ISSUES BRIEF | 1890

# Tropical river fisheries valuation: Establishing economic value to guide policy

## KEY MESSAGES

- Freshwater fisheries provide a livelihood safety net and basic food security for many poor people, including women, who have few other economic options
- Because the subsistence value of freshwater fisheries is often not properly accounted for in national income statistics, it is rarely included in policy decisions related to economic development, poverty alleviation, food security, conservation or environmental sustainability
- As modifying aquatic systems to provide water for cities and agriculture often threatens fisheries and the livelihood of many poor, fish-dependent rural communities, decisions about water allocation need to be better informed if the right tradeoffs are to be made
- Existing valuation studies estimate direct use values but rarely indirect use values, let alone non-use values
- Accurately computing the total economic value of most river fisheries is difficult at present, as little data exists on non-use values, and very little data on the value of fisheries themselves are reliable
- The challenge is to devise ways in which developing countries can use new valuation approaches to assist policymaking

## WHAT ARE FRESHWATER FISHERIES WORTH?

Annual fish production from river and other inland fisheries in the tropics is estimated at 5.5 million tons. The catch has a gross market value of US$6 billion, which is equivalent to a fifth of the $29 billion worth of fish annually exported by developing countries.

While broadly illustrating the importance of tropical river fisheries, the statement above relies on fragmented and incomplete data. Beyond the unreliability of the data are other, more methodological challenges. How does one capture the contribution of inland small-scale fisheries

to the food security of remote rural communities? How does one assign values to common resources that are exploited primarily by part-time subsistence fishers as a way to spread part of the risk inherent to rural livelihood?

The WorldFish Center set out to develop a global synthesis on the valuation of tropical river fisheries (Neiland and Béné 2008). The aim was to inform policy decision processes affecting inland fisheries with better appraisals of their value and thereby obtain a better balance of tradeoffs. As a first step, WorldFish commissioned and published five background papers on river fisheries in Latin America, West and Central Africa, southern and East Africa, tropical Asia, and, finally, a focus on the Mekong Basin. The aim was to understand

- the status of current knowledge on the value of tropical river fisheries,
- what is known about the impact of changes in river management,
- the valuation techniques that have been used to date, and
- how these techniques compare.

## THE NEED FOR VALUATION

Freshwater resources underpin the livelihoods of millions of people in developing countries. These aquatic resources, and particularly the small-scale fisheries associated to them, can contribute to poverty alleviation through employment and to economic development by generating wealth for reinvestment. Importantly, they provide a livelihood safety net and basic food security for the rural poor, including women who have few other economic options.

Although many people depend on them, freshwater fisheries receive little attention from governments or international aid organizations, perhaps because they are less commercially important than marine fisheries. As most freshwater fisheries are seasonally variable, fishing is largely part-time and opportunistic — part of a risk-spreading strategy for poor farmers and other households with vulnerable livelihoods. Because the subsistence value of freshwater fisheries is not properly accounted for in national income statistics, it is rarely included in policy decisions related to economic development, poverty alleviation, food security, conservation or environmental sustainability. Weak governance, which limits stakeholder participation and cooperation, and limited institutional capacity, which restricts information flow, contribute to the widespread failure to manage freshwater fisheries effectively. These resources and the benefits that they provide are likely to become increasingly degraded, leading to ever more competition and conflict between resource users, and deepening rural poverty.

*Freshwater fisheries provide a livelihood safety net and basic food security for many poor people.*

*Annual fish production from river and other inland fisheries in the tropics is estimated at 5.5 million tons. The catch has a gross market value of US$6 billion, which is equivalent to a fifth of the $29 billion worth of fish annually exported by developing countries.*

If the economic value of these aquatic resources were to receive due recognition and were better integrated in national policymaking, declines might be halted and even reversed.

Governments and international development agencies increasingly recognize that inland fisheries provide a wide range of economic and social benefits. River and floodplain fisheries have been shown to underpin the livelihoods of many millions of people. And new valuation techniques are starting to emerge. Meanwhile, demand for inland water resources is growing for a wide range of uses other than fishing, including hydroelectric power generation, crop irrigation and manufacturing.

Modifying aquatic systems to provide water for cities and agriculture may threaten fisheries and thus the livelihood of many poor, fish-dependent rural communities. Decisions about water allocation need to be better informed if the right tradeoffs are to be made. The contributions that the goods and services that aquatic ecosystems make to food security, local livelihoods, and local and national economies must be properly valuated if they are to guide water allocation schemes designed to maximize these values. Accurate valuation is the foundation of fair compensation for lost fishery production.

## THE CHALLENGES OF VALUATION

Valuation techniques for goods and services derived from natural resources are relatively recent developments, and gaps persist in our knowledge of how freshwater fisheries contribute to local livelihoods and economies. Information is lacking on how dams and water abstraction schemes affect fisheries. While many dam evaluations have found changes in river catches, or in the diversity of fish stocks, few studies attach numbers to these assertions or attempt to quantify the impact in an economic or monetary sense. Studies typically report the value of relocation grants given to affected households, which cover only the cost of building a new house and sometimes lost earnings. Relocation grants are a poor proxy for the economic impact of dams on fisheries because fishers have little bargaining power.

Quantifying catches is a challenge because reliable statistics are often unavailable. Fishery studies are typically based on data from a single year or less. Because they rarely take inter-annual variability into account, they cannot accurately assess sustainability.

Official statistics routinely underestimate inland fisheries. While a recent study found that 39% of households on the floodplains of the Tonle Sap — a river, lake and floodplain system attached to the Mekong River — are primarily engaged in fishing, the official population census of 1998 claimed that only 5.7% of Tonle Sap floodplain residents were involved in fishing. This gross underestimation occurred because the census recorded only primary occupations, and so completely overlooked subsistence fishing and farmers' part-time fishing, the latter a critical source not only of food but also cash.

The challenge is, therefore, to devise ways in which developing countries can use new valuation approaches to assist policymaking. What information do policymakers need? What methods can generate this information? What institutional capacities are needed to successfully apply valuation methods?

## VALUATION METHODOLOGIES

The three main valuation techniques are (1) conventional economic valuation using, for example, household surveys as the bases for undertaking economic cost-benefit analysis; (2) economic impact assessment, through monitoring fish markets to estimate output volume and value based on prices; and (3) socioeconomic and livelihood analysis through, for example, participatory rural appraisal techniques such as wealth ranking.

The authors of the background paper on West and Central Africa compared the methods in terms of how easily they are applied, the utility of the information produced, and cost-effectiveness. Economic impact assessment was found to be the best overall, as it requires relatively little data and no formal sampling. It has good potential for replicability and scaling-up and requires comparatively little time for processing data. Demands on local capacity are modest, and expertise may be strengthened quickly with relatively simple training.

**Box 1: Framework for valuation**

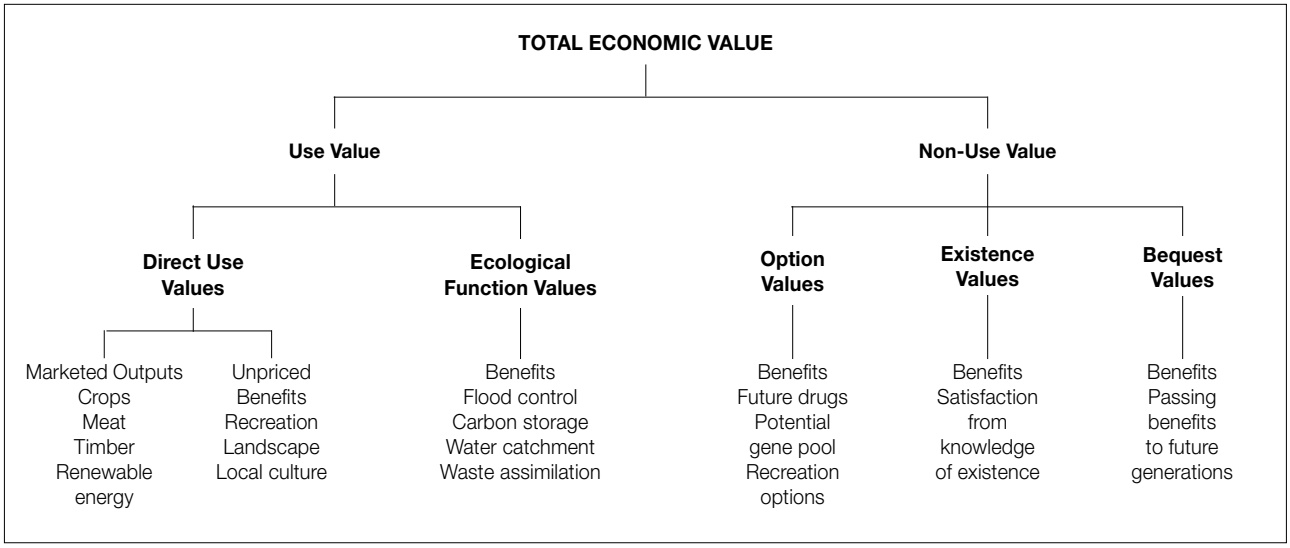
1. Choose an appropriate general assessment approach within which to apply valuation methods.
2. Define the scope and limits of the valuation and information needs.
   a. Indicate geographic and analytical boundaries.
   b. Draw up a timeframe.
   c. Identify the basic characteristics of the area in terms of structural components and functions, as well as such attributes as biodiversity and cultural uniqueness.
   d. Determine the type of value associated with each characteristic, such as direct consumptive use value.
   e. Rank the major characteristics and values in terms of relevance to the study or contribution to overall value.
   f. Tackle the most important values first and the least important ones only if it becomes necessary.
3. Define data-collection methods and valuation techniques.

Source: Barbier 1994.

## CAN VALUATION BE MORE EFFICIENT AND RAPID?

The authors of the study on southern and East Africa observed that most valuation studies require at least 2 months. Lead researchers undertake a reconnaissance visit to understand the fishery, its heterogeneity and its fishers, as well as to meet community representatives. Focus groups and key informant interviews guide the design of the household survey. Enumerators are selected and trained, questionnaires and enumerators are tested in the field, and refinements are made before the survey is carried out. The actual survey can be completed quickly if several enumerators are used and travel around the study area is easy. Data must then be entered, checked and analyzed, which can be immensely time consuming if the survey was badly designed.

**Figure 1: Total economic value and its components**




Source: Hodge 1995.

Valuation estimates can be made more roughly and cheaply using rapid assessment techniques, but probably with some tradeoffs regarding accuracy. In relatively homogeneous areas, sample sizes can be small. Remarkably little variation in household livelihood strategies and fishery values is evident among communities in different wetland systems in southern and East Africa. Benefits transfer, where researchers simply apply the results of earlier studies to similar areas, may therefore be appropriate. However, benefits transfer requires making assumptions about people's preferences and socioeconomic situation, which should not be done lightly. Baseline fishery valuation studies should probably be more intensive in the future, with rapid evaluations carried out only later for monitoring.

## TOTAL ECONOMIC VALUE

River basins offer a wide spectrum of goods and services, ranging from the harvest of timber, medicinal plants, and terrestrial and aquatic wildlife, to biodiversity prospecting and on to non-extractive options such

**Box 2: To Valuate or Not to Valuate?**

Valuation makes tangible a resource's worth to society and facilitates informed choices. If the initial value of a resource is undetermined, the resulting costs or benefits of any alteration cannot be quantified. Assigning economic value to environmental assets allows their rate of consumption to be measured. When environmental impacts are priced, they carry more weight with decision makers, who can set the data alongside other quantitative information and make better decisions.

Despite substantial improvement over the past 2 decades in techniques for environmental valuation, critics still exist against both the principle and the practice. Placing a monetary value on intangibles like the importance of species diversity or the value of life is not without problems. If objectivity is lacking, valuation ends up being used to justify any desired outcome. And accurately deriving economic value requires precise economic, scientific and technical data that are notoriously scarce in developing countries, and costly and time consuming to obtain.

Finally, valuation techniques from developed temperate countries may not be directly applicable to tropical regions and ecosystems. The use and non-use values of wetlands, for example, differ between tropical and temperate zones. Whereas tropical wetlands are directly exploited by subsistence fishers, hunters and firewood collectors, temperate wetlands are primarily used for recreation or tourism.

*Because the subsistence value of freshwater fisheries is not properly accounted for in national income statistics, it is rarely included in policy decisions related to economic development or environmental sustainability.*

as ecotourism, scientific research and carbon sequestration. Total economic value (TEV) combines these use values and non-use values (Figure 1).

Marketed use values include the capture of food fish for market and ornamental fish for export. The most notable non-fishery marketed use value is hydroelectric power. Backward linkages in fisheries include boat and gear manufacture, and forward linkages processing and marketing. Unpriced benefits include fish caught for home consumption, as bait, or for recreation and sport. Further major use values are water abstractions for irrigation or domestic use. While river basins afford a number of ecological, or indirect, use values such as flood control, the indirect benefits specific to fisheries relate principally to how species diversity supports the stability and resilience of aquatic ecosystems.

Non-use values are resources that reside unexploited in the riparian environment, to conserve them either for the time being (option value), for the benefit of future generations (bequest value), or simply because they are there (existence value). Existence value may seem nebulous in economic terms, but international organizations such as the Rainforest Alliance and Save the Whale explicitly use existence value to solicit substantial contributions.

Existing studies estimate direct use values but rarely indirect use values, let alone non-use values. A thorough assessment of river fisheries' TEV would aggregate all. As many of these values, particularly non-use ones, remain unpriced, appropriate evaluation techniques must be applied. Failure to account for the value of both the fishery and the surrounding ecosystem seriously undervalues the resource. Accurately computing a TEV for most river fisheries is difficult as little data exists on non-use values and very little data on the value of the fisheries themselves are reliable.

## OPTIMAL SUSTAINABLE USE

Most valuation studies implicitly assume that the resources are used both sustainably and optimally. Figure 2 shows the optimal sustainable use path (a) yielding the highest value. If the resource is underutilized (b) or depleted by past overutilization (d), the valuation

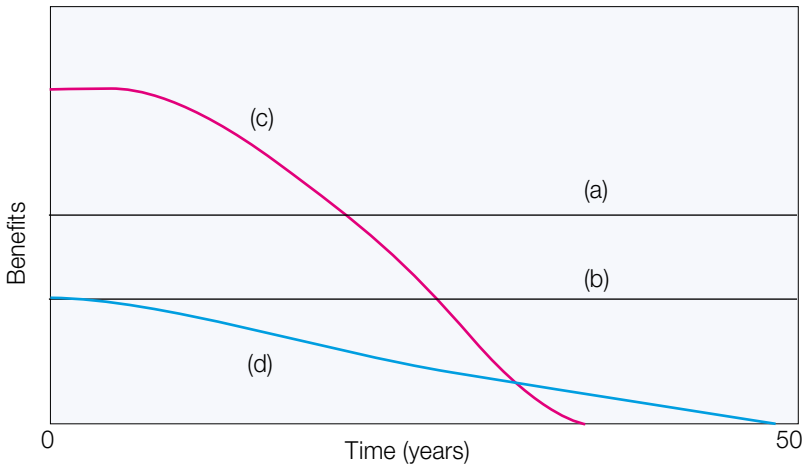



**Figure 2: Hypothetical undiscounted benefit stream**

**(a) = optimal sustainable use,**
**(b) = sustained underexploitation,**
**(c) = early overexploitation,**
**(d) = current overexploitation.**

**Table 1: Inland capture fisheries, aquaculture and total production in tropical Asia in the year 2002**

| Country | Inland capture fisheries (t) | Aquaculture (t) | | Total production (t) | Marine production | % inland to total production |
|---|---|---|---|---|---|---|
| | | Freshwater | Brackishwater | | | |
| Bangladesh | 688 435 | 696 997 | 32 026 | 1 890 459 | 473 001 | 36.4 |
| Bhutan | 300 | 0 | 0 | 300 | 0 | 100 |
| Cambodia | 411 150 | 14 133 | 0 | 425 283 | 0 | 96.9 |
| India | 425 283 | 2 076 734 | 0 | 6 061 366 | 3 559 349 | 7.0 |
| Indonesia | 316 030 | 429 166 | 313 531 | 5 679 391 | 4 620 664 | 5.6 |
| Lao PDR | 33 440 | 59 716 | 0 | 93 156 | 0 | 35.9 |
| Malaysia | 3 572 | 44 370 | 310 | 1 463 625 | 1 415 373 | 0.2 |
| Myanmar | 304 529 | 114 716 | 0 | 1 433 908 | 1 014 663 | 21.2 |
| Philippines | 131 111 | 147 362 | 216 686 | 3 371 874 | 2 876 715 | 3.9 |
| Singapore | 1 058 | 616 | 0 | 7 796 | 6 122 | 13.6 |
| Sri Lanka | 28 130 | 3 670 | 0 | 306 896 | 275 096 | 9.2 |
| Thailand | 205 500 | 327 795 | 98 | 3 566 106 | 3 032 713 | 5.8 |
| Vietnam | 149 200 | 390 000 | 28 000 | 2 042 500 | 1 475 300 | 7.3 |

Source: FAO FISHSTAT (2005)
Note: This table excludes data from China.

exercise is in danger of underestimating its value. If, on the other hand, resource use is assessed during overexploitation (c), the exercise will overestimate its value. Fishery valuation studies must consider the level of use relative to optimal sustainable use to achieve a realistic estimate of net present value. However, determining optimal yield requires detailed biological information that is rarely available.

## FRESHWATER FISHERIES OF ASIA

Asia has some of the world's most productive freshwater fisheries, which contribute significantly to national economies. Inland fisheries provide protein and livelihoods to millions of people, especially the rural poor. However, intensifying competition for water resources, unregulated fishing and high population growth put mounting pressure on these resources.

*As freshwater fisheries are seasonally variable, fishing is largely part-time and opportunistic — part of a risk spreading strategy for poor farmers and other households with vulnerable livelihoods.*

Table 1 shows fishery production in tropical Asia in 2002. Bangladesh has the highest production from inland capture fisheries, but catches are declining as habitats are damaged by water abstraction for irrigation, the construction of embankments for flood control, and siltation caused by deforestation. Excessive and destructive fishing practices are also contributing causes. Excluding landlocked Bhutan, where fishing is marginal, the contribution of inland capture fisheries to total national fish production is highest in Cambodia.

A recurring problem is discrepancy between official statistics and those based on scientific surveys. Table 2 shows official production figures typically lower than those emerging from scientific studies. A likely explanation for the discrepancy is official undercount for lack of field monitoring systems.

Assuming annual production of 300,000-400,000 tons, Cambodia's freshwater capture fisheries rank fourth worldwide, after those of China, Bangladesh and India,

**Table 2: Estimated inland capture fisheries production in the Mekong Basin in 2000, in tons**

| Country | Annual catch based on scientific assessments[1] | Annual catch according to official country statistics[2] |
|---|---|---|
| Cambodia | 289 000 – 431 000 | 245 600 |
| Lao PDR | 27 000 | 29 250 |
| Thailand | 303 000 | 209 404 |
| Vietnam | 190 000 | 161 000 |
| Total | 809 000 – 951 000 | 645 254 |

[1] Van Zalinge et al. 2000; [2] FAO data

**Figure 3: Fish catch per inhabitant in the four biggest inland fisheries**

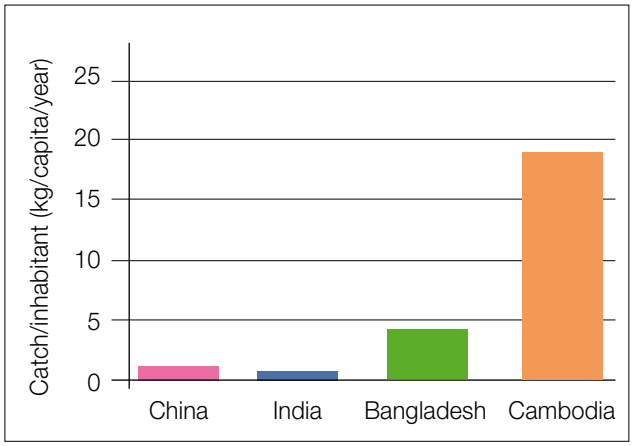



**Figure 4: Map of the Lower Mekong Basin showing major tributaries, large reservoirs and flooded areas**


Source: After Van Zalinge and Thuok 1999.

and may contribute up to 97% of Cambodia's total fish catch. When the catch is divided by population, Cambodia's inland fishery is the most intensive in the world, with 20 kilograms of fish caught per inhabitant per year (Figure 3).

## THE MEKONG BASIN

The Mekong River Commission is a unique cooperation organization in the developing world. Its mandate — agreed in 1995 by Cambodia, Laos, Thailand and Vietnam — is to cooperate in sustainable development, utilization, management and conservation. It must cope with conflicting views, as China sees the Mekong as a source of hydropower and a trade route, Thailand is primarily interested in extracting its waters for irrigation, Cambodia relies heavily on its wild fisheries, and Vietnam values it for irrigating rice paddies and holding back saline intrusion (Figure 4).

Estimates of total fishery production in the Lower Mekong Basin have shifted upwards with new studies, household surveys, and improvements in data collection and analysis. In 1991, reports estimated total production at 357,000 tons, including aquaculture. By 1996, this figure had almost doubled to 620,000 tons. It then increased in 2000 to close to 1 million tons, and again in 2002 to 1.53 million tons, such that the floodplains of the Lower Mekong Basin were reportedly producing four times as much fish per square kilometer as Europe's North Sea. In 2004, the estimates for the Lower Mekong Basin rose to 2.64 million tons from capture fisheries in rivers alone, with an additional 250,000 tons each from reservoir fisheries and aquaculture. This expansion does not reflect periodic variability but the growing appreciation of Mekong fisheries.

Interestingly, declining fish catches have been reported at the same time. In fact, while remaining the most intensive, the catch per fisher has actually decreased in Cambodia, as the population tripled between the 1940s and the 1990s, while the fish harvest only doubled. As the catch per unit of effort or per fisher falls, medium-sized and large species become rare, while small

| Table 3: Baseline scenario profits from water use in million US$ (Ringler 2001) | | | | | | |
|---|---|---|---|---|---|---|
| **Country/region** | **Irrigation** | **Municipal & industrial** | **Hydropower** | **Fisheries** | **Wetlands** | Total |
| Yunnan, PRC | 20 | 11 | | 0.05 | | 31 |
| Lao PDR | 38 | 6 | 33 | 19 | 5 | 101 |
| Thailand | 320 | 65 | 10 | 151 | 4 | 551 |
| N Thailand | 52 | 5 | | 10 | | 68 |
| NE Thailand | 268 | 60 | 10 | 141 | 4 | 483 |
| Cambodia | 26 | 7 | 7 | 188 | 80 | 301 |
| Vietnam | 513 | 81 | | 188 | 44 | 825 |
| VN, Central Highlands | 29 | 6 | | | | 35 |
| VN, Mekong Delta | 484 | 75 | | 188 | 44 | 790 |
| Total basin | 917 | 170 | 43 | 546 | 134 | 1,809 |

N = north, NE = northeast, PDR = People's Democratic Republic, PRC = People's Republic of China, VN = Vietnam.
Source: Ringler 2001

species of low market but high nutritional value become more abundant.

Various sources value annual inland Mekong fish production — from rivers, reservoirs and aquaculture — from 2002 to 2004 at $1,500 to $2,000 million, with riverine capture fisheries accounting for some two thirds. Aquaculture is closely linked with capture fisheries in the Lower Mekong Basin, as it depends heavily on captured larvae and fry. In Cambodia, farmed fish are mainly captured fish grown in cages, and the feed for valuable carnivorous cultured species is other wild species of lesser value.

Fish is vital to food security in the Lower Mekong Basin, where consumption is estimated at 2 million tons per year, and per capita consumption at a very high 36 kilograms/person/year. Small fish and fish products provide dietary calcium in the same way that milk does in the West. One hundred grams of small dried fish eaten whole (including calcium-rich bones) provides more than 1,000 milligrams of calcium, or more than half again a child's daily need.

Several factors make the future of Mekong fisheries uncertain. While demand for fish in the basin is expected to grow by a fifth in the next decade, fish habitats are threatened by barriers to fish migration such as dams, the conversion of floodplains into farms and urban areas, and changes in natural flow regimes caused by dams and irrigation.

The average wet season discharge — which is 85-90% of the annual total — was at least 10% lower in the 2 decades to 1998 than during 1924-56, and inter-annual variation has increased. The downward trend has been linked to dam building, which started in the late 1950s. In 2003, the Mekong Basin had 13 hydropower dams with a capacity higher than 10 megawatts: two in China on the main river and, on tributaries, five in Laos, four in Thailand and two in Vietnam, for total generation of 4,400 megawatts (15% of the basin's hydropower potential, estimated at 30,000 megawatts). Many more dams are under construction or planned, including at least six in China.

Hydropower dams alter the flow regime and fragment aquatic habitats but do not consume water, unlike the thousands of small irrigation reservoirs and weirs that extract water. Observations of migrating fish in Tonle Sap during 1995-2002 indicate that year-to-year variations in maximum Mekong flood levels strongly

*Cambodia's freshwater capture fisheries rank fourth worldwide, after those of China, Bangladesh and India, and may contribute up to 97% of total national fish catch. When the catch is divided by population, the inland fishery is the most intensive in the world, with 20 kilograms of fish caught per inhabitant per year.*

affect the yield of this fishery, about 40% of which is short-lived opportunistic species. Erratic flow release in 1999 from the Yali dam in Vietnam, on a river flowing down to Cambodia, is estimated to have caused over $2.5 million in lost income for 3,434 households, slashing the monthly income per household by 57%, from $109 to $46.

Finally, the concentration of suspended solids has recently been highlighted as important to the productivity of the Mekong waters. This often-neglected fact may have a huge impact on Tonle Sap fisheries in Cambodia, as more than half of the Mekong's load of suspended solids comes from China, which plans more dams on the Mekong.

Table 3 shows total profits in the Mekong Basin from water use, which were estimated at $ 1.8 billion in 1990. Irrigated agriculture ranked first at $917 million, and fisheries second at $546 million. Vietnam obtained the greatest benefit, chiefly from irrigated agriculture and fish production. Profits from hydropower were largest in Laos. Fish and wetlands were the major water-related income sources in Cambodia. Readers should bear in mind that this is based on data available in 1999, when the total Mekong catch was estimated at 1 million tons, or roughly 40% of recent estimates.

Aquaculture currently supplies only 12% of fish resources in the Mekong Basin — a scant 4% of the fish consumed in Cambodia — and cannot grow quickly without the extensive use of wild fish fry or the introduction of alien species. The priority for the region should therefore be to protect and optimize the huge natural fisheries of the Mekong. Aquaculture may play a significant role in the future, but during the coming decade the emphasis should be on protecting the existing wild fish supply.

| Table 4: Fisheries of the major river basins and lakes in West Africa: economic indicators | | | | | |
|---|---|---|---|---|---|
| | Employment (fishers) | Fisheries production (t/yr) | Value of production (million US$/yr) | Potential fisheries production (t/yr) | Value of potential production (million US$/yr) |
| River basins | | | | | |
| Senegal-Gambia | 25,500 | 30,500 | 16.78 | 112,000 | 61.60 |
| Volta (rivers) | 7,000 | 13,700 | 7.12 | 16,000 | 8.32 |
| Niger-Benue | 64,700 | 236,500 | 94.60 | 205,610 | 82.24 |
| Chad (rivers) | 6,800 | 32,200 | 17.71 | 130,250 | 71.64 |
| Congo-Zaire | 62,000 | 119,500 | 47.80 | 520,000 | 208.00 |
| Atlantic coastal | 6,000 | 30,700 | 46.66 | 118,000 | 179.30 |
| Major lakes | | | | | |
| Volta | 20,000 | 40,000 | 28.40 | 62,000 | 44.02 |
| Chad | 15,000 | 60,000 | 33.00 | 165,000 | 90.75 |
| Kainji | 20,000 | 6,000 | 3.30 | 6,000 | 3.30 |
| TOTAL | 227,000 | 569,100 | 295.17 | 1,334,860 | 749.17 |

t = ton yr = year

| Table 5: West African countries with major inland fisheries: economic indicators | | | | | |
|---|---|---|---|---|---|
| | Fisheries production (t/yr) | Value fish production (million US$/yr) | Fish supply (kg/capita) | Employment (fishers & on-shore) | Fisheries % Agricultural GDP |
| Benin | 34,000 | 29.30 | 9.1 | 75,000 | Low |
| Burkina Faso | 5,000 | 5.80 | 1.4 | 7,000 | Low |
| Cameroon | 50,000 | 36.40 | 9.3 | 65,000 | Low |
| Chad | 100,000 | n.a. | 6.5 | 170,000 | High |
| Gambia | 3,500 | 4.40 | 23.7 | 5,000 | Medium |
| Ghana | 53,000 | 380 | 26.1 | 110,000 | 5% |
| Ivory Coast | 36,000 | 50 | 11.1 | 30,000 | Medium |
| Mali | 100,000 | 350 | 8.5 | 73,000 | 0.94 |
| Niger | 16,000 | n.a. | 0.47 | 2,000 | 1% |
| Nigeria | 130,000 | 180 | 5.8 | 70,000 | <2% |
| Senegal | 60,000 | 350 | 29.9 | 60,400 | 5% ? |
| Sierra Leone | 10,000 | 30 | 12.3 | 16,000 | 1%? |
| TOTAL | 597,500 | 1,415.9 | 11.09 | 667,560 | . |

t = ton yr = year

## FRESHWATER FISHERIES OF AFRICA

With the exception of semi-industrial fisheries in the great lakes of East and southern Africa, most freshwater fisheries on the continent are small-scale and labor-intensive artisanal fisheries. For each of the estimated 840,000 inland fishers, five people are active in such support functions as processing, transport, marketing, and the production and maintenance of boats and gear. The resulting estimate that about 2.5 million people derive income from inland fisheries does not tell the

*Table 6: Estimated annual total net income (including subsistence value) and cash income per household in the Rufiji floodplain and delta in Tanzania, in US$*

| Income per household | Floodplain | | Transition | | Delta | |
|---|---|---|---|---|---|---|
| **Source of income** | **Total net income** | **Cash income** | **Total net income** | **Cash income** | **Total net income** | **Cash income** |
| Crops | 231.81 | 77.61 | 249.99 | 117.03 | 211.99 | 54.82 |
| Livestock | 51.72 | 14.48 | 30.80 | 14.10 | 51.24 | 19.30 |
| Salt | . | . | . | . | 18.47 | 26.01 |
| Clay | 0.11 | 0.08 | 0.05 | . | 1.50 | 1.86 |
| Plants | 54.34 | 7.01 | 46.05 | 18.01 | 42.68 | 15.38 |
| Wood products | 102.85 | 44.55 | 89.34 | 23.31 | 135.63 | 86.56 |
| Fishing | 198.32 | 264.86 | 154.28 | 169.13 | 868.90 | 825.20 |
| Hunting | 0.19 | 0.14 | 9.58 | 3.43 | 1.19 | 0.85 |
| Honey | 1.47 | 0.67 | 1.20 | 0.52 | 1.82 | 1.16 |
| Other | 280.50 | 280.50 | 326.30 | 326.30 | 485.30 | 485.30 |
| TOTAL | 921.32 | 689.91 | 907.59 | 671.83 | 1,818.73 | 1,516.44 |
| % Fishing | 22% | 38% | 17% | 25% | 48% | 54% |

Source: Turple 2000.

whole story, however, as researchers in the Democratic Republic of Congo recently found nine households engaged in part-time and seasonal fishing for each full-time fisher (Béné et al. 2008). In addition, recreational fishing is becoming more popular, especially in South Africa, where angling for trout and bass generates substantial economic activity.

In West and Central Africa, little information exists on the value of river and other inland fisheries, but landings data and local prices allow estimates of gross financial values of fisheries production. The total potential value of fisheries production is $749 million per year in the major river basins of West and Central Africa, while the value of current production is $295 million (Table 4). For countries with major inland fisheries, their total actual value is $1,415 million (Table 5). Case studies have revealed that inland fisheries contribute to regional and local economies and provide important livelihood benefits to households. Other studies have shown that changes in river management regimes can interrupt this flow of benefits. Valuation studies should be undertaken more widely in the region to avoid river fisheries being overlooked or underestimated in the policy process.

As in West and Central Africa, river fisheries in eastern and southern Africa tend to be small-scale, labor intensive and artisanal. They have received little attention because of their limited commercial value, compared with marine and lake fisheries. However, they make important contributions to subsistence income and the risk-spreading strategies of poor rural households (Table 6). One concern is that the capacity of small-scale fisheries to spread risk is being severely reduced by fisheries overexploitation.

## LATIN AMERICA

Central and South American fisheries present some interesting paradoxes. They boast wide biodiversity — an 80% share of the world's known freshwater fish species and three times the flora compared with similar areas in Africa and Asia — and the presence of up to a fifth of the planet's freshwater sources in the Amazon Basin alone. Yet Central and South Americans have never eaten much fish. A recent study found that only 2% of the freshwater fish eaten in Brazil are native species caught in inland waters. Meanwhile, sport

*Most freshwater fisheries on the African continent are small-scale and labor-intensive artisanal fisheries.*

fishing is the favorite pastime of an estimated 6 million Brazilians, and the region is a popular destination for anglers from Europe and North America.

Production potential in Central and South America is theoretically huge. While South America boasts two of the world's largest river basins (the Amazon and the Plate) and the world's largest freshwater wetland (the Pantanal in Brazil), Central and South America account for just 2% of all the freshwater fish caught worldwide.

Unlike in Africa and Asia, where many people depend heavily on fishing for their livelihoods, fishing for a living in the interior of Central and South America remains a marginal occupation for all but the most isolated households. The economics and management of these fisheries have therefore received little attention. Meanwhile, the region's waters and fish species have received considerable attention from taxonomists, biologists and ecologists, and the Amazon has been at the center of the debate regarding the role and importance of biodiversity and the significance of a stable ecosystem for the well-being of the planet.

If freshwater fishing is comparatively insignificant in the region, the rivers themselves are very important. Hydropower supplies 90% of Brazil's electricity. As many of the dams were built before environmental impact assessments became routine, the data needed to compare situations before and after often do not exist.

A study of commercial fishing in the regional economy of the Brazilian Amazon estimated employment within the sector and the gross income and value added it generated in 2001. A fleet of 5,457 vessels carried 29,089 commercial fishers and 49,955 subsistence fishers and delivered 46,269 tons of fish to urban markets. The estimated sectoral income of $160 million was computed by aggregating the assumed income from input supply, fishing, processing and marketing, and services, with fishing and processing and marketing contributing 89%. Meanwhile, the government's most recent agrarian census in 1997 estimated that just 17,742 people worked in fisheries. The authors of the Central and South America fisheries review pointed out that the net present value of the fisheries sector, at $31.62

*River fishing for the ornamental fish trade provides additional income for the rural poor and forms part of a diversified livelihood strategy.*

million or $3,821 per hectare, is almost double the $17 million, or $2,126 per hectare, derived from forestry.

## FUTURE DIRECTIONS

The major outcome of the WorldFish global synthesis on the valuation of tropical river fisheries (Neiland and Béné 2008) is the realization that we have some way to go before reliable estimates of their total economic value will be available to stakeholders. The synthesis highlights the need for further valuation studies of inland fisheries in developing countries. It is vital for policymakers and other stakeholders to understand the importance of these natural resources and make appropriate decisions concerning their role in development policy.

A major constraint to developing information systems and policy processes that incorporate valuation information is limited capacity at all levels of government, as well as in development organizations. Much capacity can be built through short in-country training courses.

Although the value of inland capture fisheries is much better documented in the Mekong Basin than in Africa or South America, the doubtful accuracy and datedness of much of the Mekong data must be addressed. Despite the success of the Mekong River Commission and other fishery partners in strengthening both knowledge and political recognition of the importance of fisheries in the Mekong, much remains to be done to accurately valuate them and better communicate scientific and monitoring results so that fisheries have their proper place in regional planning and the weighting of development options. The same can be said, only more so, for the rest of the tropics, though some studies conducted in parts of Latin America provide examples of the sorts of values to obtain.

One unknown is the value of sport fishing, which is rarely taken seriously as a contributor to local economies. Studies of principal sport fishing venues in Latin America and South Africa could be first steps toward generating a value for recreational freshwater fishing in the tropics.

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