9 billion to GDP, approximately 1.8 percent of both Norway's GDP and total employment in the country in 2006. Further details of sector economic multipliers are provided in the Annex.

34 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.

Chapter 4: 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, livelihoods, food security, and environmental sustainability.

The methodologies and their results form a coherent and valuable baseline for fisheries policymaking 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 policymaking 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 and rural community stability and its role in environmental sustainability and adaptation to climate change needs to be highlighted to policymakers.

Hidden harvests mean that the sector is undervalued in terms of its perceived economic contribution. This translates to inadequate weight in policy development, 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, offshore oil extraction, or tourism. Already marginalized communities may become further disadvantaged.

Healthy small-scale fisheries are vital for employment, pro-poor fisheries policies, food security, and for rural livelihoods in many communities. The relative contributions of large- and small-scale fisheries and their interactions in terms of competition for shared fish resources need increased attention from policymakers. The substantial underreporting 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- and large-scale commercial 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 that 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 from 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 science to inform community-level decisions. Some of these approaches are outlined in the Code of Conduct for Responsible Fisheries (see box 2.2) and its relevant Technical Guidelines (FAO 2005) and by other authors (Andrew *et al.* 2007; Béné *et al.* 2007; Berkes *et al.* 2001; Garcia *et al.* 2008).

Subsistence fisheries and poverty require explicit attention. The two subsistence case studies indicate substantial underreporting of subsistence fisheries. As a result, the subsector's contribution to food security and poverty alleviation in developing countries is not sufficiently recognized. This undervaluation implies that the subsector is already marginalized despite its likely high importance to the lives of the rural poor. Effective assessment of subsistence fisheries requires active collaboration with nonfisheries information systems, such as nutrition and household income surveys. 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 generally 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 a 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. Studies indicate that society attributes additional nonmarket values to recreational fisheries (Toivonen 2004). Although 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.

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 must 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 of the global loss of rents in marine capture fisheries (World Bank 2009). 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.

Fisheries contribute importantly to GDP. Based on the available data, the commercial fisheries sector's contribution to global GDP is very conservatively estimated at $274 billion in 2007, including marine and inland harvest and postharvest subsectors. The estimate is considered conservative for several reasons: (1) the analysis omitted several countries for which GDP data were not available and that, in aggregate, account for about 10 percent of global seafood production; (2) the contribution from recreational fisheries subsectors was not included; (3) subsistence fisheries remain largely unaccounted; (4) upstream economic activities are not included; and (5) only direct impacts were included—spin-off (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 percent of reported production and for which GDP values are unavailable increase 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 estimated $380 billion per year derived from input-output analyses (Dyck and Sumaila 2009). However, this estimate is not directly comparable because it refers to the marine fisheries subsector only and includes marine tourism. The simplified approach suffers from a large degree of uncertainties given the data-limited environment. The estimates provided can be substantially improved when further country-level data become available, when the scope of estimated GDPs are more rigorously defined, and when the determinants of harvest/processing multipliers can be more clearly quantified.

Accounting for the contribution of the fisheries sector to national GDP (and by extension to global GDP) exposes common methodological challenges and pitfalls in obtaining a consistent measure of fisheries GDP. Improvement of the national-level data through documenting a clear description of what is included in the GDP estimate is the initial step to address these challenges. Ideally, national statistics offices and relevant fisheries agencies should work 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 their economy's dependence on fishery resources and improve future planning for sustainable management of the 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 the national level builds arguments to take due account of the sector in environmental decision making.

Investment in good fisheries governance is justified by their value. The economic losses attributable to weak fisheries governance—estimated at over $50 billion annually—provide 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.

4.1 RECOMMENDATIONS

National and international fisheries agencies and nongovernmental organizations direct the attention of policymakers and decision makers to the value of capture fisheries as a primary industry that underpins the economic activities of an extended-value chain that can have an economic contribution several times the landed value of the catch. 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.

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 postharvest 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.

The development community considers collaboration in preparation of the following:

- 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
- Guidelines consistent with the existing UN guidance (UN and FAO 2004) to estimate the extended GDP of the fisheries sector, including a typology of sector-specific multipliers and value chain analyses, including for developing countries
- Consensus guidelines on the preparation of estimates of economic rents and associated indicators of economic performance of fisheries
- Further development of actionable fisheries governance indicators (Anderson and Anderson 2010).

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 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.

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

- Disaggregation of fisheries statistical information at the 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
- Development of fisheries satellite accounts in national accounts
- Incorporation of fisheries-specific 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 well-being
- Ensuring effective use of limited resources by engaging with survey agencies (bureaus of statistics, agriculture and nutrition departments) to provide 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
- 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

- Develop partnership arrangements at the regional or 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.

The development community considers development of partnerships or programs to make fisheries statistics and knowledge more relevant and useful for decision making and to ensure that project-level monitoring is streamed into country knowledge-management systems.

Use the formal mechanisms of the FAO[35] to improve collection and interpretation of statistical data on fisheries, including validation and improvement of the results presented, at national, regional, and global levels.

Critically review the results presented in this study 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.

35 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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Annex: DATA SOURCES AND NOTES FOR GDP CALCULATIONS

A.1 NOTES ON DATA SOURCES

Africa Caribbean Pacific and Other Developing Countries

GDP data were collected from the 17 developing country case study coordinators via email, and information was compiled from existing secondary sources, complemented where possible by primary data collection or review. In some cases (such as 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:

- Maldives. *Source:* U.S. Department of State, Country Background Notes. The fisheries industry, including fish processing, traditionally contributes about 7 percent of GDP, but it was only about 5 percent in 2007 because of a drastic drop in the fish catch. The website does not provide the data sources and method used. http://www.state.gov/r/pa/ei/bgn/5476.htm.
- Namibia. *Source:* Bank of Namibia Quarterly Report, September 2007, http://www.tradedirectory.com.na/documents/sbn5.pdf. 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.
- Seychelles. *Source:* Seychelles Strategy 2007 (K. Kelleher/X. Vincent, personal communication).
- Tanzania. *Source:* Wilson 2004. The fisheries contribution to GDP was obtained from the Bank of Tanzania, Economic Operations Report 2001. No detail is provided on how GDP was calculated. http://www.fao.org/docrep/007/j2760e/j2760e00.htm#Contents.
- Uganda. *Source:* Banks (2003), cited in Bahiigwa, Mugambe, and Keizire 2003.

The Caribbean Regional Fisheries Mechanism's website (http://www.caricom-fisheries.com/members/antigua.asp) 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).

A.1.1 Asia and Pacific

Bangladesh, China, Indonesia, Malaysia, Philippines, Lao PDR, Thailand, Vietnam. A report by Sugiyama *et al.* (2004) 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."

Cambodia. Assumptions were made for production/postharvest breakdown on the basis of government official figures of 10 percent fisheries GDP (capture, 5.85 percent; postharvest, 3.74 percent; and the rest is aquaculture). Value added for postharvest includes smoking, drying, and making fish sauce and naim pickled fish (Thompson 1980).

China. Data from the *Chinese Fisheries Yearbook* for 2004. The capture fisheries value accounted for about 1 percent of overall national GDP. The total value of capture fisheries and aquaculture accounted for about 2.4 percent of overall national GDP. The total value of capture fisheries, aquaculture, aquatic products processing, boatbuilding, and fishery industry accounted for about 3 percent of the overall national GDP (Xie 2008).

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

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

Canada. GDP contributions of Canadian fishing industry was divided into two groups: (1) primary fisheries and mariculture and (2) processing. In addition, the contribution of the ocean transport industry (including marine shipping, ship- and 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 (Roger A. Stacey Consultants 1998).

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A.1.2 Europe

Production and processing values were compiled mainly from Eurostat data in 2006. Eurostat has data for value added for "Processing and preserving of fish and fish products" for EU countries. Data do not include marketing and postharvest activities other than processing.

EU fleet performance and employment (except Spain), data 2006, from STECF-SGECA (2008), *Annual Economic Report 2008,* Copenhagen, April 21–25, 2008. Employment is in full-time equivalents, including self-employed.

Spanish data on fleet performance, data 2006 (value and volume of catch, value added and employment), from MAPYA (Ministerio de Agricultura, Pesca y Alimentación), Indicadores económicos de pesca marítima, Principales resultados, Ejercicio 2006.

Aquaculture employment data for 2005–06 is from Salz *et al.* (2008). Review of the EU Aquaculture Subsector, Draft Final Report (under preparation), Project Definition of Data Collection Needs for Aquaculture (FISH/2006/15 lot 6). Employment is in employed persons, including self-employed (not in full-time equivalents).

Employment in fish processing is from Eurostat, data 2006. Employment is in full-time equivalents.

GDP and euro-dollar exchange rate is from Eurostat, data 2006. Contribution to GDP is related only to income created by the catching subsector.

Fuel prices are from van Marlen (2008).

France. Inland fisheries data are from European Fisheries Fund. National Strategic Programme 2007–2013.

Denmark. Data are from Statistics Denmark, http://www.statistikbank-en.dk/statbank5a/default.asp?w=1280. Inland fisheries information via personal communication from Institute of Food and Resource Economics, and catch for nonhuman uses information from Danish Ministry of Agriculture and Fisheries Yearbook 2006, p. 59.

Netherlands. Processing data are from Smit and Taal (2007).

Scotland. Data are from the Scottish Government, http://www.scotland.gov.uk/Publications/2004/03/19079/34369.

Iceland. Data are from Central Bank of Iceland 2008. The economy of Iceland. Available at: http://www.sedlabanki.is/lisalib/getfile.aspx?itemid=6372 and Agnarsson, S., and Árnason, R. 2003. The Role of the Fishing Industry in the Icelandic Economy: A Historical Examination. http://www.ioes.hi.is/publications/wp/w0307.pdf. The reports show fishing and fish processing account for 7 percent of GDP.

TABLE A.1: Postharvest Share of Fisheries GDP for 21 Sample Countries

COUNTRY	FISHING GDP %	POSTHARVEST GDP %	FISHERIES GDP %	POSTHARVEST SHARE %	YEAR	SOURCE
Benin	1.76	1.24	3.00	41.3	2002	Kébé and Tallec 2006
Burkina Faso	0.20	0.10	0.30	33.3	2002	Kébé and Tallec 2006
Cambodia	10.00	6.00	16.00	37.5	2003	Thomson 1980
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 and Tallec 2006
Congo, Republic of	1.39	1.36	2.75	49.5	2003	FAO 2008b
Côte d'Ivoire	0.76	0.76	1.52	50.0	2002	Kébé and 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?	Westlund 2009b and personal communication January 2010.
Gabon	0.76	0.75	1.51	49.5	2002	Kébé and Tallec 2006
Gambia	1.75	3.95	5.70	69.3	2002	Kébé and Tallec 2006
Ghana	8.00	1.70	9.70	17.5	2006	Eurostat 2006
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 2008b
Senegal	1.81	2.29	4.10	55.9	2003	FAO 2008b
Sweden	0.02	0.03	0.06	57.1	n.a.	Westlund 2009b and personal communication January 2010.
Uganda	3.00	9.00	12.00	75.0	2002	Banks 2003
United States	0.30	0.27	0.57	47.4	2006	unstat.org

Notes: Kébé and Tallec (2006) includes marketing, processing, handling, sale and repair of canoes, etc.

Roger A. Stacey Consultants 2003 includes aquaculture.

Eurostat (2006) includes processing but excludes marketing and other post-harvest activities.

Hall, Heidarsson, and Saevaldsson (no date) includes both fishing and fish processing.

Banks (2003) includes trade sector. Official figure of 2.4 percent is assumed undervalued.

Westlund 2009b and personal communication January 2010.

TABLE A.2: Calculation of Mean and Median Extended Fisheries Sector GDPs Based on 128 Countries

	FISHING GDP % NATIONAL		EXTENDED FISHERIES GDP (BASED ON MEDIAN FISHING GDP)	EXTENDED FISHERIES GDP (BASED ON MEAN FISHING GDP)
	MEDIAN	MEAN	MEDIAN	MEAN
128 countries	1.29%	2.64%	2.20%	4.49%
Developed	0.19%	0.46%	—	—
Developing	1.79%	3.23%	—	—
			EXTENDED FISHERIES GDP (mUSD)	EXTENDED FISHERIES GDP (mUSD)
	TOTAL GDP (mUSD)		MEDIAN	MEAN
128 countries	43,254,750		950,404	1,942,179
Developed	32,323,881		710,228	1,451,373
Developing	10,930,869		240,176	490,806

Source: Authors, based on data from Table A.3.

TABLE A.3: Base Data and Data Sources Used to Estimate Extended Fisheries Sector GDP

COUNTRY	FISHING GDP (MILLION USD)	POSTHARVEST GDP	FISHERIES GDP	AQUACULTURE INCLUDED	COMMENT ON FISHERIES GDP CALCULATION	YEAR	SOURCE
American Samoa	0.23	n.a.	n.a.	0.47	Commercial and subsistence fishing, aquaculture	2007	Gillett 2009
Angola	3.00	n.a.	n.a.	n.a.	No detail on how fishery GDP was calculated	2006	SIFP 2008
Anguilla	2.60	n.a.	n.a.	n.a.		?	Lovell, T. 2008
Antigua and Barbuda	1.48	n.a.	n.a.	n.a.	No detail on how fishery GDP was calculated	2003	CRFM website[a]
Bahamas	1.40	n.a.	n.a.	n.a.	No detail on how fishery GDP was calculated	2004	CRFM website
Bangladesh	3.92	n.a.	n.a.	n.a.	No detail on how fishery GDP was calculated	2009	FAO Country Profile
Barbados	1.00	n.a.	n.a.	n.a.	No detail on how fishery GDP was calculated	2002	FAO Country Profile
Belgium	0.00	n.a.	n.a.	n.a.	Share in the national GDP and contribution to employment almost negligible	2003	FAO Country Profile
Belize	2.80	n.a.	n.a.	2.20	Includes aquaculture; unclear whether processing, etc., is included	2003	FAO Country Profile
Benin	1.76	1.24	3.00	n.a.	Includes marketing, processing, handling, sale and repair of canoes, etc.	2002	Kébé and Tallec 2006
Botswana	0.00	n.a.	n.a.	n.a.	No detail on how fishery GDP was calculated	2002	FAO Country Profile
Brazil	0.40	n.a.	n.a.	n.a.	No detail on how fishery GDP was calculated	2000	FAO Country Profile
British Virgin Islands	0.70	n.a.	n.a.	n.a.		n.a.	Lovell, T. 2008
Burkina Faso	0.20	0.10	0.30	n.a.	Includes marketing, processing, handling, sale and repair of canoes, etc.	2002	Kébé and Tallec 2006
Burundi	1.00	n.a.	n.a.	n.a.	GDP contribution of 1% based on fish production only	2003	FAO Country Profile
Cambodia	10.00	6.00	16.00	n.a.		2003	Thomson 1980
Cameroon	0.90	0.80	1.70	n.a.	Includes marketing, processing, handling, sale and repair of canoes, etc.	2002	Kébé and 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	n.a.	Includes marketing, processing, handling, sale and repair of canoes, etc.	2002	Kébé and Tallec 2006
Chad	1.30	n.a.	n.a.	n.a.	No detail on how fishery GDP was calculated	2002	FAO Country Profile
China	2.40	n.a.	n.a.	n.a.	GDP share based on gross value of fisheries output	2004	FAO Country Profile
Chile	1.50	n.a.	n.a.	n.a.		1998	FAO Country Profile

TABLE A.3: Base Data and Data Sources Used to Estimate Extended Fisheries Sector GDP (continued)

COUNTRY	FISHING GDP (MILLION USD)	POSTHARVEST GDP	FISHERIES GDP	AQUACULTURE INCLUDED	COMMENT ON FISHERIES GDP CALCULATION	YEAR	SOURCE
Comoros	15.00	n.a.	n.a.	n.a.	Gross value of fisheries output as % of GDP	?	SWIOFC 2006[b]
Congo, Republic of	1.39	1.36	2.75	n.a.	SFLP method (see note)	2003?	FAO 2008b
Cook Islands	4.16	n.a.	n.a.	2.14	Commercial and subsistence fishing, aquaculture	2007	Gillett 2009
Costa Rica	0.32	n.a.	n.a.	n.a.	No detail on how fishery GDP was calculated	2002	FAO Country Profile
Côte d'Ivoire	0.76	0.76	1.52	n.a.	Includes marketing, processing, handling, sale and repair of canoes, etc.	2002	Kébé and Tallec 2006
Croatia	0.23	n.a.	n.a.	n.a.	Catch value only	2004	FAO Country Profile
Cyprus	0.24	n.a.	n.a.	n.a.	No detail on how fishery GDP was calculated	2004	FAO Country Profile
Czech Republic	0.03	n.a.	n.a.	n.a.	The role of fisheries is rather marginal. No detail on how GDP was calculated	2004	FAO Country Profile
Denmark	0.13	0.22	0.35	n.a.	n.a.	2005	Statistics Denmark[a]
Djibouti	0.10	n.a.	n.a.	n.a.	Contribution of fisheries to GDP less than 0.1%	2001?	FAO Country Profile
Dominica	1.77	n.a.	n.a.	n.a.	No detail on how fishery GDP was calculated	1994	CRFM website
Dominican Republic	0.01	n.a.	n.a.	n.a.	No detail on how fishery GDP was calculated	2005	FAO Country Profile
Eritrea	2.30	n.a.	n.a.	n.a.	GDP contribution includes value of production only	2002	WB 2004; Fisheries ESW[c]
Ethiopia	0.00	n.a.	n.a.	n.a.	Contribution of fisheries to GDP is marginal	2001	FAO Country Profile
Fiji Islands	1.38	n.a.	n.a.	0.02	Commercial and subsistence fishing, aquaculture	2007	Gillett 2009
Finland	0.10	0.02	n.a.	n.a.	n.a.	2000	Eurostat 2006
France	0.07	0.04	n.a.	n.a.	n.a.	2003?	Westlund personal communication February 2010.
French Polynesia	1.10	n.a.	n.a.	n.a.	SFLP method (see note)	2001	SFLP
Gabon	0.76	0.75	1.51	n.a.	Includes marketing, processing, handling, sale and repair of canoes, etc.	2002	Kébé and Tallec 2006
Gambia	1.75	3.95	5.70	n.a.	Includes marketing, processing, handling, sale and repair of canoes, etc.	2002	Kébé and Tallec 2006
Georgia	1.10	n.a.	n.a.	n.a.	No detail on how fishery GDP was calculated	2003	FAO Country Profile
Germany	0.02	0.02	0.04	n.a.	Value of fishery production only	2005	Eurostat 2006
Ghana	8.00	1.70	9.70	n.a.	Processing included; marketing and other postharvest activities excluded	2006	Eurostat 2006

TABLE A.3: Base Data and Data Sources Used to Estimate Extended Fisheries Sector GDP (continued)

COUNTRY	FISHING GDP (MILLION USD)	POSTHARVEST GDP	FISHERIES GDP	AQUACULTURE INCLUDED	COMMENT ON FISHERIES GDP CALCULATION	YEAR	SOURCE
Greece	0.35	0.07	0.42	n.a.	Value of primary production only; 0.42% from Eurostat (2006)	2003	FAO Country Profile
Grenada	1.83	n.a.	n.a.	n.a.	No detail on how fishery GDP was calculated	1994	CRFM website
Guinea	1.80	n.a.	n.a.	n.a.	Includes marketing, processing, handling, sale and repair of canoes, etc.	2002	Kébé and Tallec 2006
Guinea Bissau	3.70	n.a.	n.a.	n.a.	No detail on how fishery GDP was calculated	1999	FAO Country Profile
Guyana	2.80	n.a.	n.a.	n.a.	Primary (harvest) subsector only	2004	FAO Country Profile
Haiti	2.50	n.a.	n.a.	n.a.	No detail on how fishery GDP was calculated	?	UNLOS 2008
Iceland	5.00	2.00	7.00	n.a.	Includes both fishing and fish processing	2007	Hall, Heidarsson, and Saevaldsson, no date
India	1.07	n.a.	n.a.	n.a.	GDP based on price of fish in 2003–04	2003–04	FAO Country Profile
Indonesia	2.40	n.a.	n.a.	n.a.	No detail on how fishery GDP was calculated	2004	FAO Country Profile
Iran, Islamic Republic of	0.23	n.a.	n.a.	n.a.	No detail on how fishery GDP was calculated	2002	FAO Country Profile
Israel	0.06	n.a.	n.a.	n.a.	No detail on how fishery GDP was calculated	2005	FAO Country Profile
Italy	0.10	n.a.	n.a.	n.a.	Processing included; marketing and other postharvest activities excluded		Eurostat 2006
Jamaica	0.50	n.a.	n.a.	n.a.	No detail on how fishery GDP was calculated	2003?	FAO Country Profile
Japan	0.13	n.a.	n.a.	0.07	Value of fisheries production only. Includes aquaculture	2006	MAFF 2010
Jordan	0.01	n.a.	n.a.	n.a.	No detail on how fishery GDP was calculated	2001–02	FAO Country Profile
Kenya	0.50	n.a.	n.a.	n.a.	Production only; value added from various supply chains excluded	2005	FAO Country Profile
Kiribati	21.5	n.a.	n.a.	n.a.	n.a.	2000	FAO Country Profile[b]
Korea, Republic of	1.00	n.a.	n.a.	n.a.	No detail on how fishery GDP was calculated	2000	FAO Country Profile
Kyrgyzstan	1.00	n.a.	n.a.	n.a.	No detail on how fishery GDP was calculated	2006	FAO Country Profile
Laos	6.80	n.a.	n.a.	n.a.	No detail on how fishery GDP was calculated	2005	FAO Country Profile
Latvia	1.15	n.a.	n.a.	n.a.	No detail on how fishery GDP was calculated	2003	FAO Country Profile
Lesotho	0.00	n.a.	n.a.	n.a.	Currently no significant economic role	2007	FAO Country Profile
Liberia	4.00	n.a.	n.a.	n.a.	No detail on how fishery GDP was calculated	2005	FAO Country Profile

TABLE A.3: Base Data and Data Sources Used to Estimate Extended Fisheries Sector GDP (continued)

COUNTRY	FISHING GDP (MILLION USD)	POSTHARVEST GDP	FISHERIES GDP	AQUACULTURE INCLUDED	COMMENT ON FISHERIES GDP CALCULATION	YEAR	SOURCE
Madagascar	5.46	n.a.	n.a.	1.54	Includes aquaculture. Unclear whether processing and marketing is included	2006?	FAO Country Profile
Malawi	4.00	n.a.	n.a.	n.a.	No detail on how fishery GDP was calculated	2003	FAO Country Profile
Malaysia	1.73	n.a.	n.a.	n.a.	GDP based on total value of fish landings in 2004	2004	FAO Country Profile
Maldives	4.50	n.a.	n.a.	n.a.	Includes fish processing	2007	Global Edge 2010
Mali	4.50	n.a.	n.a.	n.a.	SFLP method (see note)	2002?	FAO 2008b
Malta	0.16	n.a.	n.a.	n.a.	Catch value only	2004	FAO Country Profile
Marshall Islands	26.65	n.a.	n.a.	0.05	Commercial and subsistence fishing, aquaculture	2007	Gillett 2009
Mauritania	4.50	n.a.	n.a.	n.a.	SFLP method (see note)	2006?	FAO 2008b
Mauritius	1.00	n.a.	n.a.	n.a.	No detail on how fishery GDP was calculated	2004	FAO Country Profile
Mexico	0.80	n.a.	n.a.	n.a.	No detail on how fishery GDP was calculated	2001	FAO Country Profile
Micronesia, Federal States of	9.53	2.23	11.76	0.01	Commercial and subsistence fishing, aquaculture	2006	Gillett 2009
Morocco	2.50	n.a.	n.a.	n.a.	No detail on how fishery GDP was calculated	2005	FAO Country Profile
Mozambique	4.00	n.a.	n.a.	n.a.	No detail on how fishery GDP was calculated	2006	FAO Country Profile
Namibia	2.97	0.83	3.80	n.a.	n.a.	2006	Bank of Namibia Qu. Rep. 2007[c]
Netherlands	0.07	n.a.	n.a.	n.a.	Processing included, but marketing and other postharvest not included	2006	Eurostat 2006
New Zealand	0.25	n.a.	n.a.	n.a.	Includes manufacturing; excludes downstream	2006	MAF 2006
Nigeria	1.55	n.a.	n.a.	n.a.	Capture and aquaculture production value only (2000–05 average)	2000–05	FAO Country Profile
Norway	0.30	n.a.	n.a.	0.10	Fishing and farming of all commercial fishing for fish, sharks, mollusks, and crustaceans	2008	Statistics Norway 2008
Oman	0.60	n.a.	n.a.	n.a.	GDP based on total value of fish landings in 2004	2005	FAO Country Profile
Palau	6.08	n.a.	n.a.	0.02	Commercial and subsistence fishing, aquaculture	2006	Gillett 2009
Papua New Guinea	3.09	n.a.	n.a.	0.01	Commercial and subsistence fishing, aquaculture	2006	Gillett 2009
Peru	1.98	n.a.	n.a.	n.a.	No detail on how fishery GDP was calculated	2002	FAO Country Profile
Philippines	2.20	n.a.	n.a.	n.a.	GDP based on total value of fish landings in 2003	2002	FAO Country Profile
Poland	0.01	n.a.	n.a.	n.a.	Harvesting only. Share in national GDP is almost negligible	2005	FAO Country Profile
Portugal	0.22	n.a.	n.a.	n.a.	Processing included; marketing and other postharvest activities excluded	2006	Eurostat 2006

TABLE A.3: Base Data and Data Sources Used to Estimate Extended Fisheries Sector GDP (continued)

COUNTRY	FISHING GDP (MILLION USD)	POSTHARVEST GDP	FISHERIES GDP	AQUACULTURE INCLUDED	COMMENT ON FISHERIES GDP CALCULATION	YEAR	SOURCE
Qatar	0.10	n.a.	n.a.	n.a.	No detail on how fishery GDP was calculated	2001–02	FAO Country Profile
Romania	0.00	n.a.	n.a.	n.a.	Sector makes a marginal contribution to GDP	2002	FAO Country Profile
Russian Federation	0.30	n.a.	n.a.	n.a.	Value of fishery production only	2006	FAO Country Profile
Rwanda	0.33	n.a.	n.a.	n.a.	No detail on how fishery GDP was calculated	2004?	FAO Country Profile
Saint Kitts and Nevis	0.84	n.a.	n.a.	n.a.	No detail on how fishery GDP was calculated	2005	FAO Country Profile
Saint Lucia	1.50	n.a.	n.a.	n.a.	No detail on how fishery GDP was calculated	2001	CRFM website
Saint Vincent/ Grenadines	2.00	n.a.	n.a.	n.a.	No detail on how fishery GDP was calculated	1999	FAO Country Profile
Samoa	6.20	n.a.	n.a.	0.00	Commercial and subsistence fishing, aquaculture	2007	Gillett 2009
Sao Tome and Principe	5.20	0.60	5.80	n.a.	SFLP method (see note)	2002?	FAO 2008b
Senegal	1.81	2.29	4.10	n.a.	SFLP method (see note)	2003	FAO 2008b
Seychelles	30.00	n.a.	n.a.	n.a.	n.a.	2005	Seychelles Strategy 2007
Sierra Leone	9.40	n.a.	n.a.	n.a.	No detail on how fishery GDP was calculated	2006	FAO Country Profile
Solomon Islands	6.19	n.a.	n.a.	0.01	Commercial and subsistence fishing, aquaculture	2007	Gillett 2009
Somalia	2.00	n.a.	n.a.	n.a.	No detail on how fishery GDP was calculated	1990	FAO Country Profile
South Africa	1.00	n.a.	n.a.	n.a.	No detail on how fishery GDP was calculated	2002	FAO Country Profile
Spain	0.17	n.a.	n.a.	n.a.	Processing included; marketing and other postharvest activities excluded	2006	Eurostat 2006
Sri Lanka	2.00	n.a.	n.a.	n.a.	No detail on how fishery GDP was calculated	2004	FAO Country Profile
Sudan	0.00	n.a.	n.a.	n.a.	The contribution of fisheries to GDP is marginal	2006	FAO Country Profile
Suriname	4.00	n.a.	n.a.	n.a.	No detail on how fishery GDP was calculated	?	UNLOS 2008
Swaziland	0.00	n.a.	n.a.	n.a.	Fishing does not play a significant economic role	2003	FAO Country Profile
Sweden	0.02	0.03	0.06	n.a.	n.a.	?	Lena Westlund (personal communication, February 2010)
Taiwan	0.54	n.a.	n.a.	n.a.	Overseas Fisheries Development Council, Republic of China	2003	
Tanzania	2.70	n.a.	n.a.	n.a.	No detail on how fishery GDP was calculated	2000	Wilson 2004

TABLE A.3: Base Data and Data Sources Used to Estimate Extended Fisheries Sector GDP (continued)

COUNTRY	FISHING GDP (MILLION USD)	POSTHARVEST GDP	FISHERIES GDP	AQUACULTURE INCLUDED	COMMENT ON FISHERIES GDP CALCULATION	YEAR	SOURCE
Thailand	1.90	n.a.	n.a.	n.a.	No detail on how fishery GDP was calculated	1996	FAO Country Profile
Togo	4.00	n.a.	n.a.	n.a.	Harvesting subsector only	2005	FAO Country Profile
Tonga	5.10	n.a.	n.a.	0.00	Commercial and subsistence fishing, aquaculture	2005–06	Gillett 2009
Trinidad and Tobago	0.09	n.a.	n.a.	n.a.	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	n.a.	Commercial and subsistence fishing. No aquaculture	2002	Gillett 2009
Uganda	3.00	9.00	12.00	n.a.	Includes trade sector. Official figure of 2.4% assumed undervalued	2002	Banks 2003
United Kingdom	0.04	n.a.	n.a.	n.a.	Processing included; marketing and other postharvest activities excluded	2006	Eurostat 2006
United States	0.30	0.27	0.57	n.a.	n.a.	2006	unstat.org
Vanuatu	1.67	n.a.	n.a.	0.03	Commercial and subsistence fishing, aquaculture	2007	Gillett 2009
Venezuela, Bolivarian Republic of	0.50	n.a.	n.a.	n.a.	No detail on how fishery GDP was calculated	2002	FAO Country Profile
Vietnam	4.00	n.a.	n.a.	5.78	Direct production value only	2005	Van Trong
Zambia	0.42	n.a.	n.a.	n.a.	GDP based on contribution from capture fishery alone	2005	FAO Country Profile
Zimbabwe	0.00	n.a.	n.a.	n.a.	Fish production is not a major contributor to GDP	2004	FAO Country Profile

Note: Unadjusted values with respect to the economic contribution of aquaculture.
[a] http://www.statistikbanken.dk/statbank5a/default.asp?w=1280.
[b] Lena Westlund (personal communication). February 2010.
[c] http://www.tradedirectory.com.na/documents/sbn5.pdf.

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TABLE A.4: Estimated Extended Fisheries Sector GDP (proportion and $ millions)

COUNTRY	GDP IN 2007 ($ MILLION)	FISHING GDP (%)	POST-HARVEST GDP (%)	EXTENDED FISHERIES GDP ($ MILLION)
American Samoa	—	0.2%	—	—
Angola	58,547	3.0%	—	3,100
Anguilla	109	2.6%	—	5
Antigua Barbuda	1,026	1.5%	—	27
Bahamas	6,586	1.4%	—	163
Bangladesh	67,694	2.3%	—	2,798
Barbados	3,430	1.0%	—	61
Belgium	448,560	0.0%	—	—
Belize	1,274	2.8%	—	63
Benin	5,428	1.8%	1.2%	163
Botswana	11,781	0.0%	—	—
Brazil	1,314,170	0.3%	—	7,113
British VI	—	0.7%	—	—
Burkina Faso	6,767	0.2%	0.1%	20
Burundi	974	1.0%	—	17
Cambodia	8,628	9.2%	6.0%	1,314
Cameroon	20,644	0.9%	0.8%	351
Canada	1,326,376	0.2%	0.1%	3,714
Cape Verde	1,434	1.3%	2.7%	56
Chad	7,085	1.3%	—	163
China	3,280,053	0.8%	—	43,764
Chile	169,458	1.3%	—	3,950
Comoros	449	15.0%	—	119
Congo R	7,646	1.4%	1.4%	210
Cook Islands	183	4.2%	—	13
Costa Rica	25,225	0.2%	—	89
Cote d'Ivoire	19,570	0.8%	0.8%	297
Croatia	51,277	0.2%	—	208
Cyprus	21,277	0.2%	—	60
Czech Republic	168,142	0.0%	—	16
Denmark	308,093	0.1%	0.2%	1,078
Djibouti	830	0.1%	—	1
Dominica	328	1.8%	—	10
Dominican Republic	36,686	0.0%	—	6
Eritrea	1,201	2.0%	—	42
Ethiopia	19,395	0.0%	—	—
Fiji	3,433	1.4%	—	84
Finland	246,020	0.1%	—	434
France	2,562,288	0.1%	—	2,279
French Polynesia	5,300	1.0%	—	92
Gabon	10,654	0.8%	0.8%	161

TABLE A.4: Estimated Extended Fisheries Sector GDP (proportion and $ millions) (continued)

COUNTRY	GDP IN 2007 ($ MILLION)	FISHING GDP (%)	POST-HARVEST GDP (%)	EXTENDED FISHERIES GDP ($ MILLION)
Gambia	643	1.8%	4.0%	37
Georgia	10,176	1.1%	—	198
Germany	3,297,233	0.0%	—	1,164
Ghana	15,246	8.0%	1.7%	1,479
Greece	360,031	0.2%	0.1%	897
Grenada	554	1.8%	—	18
Guinea	4,564	1.8%	—	145
Guinea Bissau	357	3.7%	—	23
Guyana	1,044	2.8%	—	52
Haiti	6,137	2.5%	—	271
Iceland	19,510	5.0%	2.0%	1,366
India	1,170,968	0.6%	—	13,313
Indonesia	432,817	1.8%	—	13,906
Iran	270,937	0.2%	—	908
Israel	161,822	0.0%	—	31
Italy	2,107,481	0.1%	—	2,346
Jamaica	10,739	0.4%	—	68
Japan	43,767	0.1%	—	100
Jordan	15,832	0.0%	—	3
Kenya	29,509	0.5%	—	260
Kiribati	87	53.4%	—	82
Korea R	969,795	0.7%	—	11,423
Kyrgyzstan	3,505	0.4%	—	22
Lao	4,008	2.4%	—	170
Latvia	27,154	1.2%	—	551
Lesotho	1,600	0.0%	—	—
Liberia	725	4.0%	—	51
Madagascar	7,326	5.5%	—	706
Malawi	3,552	4.0%	—	251
Malaysia	180,714	1.5%	—	4,798
Maldives	1,049	4.5%	—	83
Mali	6,863	4.5%	—	545
Malta	6,375	0.1%	—	8
Marshall Islands	163	26.7%	—	77
Mauritania	2,644	4.5%	—	210
Mauritius	6,363	1.0%	—	112
Mexico	893,364	0.8%	—	12,614
Micronesia	257	9.4%	2.2%	30
Morocco	73,275	2.5%	—	3,233
Mozambique	7,752	4.0%	—	547
Namibia	6,740	3.0%	0.8%	256

TABLE A.4: Estimated Extended Fisheries Sector GDP (proportion and $ millions) (continued)

COUNTRY	GDP IN 2007 ($ MILLION)	FISHING GDP (%)	POST-HARVEST GDP (%)	EXTENDED FISHERIES GDP ($ MILLION)
Nauru	28	2.1%	—	1
Netherlands	754,203	0.1%	—	825
New Zealand	129,372	0.2%	—	488
Nigeria	165,690	1.4%	—	4,184
Niue	—	4.2%	—	—
Norway	381,951	0.3%	—	2,022
Oman	35,729	0.6%	—	378
Palau	164	6.1%	—	18
Papua New Guinea	6,261	3.1%	—	341
Peru	109,088	2.0%	—	3,812
Philippines	144,129	1.3%	—	3,305
Poland	420,321	0.0%	—	31
Portugal	—	0.2%	—	—
Qatar	42,463	0.1%	—	75
Romania	165,980	0.0%	—	—
Russia	1,291,011	0.3%	—	6,836
Rwanda	3,320	0.3%	—	19
Saint Kitts	527	0.8%	—	8
Saint Lucia	958	1.5%	—	25
Saint Vincent	553	2.0%	—	20
Samoa	482	6.2%	—	53
SaoTome Principe	145	5.2%	0.6%	8
Senegal	11,151	2.3%	2.6%	544
Seychelles	728	30.0%	—	385
SierraLeone	1,672	9.4%	—	277
Solomon Islands	369	6.2%	—	40
Somalia	2,532	2.0%	—	89
South Africa	277,581	1.0%	—	4,899
Spain	1,429,226	0.1%	—	3,373
SriLanka	32,354	2.0%	—	1,142
Sudan	47,632	0.0%	—	—
Suriname	2,241	4.0%	—	158
Swaziland	2,942	0.0%	—	—
Sweden	444,443	0.0%	0.0%	222
Tanzania	16,181	2.7%	—	771
Thailand	245,818	1.4%	—	6,068
Togo	2,493	4.0%	—	176
Tonga	231	5.1%	—	21
Trinidad Tobago	19,982	0.1%	—	32
Turkey	657,091	0.2%	—	2,551
Tuvalu	27	8.2%	—	4

TABLE A.4: Estimated Extended Fisheries Sector GDP (proportion and $ millions) (continued)

COUNTRY	GDP IN 2007 ($ MILLION)	FISHING GDP (%)	POST-HARVEST GDP (%)	EXTENDED FISHERIES GDP ($ MILLION)
Uganda	11,214	2.9%	9.0%	1,336
United Kingdom	2,727,806	0.0%	—	1,666
United States	14,093,310	0.3%	0.3%	76,366
Vanuatu	452	0.5%	—	4
Venezuela	228,071	0.5%	—	2,013
Viet Nam	71,216	4.0%	—	5,028
Zambia	11,363	0.4%	—	84
Zimbabwe	3,418	0.0%	—	—
				274,099

Source: Authors, based on data from Tables A.1–A.3.
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 aquacultre production.

TABLE A.5: Fisheries Sector Multipliers

COUNTRY/ LOCATION	SOURCES	YEAR	MARINE INDUSTRY	OUTPUT		EMPLOYMENT		VALUE ADDED		INCOME	
			MULTIPLIER TYPE (I/II)	I	II	I	II	I	II	I	II
Australia	Allen Consulting Group 2004	1996–97	Marine tourism	2.50	n.a.	2.37	n.a.	n.a.	n.a.	n.a.	n.a.
Australia	Allen Consulting Group 2004	1996–97	Fisheries and seafood	2.27	n.a.	2.19	n.a.	n.a.	n.a.	n.a.	n.a.
Queensland	KPMG Consulting	1994–95	Commercial fishing	1.60	n.a.	1.74	n.a.	n.a.	n.a.	n.a.	n.a.
Queensland	KPMG Consulting	1994–95	Recreational fishing / boating	2.10	n.a.	1.74	n.a.	n.a.	n.a.	n.a.	n.a.
Canada	Fisheries and Oceans Canada	2006	Traditional fishery	n.a.	n.a.	n.a.	n.a.	n.a.	0.66	n.a.	n.a.
Canada	Fisheries and Oceans Canada	2006	Fish processing	n.a.	n.a.	n.a.	n.a.	n.a.	0.79	n.a.	n.a.
Canada	Fisheries and Oceans Canada	2006	Ocean-related tourism	n.a.	n.a.	n.a.	n.a.	n.a.	0.83	n.a.	n.a.
Newfoundland/ Labrador	Pinfold 2009	2006	Fishing	n.a.	n.a.	5.71	7.10	0.55	0.67	n.a.	n.a.
Newfoundland/ Labrador	Pinfold 2009	2006	Fish processing	n.a.	n.a.	9.94	12.03	0.58	0.61	n.a.	n.a.
Newfoundland/ Labrador	Pinfold 2009	2006	Marine tourism	n.a.	n.a.	17.00	20.57	0.70	0.85	n.a.	n.a.
Nova Scotia	Pinfold 2009	2006	Fishing	n.a.	n.a.	9.23	11.54	0.64	0.81	n.a.	n.a.
Nova Scotia	Pinfold 2009	2006	Fish processing	n.a.	n.a.	12.50	15.63	0.53	0.67	n.a.	n.a.
Nova Scotia	Pinfold 2009	2006	Marine tourism	n.a.	n.a.	19.00	23.75	0.67	0.84	n.a.	n.a.
New Brunswick	Pinfold 2009	2006	Fishing	n.a.	n.a.	11.74	14.79	0.78	0.96	n.a.	n.a.
New Brunswick	Pinfold 2009	2006	Fish processing	n.a.	n.a.	6.36	8.01	0.33	0.40	n.a.	n.a.
New Brunswick	Pinfold 2009	2006	Marine tourism	n.a.	n.a.	21.00	26.72	0.60	0.74	n.a.	n.a.
Prince Edward Island	Pinfold 2009	2006	Fishing	n.a.	n.a.	7.64	9.70	0.69	0.83	n.a.	n.a.

TABLE A.5: Fisheries Sector Multipliers (continued)

COUNTRY/ LOCATION	SOURCES	YEAR	MARINE INDUSTRY MULTIPLIER TYPE (I/II)	OUTPUT		EMPLOYMENT		VALUE ADDED		INCOME	
				I	II	I	II	I	II	I	II
Prince Edward Island	Pinfold 2009	2006	Fish processing	n.a.	n.a.	14.46	18.36	0.45	0.54	n.a.	n.a.
Prince Edward Island	Pinfold 2009	2006	Marine tourism	n.a.	n.a.	15.00	19.05	0.58	0.70	n.a.	n.a.
Québec	Pinfold 2009	2006	Fishing	n.a.	n.a.	7.80	10.69	0.73	0.98	n.a.	n.a.
Québec	Pinfold 2009	2006	Fish processing	n.a.	n.a.	5.27	7.22	0.43	0.58	n.a.	n.a.
Québec	Pinfold 2009	2006	Marine tourism	n.a.	n.a.	20.00	27.40	0.86	1.15	n.a.	n.a.
British Columbia	Pinfold 2009	2006	Fishing	n.a.	n.a.	3.49	4.57	0.61	0.82	n.a.	n.a.
British Columbia	Pinfold 2009	2006	Fish processing	n.a.	n.a.	8.36	10.95	0.50	0.67	n.a.	n.a.
British Columbia	Pinfold 2009	2006	Marine tourism	n.a.	n.a.	15.00	19.65	0.73	0.98	n.a.	n.a.
Canada	GPOR and SGA	2006	Recreational fishing/ boating	n.a.	2.76	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
United Kingdom	Greig 1999	>1999	Catching	1.82	n.a.	1.44	n.a.	n.a.	n.a.	n.a.	n.a.
United Kingdom	Greig 1999	>1999	Processing	2.14	n.a.	2.72	n.a.	n.a.	n.a.	n.a.	n.a.
England	Seafish 2007	2007	Demersal fishing	2.17	3.35	1.52	2.13	3.16	5.50	n.a.	n.a.
England	Seafish 2007	2007	Shellfish fishing	2.39	3.83	1.32	1.59	6.50	12.34	n.a.	n.a.
England	Seafish 2007	2007	Pelagic fishing	2.35	3.38	2.81	4.32	1.89	2.97	n.a.	n.a.
England	Seafish 2007	2007	Fish processing	2.08	3.65	3.33	6.89	2.39	4.78	n.a.	n.a.
Scotland	Greig 1999	>1999	Catching	1.65	n.a.	1.50	n.a.	n.a.	n.a.	n.a.	n.a.
Scotland	Greig 1999	>1999	Processing	2.26	n.a.	2.64	n.a.	n.a.	n.a.	n.a.	n.a.
Scotland	Robert *et al., 1999*	1999	Sea fishing	1.66	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Scotland	Robert *et al., 1999*	1999	Finfish farming	1.17	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Scotland	Robert *et al., 1999*	1999	Fish processing	1.72	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
United States (Pennsylvania)	Murray and Shields 2004	2004	Steelhead fishery	1.56	n.a.	1.29	n.a.	1.60	n.a.	n.a.	n.a.
United States (Hawaii)	Peterson 2005	1997	Swordfish longline	1.44	1.84	14.64	19.34	n.a.	n.a.	n.a.	n.a.
United States (Hawaii)	Peterson 2005	1997	Small commercial boat	1.49	2.16	49.69	57.39	n.a.	n.a.	n.a.	n.a.
United States (Tennessee)	O'Bara C. 1999	1997	Recreational walleye fishery	2.08	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Southeast Asia	Thia-Eng and Garces 1994	1992	Fishing	n.a.	n.a.	n.a.	n.a.	1.50	n.a.	n.a.	n.a.
Bangladesh	MacFadyen *et al.,* 2001	>2001	Shrimp farming	2.15	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
New Zealand	McDermott Fairgray	1998	Ocean/coastal fishing	1.97	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
New Zealand	n.a.	1998	Inland fishing and fish farming	4.52	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
New Zealand	n.a.	1998	Fish and shellfish processing	3.02	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Taranaki (NZ)	BERL 2007	2006	Commercial fishing	1.37	1.52	1.45	1.67	1.50	1.76	n.a.	n.a.
Taranaki (NZ)	BERL 2007	2006	Seafood processing	1.35	1.45	1.68	1.89	1.46	1.64	n.a.	n.a.
Africa	Dyck and Sumaila 2009	2003	Ocean fishing	2.12	3.88	n.a.	n.a.	n.a.	n.a.	0.3	0.57

TABLE A.5: Fisheries Sector Multipliers (continued)

COUNTRY/ LOCATION	SOURCES	YEAR	MARINE INDUSTRY	OUTPUT		EMPLOYMENT		VALUE ADDED		INCOME	
			MULTIPLIER TYPE (I/II)	I	II	I	II	I	II	I	II
Asia	Dyck and Sumaila 2009	2003	Ocean fishing	1.81	3.33	n.a.	n.a.	n.a.	n.a.	0.27	0.47
Europe	Dyck and Sumaila 2009	2003	Ocean fishing	2.72	5.65	n.a.	n.a.	n.a.	n.a.	0.37	0.81
Latin America and Caribbean	Dyck and Sumaila 2009	2003	Ocean fishing	1.84	3.21	n.a.	n.a.	n.a.	n.a.	0.25	0.45
North America	Dyck and Sumaila 2009	2003	Ocean fishing	3.38	7.98	n.a.	n.a.	n.a.	n.a.	0.49	1.27
Oceania	Dyck and Sumaila 2009	2003	Ocean fishing	2.68	4.99	n.a.	n.a.	n.a.	n.a.	0.34	0.67

Source:

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TABLE A.6: Examples of 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 wholesaling	2.4	2.5	6.2	7.3
United States (Hawaii)	1997	Tuna longline	1.4	1.0	n.a.	n.a.
United States (Hawaii)	1997	Swordfish longline	1.4	1.3	n.a.	n.a.
United States (Hawaii)	1997	Small commercial	1.5	1.3	n.a.	n.a.
United States (Hawaii)	1997	Charter boats	1.5	1.0	n.a.	n.a.
United States (Hawaii)	1997	Recreation boats	2.2	1.0	n.a.	n.a.
United States (Hawaii)	1997	Expense boats	2.3	1.3	n.a.	n.a.

Sources: Finland: Virtanen *et al.* 2003; United States: Cai *et al.* 2005.

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