

A bottom-up re-estimation of global fisheries subsidies

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Abstract Using a recently developed database of fisheries subsidies for 148 maritime countries spanning 1989 to the present, total fisheries subsidies for the year 2003 is computed. A key feature of our estimation approach is that it explicitly deals with missing data from official sources, and includes estimates of subsidies to developing country fisheries. Our analysis suggests that global fisheries subsidies for 2003 are between US\$ 25 and 29 billion, which is higher than an earlier World Bank estimate of between US\$ 14–20 billion. This new estimate is lower than our 2000 global subsidies estimate of US\$ 30–34 billion. We find that fuel subsidies compose about 15–30% of total global fishing subsidies, and that capacity enhancing subsidies sum to US\$ 16 billion or about 60% of the total. These results imply that the global community is paying

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the fishing industry billions each year to continue fishing even when it would not be profitable otherwise—effectively funding the over-exploitation of marine resources.

Keywords Overcapacity · Overfishing · World Trade Organization · Fuel subsidies

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1 Introduction

Fishery subsidies are defined here as financial transfers, direct or indirect, from public entities to the fishing sector, which help the sector make more profit than it would otherwise. Subsidies have gained worldwide attention because of their complex relation to trade, ecological sustainability and socioeconomic development. It is widely acknowledged that global fisheries are overcapitalized, resulting in the depletion of fishery resources (Hatcher and Robinson 1999; Munro and Sumaila 2002). Although many reasons have been ascribed to the decline of fishery resources, the role of subsidies to the issue of overcapacity and overfishing cannot be sufficiently emphasized (WWF 2001). The relationship between subsidies, overcapacity and overfishing has been reiterated at the WSSD (2002) in Johannesburg, the Doha 2001 Ministerial Conference (Doha Conference 2001), by the FAO (1995) Code of Conduct for Responsible Fisheries, and in the Millennium Ecosystem Assessment (2005), prompting significant research interests.

Subsidies that enhance revenues or reduces fishing costs lead to a marginal increase in profit, thereby increasing participation and fishing effort (Sumaila 2003). Subsidies that promote fishery resource conservation and management are, however, regarded as beneficial and necessary (Milazzo 1998).

The objectives of this paper are to address the following questions: (i) what types and categories of fishery subsidies are provided worldwide? (ii) what is the present amount and extent of each subsidy type nationally, regionally and globally? and (iii) what proportion of estimated subsidies contribute towards increased fishing capacity?

Previous global estimates of fishery subsidies have ranged from US\$ 14–20 billion (Milazzo 1998) to US\$ 54 billion (FAO 1992). Reports by the Organization for Economic Cooperation and Development (OECD), the WWF, the Asia-Pacific Economic Cooperation (APEC) and the United Nations Environmental Program (UNEP) have also produced significant data on fisheries subsidies. Regional estimates of about US\$ 12 billion have been provided for the Asia Pacific Rim (APEC 2000) and about US\$ 2.5 billion for the North Atlantic (Munro and Sumaila 2002).

A more recent study of global fisheries subsidies estimates the world total to be between US\$ 30 and 34 billion for the year 2000 (Sumaila and Pauly 2006). The work in this paper builds on and improves these estimates by collecting more recent data and improving the methodology, as described later in the paper, for estimating missing data. The current contribution highlights the need for a comprehensive inventory of fishery subsidies both regionally and globally. Policy-makers at the national, regional and global levels are all in need of subsidies data to help them design effective

fisheries management policies that will ensure sustainable use of fishery resources for the benefit of both current and future generations.

2 Subsidies identified and classified

There is no single criterion for classifying fishery subsidies; the various categories (Milazzo 1998; OECD 2000; APEC 2000) mostly overlap depending on the nature of the subsidy and the purpose of classification. The complexity of this issue is based on the fact that there is no single agreement on what a subsidy is or how its effect can be measured. Subsidies, support programs, financial support, economic assistance, and government financial transfers are just five of the most commonly used names for payments that governments provide to the fisheries sector.

The following guidelines are useful in identifying and assessing fisheries subsidies in this paper: (i) policy objective of the subsidy; (ii) the subsidy program descriptions; (iii) scope, coverage and duration; (iv) annual US\$ amounts; (v) sources of funding; (vi) administering authority; (vii) subsidy recipients; and (viii) the mechanisms of transfer (FAO 2003; Westlund 2004).

The criterion for the classification of a subsidy in this study is the potential impact on the sustainability of the fishery resource. The effect of a subsidy, however, depends on the status of the fishery and the management system in place. Given the current dismal state of global fisheries (Pauly et al. 2002), it is hard to argue that these fisheries are currently effectively managed.

Economists have come to regard fishery resources, like all other natural resources, as natural capital (Munro and Sumaila 2002). A set of fishery resources in a particular region, therefore, can be viewed as a portfolio of natural capital assets capable of yielding a stream of economic benefits (both market and non-market) to society through time. If natural capital is renewable then one can, within limits, engage in 'investment' in the natural capital assets, by refraining from fishing and allowing the resource to rebuild to a biological optimum. Similarly, one can also engage in 'disinvestment' in the natural resource, for example, through overfishing. Based on this theory, three broad categories of subsidies are identified: (i) 'beneficial' or 'Good'; (ii) 'capacity-enhancing' or 'bad'; and (iii) 'ambiguous' or 'ugly' subsidies.

2.1 Beneficial subsidies

'Beneficial subsidies' are programs that lead to investment in natural capital assets. They enhance the growth of fish stocks through conservation, and the monitoring of catch rates through control and surveillance measures to achieve maximum long-term sustainable net benefits. Fisheries management programs and services have been questioned on the basis that the services mostly benefits the private sector, and not the public, i.e., the rightful owners of marine resources (WWF 2001; Bromley 2009). However, most countries have justified it as their sovereign right to manage and conserve their marine resources within their EEZs as espoused under the United Nations Convention on the Law of the Sea (UNCLOS 1982). Beneficial subsidies are made up of the following types.

2.1.1 Fisheries management programs and services

These are subsidy programs that ensure publicly-owned fisheries resources are appropriately managed and that regulations are enforced (OECD 2005a). Sub categories include: (a) monitoring, control and surveillance programs; (b) stock assessment and resource surveys; (c) fishery habitat enhancement programs; and (d) stock enhancement programs.

2.1.2 Fishery research and development (R&D)

These are subsidy programs geared towards improving methods for fish catching and processing, and other strategies that enhance the fishery resource base through scientific and technological breakthroughs.

2.1.3 Marine Protected Areas (MPA)

These programs aim to improve stock resilience by setting up and enforcing areas where commercial fishing is prohibited; allowing new generations of juveniles to replenish the resource.

2.2 Capacity-enhancing subsidies

‘Capacity-enhancing subsidies’ are defined as subsidy programs that lead to disinvestments in natural capital assets such that the fishing capacity develops to a point where resource overexploitation makes it impossible to achieve maximum sustainable long-term benefits. The aggregate impact of subsidies that enhance overcapacity and overfishing through artificially increased profits is to further stimulate effort and compound resource overexploitation problems (Milazzo 1998). Capacity-enhancing subsidies include all forms of capital inputs and infrastructure investments from public sources that reduce cost or enhance revenue, including the following types.

2.2.1 Fuel subsidies

Fuel subsidies are defined narrowly here as the difference between the price per litre of fuel paid by fishers and the national price applied to fuel purchases for other uses in a given economy.

Fishing sector fuel subsidies can subvert the workings of the market, and negate the expected conservation value of an increase in fuel prices. In fact, recent events have demonstrated this to be true, as increased fuel prices have led to an increase in fuel subsidies in some countries. For example, in June 2006, the Malaysian government started providing coastal fishers with subsidized petrol at RM1 per litre, a RM0.92 (US\$ 0.25) subsidy.¹ In October 2005, the Spanish government agreed to a 60% increase in fuel subsidies after fishers blockaded several Mediterranean ports in the

¹ <http://www.nst.com.my/>, last accessed March 16th, 2006.

country (PravdaRU 2005).² The preceding cases illustrate that in some instances, the decision to provide fuel subsidies is influenced more by political and social concerns, rather than on the sustainability of fisheries resources (Sumaila et al. 2008).

2.2.2 Boat construction, renewal and modernization programs

These support programs include lending programs below market rate and geared toward fishing vessel construction, renewal and modernization such as loan guarantees, restructuring and other lending programs. They also involve public support programs to adopt new and/or improve fishing technology.

2.2.3 Fishing port construction and renovation programs

These support programs include public funds toward the provision of fish landing site infrastructure, port improvements for fishing fleets (APEC 2000), harbor maintenance, jetty and landing facilities and low or free moorage for fishing fleets.

2.2.4 Price and marketing support, processing and storage infrastructure programs

These are support programs towards market interventions such as value addition and price support. They also include infrastructure investment programs from public funds toward processing and storage of fishery products and fish auction facilities.

2.2.5 Fishery development projects and support services

These are support programs towards fisheries enterprises development. Also included here are support programs such as the provision of institutional support and services, the provision of baits, and search and rescue programs.

Tax exemptions: These are subsidy programs for investment in the fisheries sector that have a direct impact on profits such as rebates and other government-funded insurance support programs including: (a) income tax deferral for fishers; (b) crew insurance (OECD 2004); (c) duty free imports of fishing inputs; (d) vessel insurance programs, and (e) other economic incentive programs.

2.2.6 Foreign access agreements

These entail a combination of one of the following: (a) explicit monetary transfer; (b) the transfer of fishing technology; and (c) the provision of market access in another fishing country (OECD 2005a). Out of these varied combinations, three types of access agreements can be identified worldwide: (i) reciprocal access; (ii) access for trade agreements; and (iii) access fees for third country agreements (Milazzo 1998).

Access payments are in the form of (i) bilateral access such as the EU-ACP agreement, which involve financial compensation and 'trade for access' arrangements;

² http://newsfromrussia.com/world/2005/10/27/66385_.html. Last accessed Nov. 7th, 2006.

(ii) multilateral tuna fisheries access agreements between the USA and seventeen Pacific Island countries; and (iii) Japanese and other far-east distant water fleets from Korea, China and Taiwan who usually fish under private access agreements, joint ventures or payments made in the form of government development aid. Fishing access agreements seek to reconcile trade and development aid, but have contributed little to the development of local fishing industries in recipient states (Milazzo 1998). These arrangements can be of mutual long-term benefit only if effectively enforced and measures are in place to ensure compliance (Atta-Mills et al. 2004). Most of the EU agreements signed with West African states do not contain catch quotas for EU vessels and this usually results in resource overexploitation (Kaczynski and Fluharty 2002). Between 1992 and 2000, EU companies signed 152 joint ventures involving 241 boats, representing about 88,319 Gross Register Tonnage (GRT); these deals were highly subsidized (COFREPECHE 2000).

2.3 Ambiguous subsidies

‘Ambiguous subsidies’ are defined as programs whose impacts are undetermined, i.e., they may lead to either investment or disinvestment in the fishery resource. These subsidy programs can lead to positive impacts such as resource enhancement programs or to negative impacts such as resource overexploitation. Subsidies in this category include controversial fisher assistance programs, vessel buyback programs and rural fisher community development programs.

2.3.1 Fisher assistance programs

These are payments to fishers to stop fishing temporarily or to ensure income during bad times. These subsidies can also be given due to a lack of alternative employment opportunities in regions where fishing is the main activity (OECD 2005b). This subsidy type could be revenue enhancing from government budgets and increase community dependence on government funds; or may reduce fishing pressure through retraining programs into other economic sectors. They include income support programs, unemployment insurance, worker adjustment programs, and fisher retraining, and other direct payments to fishers.

Fisher assistance programs, though applauded for their social welfare objectives in many instances, are also criticized for their role in creating subsidy-dependent communities. The argument against fisher assistance programs is that it encourages fishers to remain in the fishing industry rather than diversify into other economic activities (Schrank 2003). The impact of such subsidies is to artificially raise the price of fish or reduce the cost of fishing (Munro and Sumaila 2002). Subsidy policies that are directed, either implicitly and/or explicitly, at social objectives need to be analyzed to ensure that they do not hamper the effective management of fish stocks (OECD 2005a). Such policies should at least be coherent and mutually supportive for sustainable resource management.

2.3.2 Vessel buyback programs

These are fishing capacity reduction programs including two types: (a) permit buybacks; and (b) license retirements. These subsidies can reduce fishing pressure and foster resource management goals; however their effectiveness has been seriously questioned (Holland et al. 1999; Munro and Sumaila 2002; Clark et al. 2005). These programs, which aim to reduce fishing capacity, are criticized for their ineffectiveness as the fishing capacity usually seeps back into the fishery over time (Holland et al. 1999; Cunningham and Gréboval 2001; Clark et al. 2005). It has also been suggested that buybacks can be beneficial when not anticipated by fishers, but capacity-enhancing when anticipated because fishers will increase their effort in anticipation of a buyout, thereby neutralizing the expected benefits (Munro and Sumaila 2002). Furthermore, there is a fear of 'spillover effects' where vessels move from one fishery to another, either in the high seas or as distant water fleets operating in other EEZs (Munro 1998). For example, it has been reported that vessels decommissioned from the Canadian cod fishery were transferred to Argentinean waters (UNEP 2003). These programs need to be carefully considered; otherwise they will not achieve the goals for which they are created.

2.3.3 Rural fishers' community development programs

These consist of programs that are geared towards rural fisher development with an overall objective of poverty alleviation and food sufficiency. These programs include multiple stakeholder participation within local communities involving cooperatives, with assistance from donor agencies and NGOs for integrated livelihood development policy objectives. Despite such development policy objectives, a number of fisheries development donor consultations³ have concluded that projects concentrated on enhancing productive capacity in developing countries are contributing to overcapacity, and with poor rate of management success (SIFR 1992).

Rural fisher community development programs are a form of fisher assistance that is integrated with livelihood program activities within coastal communities. In several developing countries, excess capacity in the form of human capital or labor is likely to be more significant than capital in the form of vessels, particularly where barriers to labor mobility are commonplace (Clark et al. 2005). This is further exacerbated by an intergenerational shift into fishing activities from other sectors (Tietze et al. 2000), and the lack of access to alternative income generating activities in many coastal communities. Subsidy support programs in such circumstances are regarded as unsustainable if they promote indiscriminate gear use by coastal fishers (CECAF 2000), and/or promote a large excess of rural labor that leads to Malthusian overfishing (Pauly 1997, 2006).

³ <http://www.onefish.org/global/archive/sifar/onefish.htm>, last accessed 12/08/06.

3 Methodology for computing subsidy estimates

3.1 Data collection and compilation

Subsidy information is recorded for 25 fishery non-fuel subsidy types identified in this study⁴ for 148 maritime countries/political entities. Of the countries/political entities under investigation, subsidy information (both qualitative and quantitative) was found for 146 countries ranging from one to all 25 subsidy types identified below. No information regarding fishery subsidies was found for Bosnia-Herzegovina or Gaza Strip and they are assumed not to provide any.

Recognizing that subsidy strategies vary with development goals, maritime countries/political entities are grouped into two categories: developed (Group I) and developing (Group II) countries. The United Nations Human Development Index (HDI), which is a composite index measuring development by considering three basic components of human development: (i) life-expectancy; (ii) education attainment; and (iii) standard of living.⁵ Countries/political entities with HDI scores ranging from 0.80 to 1.00 are classified as Group I, and those with HDI scores from 0.00 to 0.79 are classified as Group II. Recognizing that our definition of developed or developing refers more to fishing capacity than to the country/political entity in general we make a few adjustments to these groupings. The Russian Federation, China and Taiwan are assigned to the developed category based on their level of fishing capacity. Similarly, Trinidad & Tobago, Cuba and Uruguay, whose fisheries sectors are less developed, are assigned to the developing group of countries/political entities.

Data collected and recorded for any given country, year and subsidy type can be (i) quantitative figures; (ii) boolean (true/false) where sources indicate a subsidy program in effect without quantitative estimate; and (iii) blank entries where information for a given country/political entity, year, and subsidy type is not available.

Data is obtained from the following major sources: (a) Organization for Economic Cooperation and Development (OECD 2000, 2004, 2005a,b, 2006); (b) Asian Pacific Economic Cooperation (APEC 2000); (c) European Commission; (d) Food and Agricultural Organization of the United Nations web resources on sections that concern 'aid' and 'international cooperation' under specific country profiles and 'investment' or 'subsidies' under the fisheries management information link for any given country; (e) national fisheries department web links, financial and budgetary reports, and fishery reports and documents; (f) the web resources of the Support for International Fisheries and Aquatic Research, now known as the 'onefish' community directory program; (g) United Nations Environment Program reports (UNEP 2002, 2003, 2004); (h) Global MPA costs database (Cullis-Suzuki and Pauly 2008); (i) regional financial institution portfolios such as the African Development Bank; (j) overseas development project

⁴ These 25 subsidy types are mapped to the eleven categories in the section above. Table 1 in Sect. 4 describes how each of the subsidy types is related to their parent categories.

⁵ <http://hdr.undp.org/en/statistics/>, last accessed 01/12/2008.

Table 1 Mean subsidy intensity estimates used to infer subsidies for countries with missing data

	Developed countries				Developing countries			
	Subsidy intensity	Std. error	Countries reporting	Countries estimated	Subsidy intensity	Std. error	Countries reporting	Countries estimated
Beneficial								
Fisheries management	0.075 ^c	0.026	18	5	0.088	0.048	7	11
Stock assessment	0.003	0.003	3	4	0.002	0.002	3	13
Stock enhancement	0.021	0.011	8	8	0.082	0.055	6	82
Monitoring and control	0.086	0.044	10	6	0.007	0.003	12	7
Other good subsidies	0.043 ^c	0.012	19	4	0.023	0.020	7	7
Fishery R&D	0.028	0.007	19	13	0.059	0.030	12	61
Marine protected areas ^a	0.028	–	–	–	0.040	–	–	–
Capacity-enhancing								
Boat construction and renovation								
State investment in firms	0.016	0.015	2	3	0.160	0.147	4	22
Boat modernization	0.047 ^c	0.032	15	5	0.047	0.037	7	6
Subsidized lending	0.008	0.003	5	6	–	–	0	0
Other bad subsidies	0.037 ^c	0.026	9	3	0.004	0.001	3	2
Fisheries development projects								
Development aid	0.009 ^c	0.007	8	2	0.179*	0.001	93	6
Institutional support	0.024	0.012	6	0	0.023	0.007	9	12
Fishing port development	0.054 ^c	0.017	11	2	0.026	0.015	8	12
Marketing and storage infrastructure	0.050 ^c	0.021	18	8	0.045	0.023	16	36
Tax exemption	0.010	0.004	6	5	0.051	0.019	3	28
Fishing access	0.045	0.013	19	0	–	–	–	–
Fuel subsidies ^b	0.104	–	–	–	0.141	–	–	–
Ambiguous								
Fisher assistance								
Income support	0.007	0.005	3	3	0.002	–	1	1
Unemployment support	0.030	0.019	3	2	0.023	–	1	0
Retraining initiatives	0.005	0.003	3	2	–	–	0	0
Other fisher assistance subsidies	0.040 ^c	0.018	12	4	0.005	–	1	0
Vessel buyback								
Vessel decommissioning	0.088 ^c	0.037	10	1	–	–	0	0
License and permit buyback	0.004	0.004	2	0	–	–	0	0
Other decommissioning	0.044	0.034	5	10	–	–	0	0
Rural fisher communities	–	–	0	0	0.012	0.003	12	49

^a The subsidy intensity of MPA is reported here without std. error, as it was reported for all countries by [Cullis-Suzuki and Pauly \(2008\)](#)

^b We report the mean subsidy intensity for fuel subsidies. The mean subsidy per litre and standard error is reported in [Sumaila et al. \(2008\)](#)

^c Indicates estimates that the authors feel to be robust. Estimates are said to be robust when the ratio of estimated countries to those with observed data is less than 0.5

reports on fishery issues such as the UK's Department for International Development⁶ (DFID); (k) the World Trade Organization (WTO) trade notifications (<http://www.wto.org/>); (l) NGO reports on marine issues, such as WWF (2001); and (m) various on-line resources including news articles and grey literature.

To improve the accuracy of collected data, we contacted more than five hundred fisheries representatives from all maritime countries/political entities of the world, including ministers responsible for fisheries, WTO negotiators and UN permanent mission representatives. The purpose of this effort was to bring the preliminary estimates reported in Sumaila and Pauly (2006) to the attention of these representatives, and ask for official data to improve our estimates where necessary and possible. Despite receiving valuable input from representatives in 35 countries/political entities, more than 60% of data cells within the database are assumed to be zero because there is no information indicating a subsidy program's existence. This assumption is strong and may indicate that our results underestimate the full magnitude of fishery subsidies in the year 2003.

3.2 Analysis of collected data

We create a database of 25 subsidy types identified for 148 maritime political entities which span the years 1989 to present. Though this is a static analysis for the year 2003, where a subsidy is known to exist but values are not stated, values are estimated based on information from within five years of 2003. The data from years prior to or after 2003 are normalized to constant 2003 US dollars by applying the consumer price index (CPI), extracted from the World Development Indicators.⁷

Every entry in the database used for this study, is supported by documentation of the source(s) of information, nature of the program, and recipients. For each entry where program information is supplemented with information on the amount and duration, the absolute annual amounts in United States dollars (US\$) are recorded in the database. This information is referred to as 'known subsidy amounts'. In the OECD (2004) report, from which some of the subsidy data is obtained, the government financial transfer (GFT) categories are reclassified under the 25 types of subsidies identified in this study. The values of GFT from this report are converted from OECD member countries' local currency to US\$. This study focuses on marine capture fisheries only, and subsidies within other fishery sectors such as aquaculture and inland capture fisheries are not considered.

Several steps are taken to normalize collected data: (a) subsidy programs towards capital cost such as infrastructure are annualized by considering depreciation costs (if available), or by using World Bank statistics; (b) multi-year subsidy programs are assumed to last 5 years if the project cycle is not provided; (c) subsidy programs in the form of concession loans (i.e., subsidized interest rate or interest-free) are calculated

⁶ International assistance in fisheries is provided in the form of capital aid or technical assistance from bilateral cooperation, multilateral donors and regional financial development banks (Insull and Orzesko 1991). Thus, for developing countries, fisheries subsidies are identified from both domestic and international sources, and data is collected from both the subsidy providers and the recipients.

⁷ www.worldbank.org, last accessed May 31, 2009.

on the basis of forgone interest rate. The real subsidy benefit is calculated as the market cost of the loan less the total cost of subsidized loan, which is estimated at 4–5% of the principal loan amount.

This estimate, however, depends on available information on subsidized lending such as: (i) the subsidization rate; (ii) the amount of reduced interest rate; (iii) the time of maturities associated with government-guaranteed loans; and (iv) the amount of forgiven loans. According to [Milazzo \(1998\)](#), in the absence of such information, 10% of the principal amount is a reasonable measure of benefits for all subsidized lending. This rule-of-thumb is applied where information on subsidized loans is not available.

It should be noted that payments for fishing access are provided by only a few countries, mostly in the EU, USA and some Asian political entities, including Japan, China, Taiwan and South Korea. The most significant are the European Union—African, Caribbean and Pacific Countries (EU-ACP) fishing agreements, which involves lump sum payments from the EU. Other kinds of payments from the US and Japan included access fees for tuna fishing fleets to the Pacific Island States. It has been reported that the EU devotes one third of its fisheries budget to these agreements, resulting in a subsidy of some US\$ 400 million in total ([MRAG 2000](#)). These foreign agreements are funded mainly for the benefit of Spanish, French and Portuguese fleets ([Milazzo 1998](#)).

Spain has been particularly successful with EU assistance subsidies for joint ventures, with over 250 vessels in 22 countries and catching up to reaching 190,000 tonnes ([MRAG 2000](#)). These EU lump sum payments are prorated by Landed Value (LV) with about 60% of the amount to Spain, France and Portugal and the remaining 40% to the rest of the EU membership. Known subsidy amounts for fishing access payments are about three quarter billion dollars ([Milazzo 1998](#)), which is scaled up to US\$ 1 billion assuming other payments from Russia, China, USA, Taiwan and South Korea sum to at least US\$ 250 million ([Milazzo 1998](#); [MRAG 2000](#); [Mwilya 2006](#)).

3.3 Estimating missing data

Two approaches are used to fill missing data for non-fuel and fuel subsidies, respectively. Fuel subsidies estimated in [Sumaila et al. \(2008\)](#) are used where data collected was expressed as a subsidy per litre of fuel usage or where the total fuel subsidy is not reported. In cases where total fuel subsidy is reported we use this data rather than estimates from [Sumaila et al. \(2008\)](#). The approach for estimating non-fuel subsidies is presented below.

Using collected quantitative data, we compute the subsidy intensity for each type of subsidy. We define subsidy intensity as the ratio of known subsidies for a given subsidy type to a country's total landed value. We then compute estimates of the mean subsidy intensity for our two groups of countries, i.e., developed (Group I) and developing (Group II) countries. The mean subsidy intensity for each subsidy type and country group is used, along with the 2003 landed value for a given country, in cases where subsidies are reported but with unknown magnitude, to compute estimates of subsidies provided by each country. Mathematically, we estimate fisheries subsidies using the equation:

$$\widehat{\text{subsidy}}_{i,j} = \left(\sum_{i=1}^n \frac{\text{subsidy}_{i,j}}{LV_i} LV_i \right) \quad (1)$$

where n is the number of recorded data entries for a given subsidy type j , and i indexes countries/political entities. Once we have estimated values for qualitative data, we aggregate 25 subsidy types into 11 parent categories when reporting our estimates in Table 1 of Sect. 4.

Lastly, we assume that all countries with a fisheries ministry or department do spend resources towards fisheries management. The four subsidy types classified as fisheries management—stock assessment, stock enhancement, monitoring and other beneficial subsidies—are first estimated individually and then aggregated into the broader fisheries management category. We use subsidies for fisheries management in countries for which we have data to infer fisheries management subsidies for countries/political entities that have fisheries ministries or department but no reported data.

4 Results and discussion

4.1 Estimates of subsidy intensity

Table 1 summarizes important aspects of our methodology, and presents some key results. As can be seen, the ratio of countries with data to country without varies between subsidy types. However, the general pattern we observe is that we have more data about subsidies in developed countries, which is comforting, as this group of countries provides far more in subsidies than developing countries. Another inference is that the standard errors around the mean intensity for several subsidy types (e.g., fisheries management fishingport development) are relatively low, such that uncertainty of estimates for these categories is not likely to be high. Table 1 also reveals that there are some subsidy types, such as those for state Investments in firms in developing countries, where the level of uncertainty is somewhat higher. Higher uncertainty in some subsidy types indicates that there are great opportunities for improvement in data collection, reporting and transparency by fisheries statistical offices around the world.

In addition to providing the reader a measure of the reliability of our estimates, the information in Table 1 also reveals subsidy types for which improvements in terms of reporting can be made. We use a rule-of-thumb that compares the number of known data points to estimates to identify subsidy types where reporting by fisheries department offices needs to be improved. Among subsidy types for the developing world only development aid satisfies this rule-of-thumb criteria that the number of known data points sufficiently exceeds the number of imputed estimates. Similarly, in the developed world where subsidy reporting tends to be more consistent, there is room for improvement in reporting subsidies to fisheries research and development and other decommissioning (buyback) programs, where the ratio of estimates to known data is high. The issue of consistent reporting is one that requires the attention of statistical offices around the world in order to increase the transparency of government involvement in the fisheries sector.

Table 2 Global fisheries subsidy estimates for 2003 in billion USD

Fishery subsidy type	Developing countries ^a	Developed countries ^b	Global total	%
Beneficial				
Fisheries management	1.69	3.50	5.19	19
Fishery R&D	0.90	0.93	1.83	7
MPAs	0.19	0.73	0.92	3
Capacity-enhancing				
Boat construction and renovation	2.14	0.73	2.87	11
Fisheries development projects	0.43	0.36	0.78	3
Fishing port development	0.31	2.52	2.83	10
Marketing and storage infrastructure	0.76	0.63	1.39	5
Tax exemption	0.64	0.36	1.00	4
Fishing access ^c	0.00	1.00	1.00	4
Fuel subsidies	1.48	4.88	6.36	23
Ambiguous				
Fisher assistance	0.03	1.35	1.39	5
Vessel buyback ^c	0.00	1.44	1.44	5
Rural fisher communities ^c	0.20	0.00	0.20	1
Global total	8.75	18.44	27.20	100

^a Includes Trinidad & Tobago, Cuba and Uruguay

^b Includes China, Russia and Taiwan

^c Generally, zero is more indicative of a lack of data rather than the absence of subsidy

4.2 Global estimate of fisheries subsidies

The total magnitude of fishery subsidies in marine capture fisheries is estimated at US\$ 27 billion for the 12 types of subsidies.⁸ Table 2 shows us that 68% of the total estimated subsidies are provided in developed countries (US\$ 18.5 billion), with the rest provided by developing countries (US\$ 8.7 billion). Fuel subsidies account for the largest portion (about 23%) of the global total, with fishery development projects and rural fishing community development programs contributing the smallest portions (about 3 and 1%, respectively).

The US\$ 27 billion subsidy estimate in this study is bracketed by earlier global estimates as shown in Fig. 1. Milazzo's (1998) estimate of US\$ 14–20 billion, which does not include management expenditure, is likely a low estimate, and the FAO's (1992) estimate of US\$ 54 billion, which may be influenced by large former Soviet Union budgets, is generally assumed to be high. Unlike these previous estimates of

⁸ The full list of subsidies estimates for each maritime country/political entity can be found in the Appendix and on-line at: <http://www.seaaroundus.org/>.

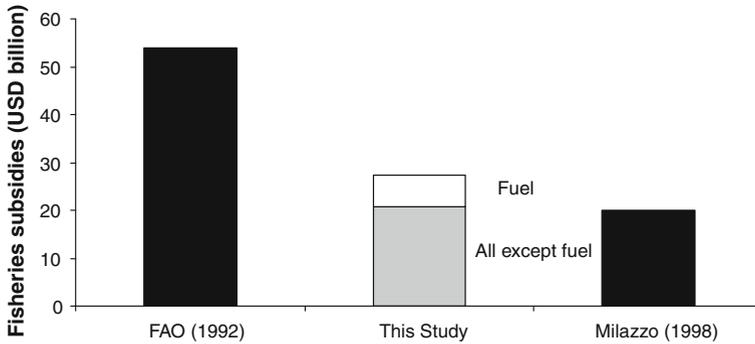


Fig. 1 A comparison of global fishery subsidy estimates for 2003

global fisheries subsidies, our study takes a bottom-up approach that treats missing data as missing rather than zero. Where previously subsidy estimates treat subsidy programs with insufficient quantitative data as providing no subsidy at all we leverage characteristics of a given subsidy program and country/political entity to make quantitative estimates in such cases.

Our estimate of subsidies is, however, lower than the estimate reported in [Sumaila and Pauly \(2006\)](#) of US\$ 30–34 billion for the year 2000. The difference between the current estimates from those reported in [Sumaila and Pauly \(2006\)](#) is largely due to the replacement of estimates in several cases with new data uncovered through an expanded data collection effort via representatives of maritime countries/political entities at the World Trade Organization and government fisheries departments. The majority of our estimates differ little from the previous estimates; however, the latest estimation process uncovered important adjustments for a few countries/political entities.⁹ In some cases, the addition of new data caused our estimates to be lower than estimates reported in [Sumaila and Pauly \(2006\)](#), while in other cases our new estimates increased for a given country/political entity. For example, our approach to management subsidies where we assume all fisheries departments or ministries provide some form of management funding increased the management subsidy estimates for many countries/political entities.

4.3 Fisheries subsidy estimates by category

Subsidy estimates organized by category are presented in [Fig. 2](#). Subsidies in the ‘capacity-enhancing’ category are the highest, totaling US\$ 16.2 billion, with about 65% of this category provided in developed countries. ‘Beneficial’ subsidies, which are mostly provided in developed nations, are the next highest in total (US\$ 8 billion).

⁹ Most notable among these changes are for Brazil, Denmark, Gabon, and India. The adjustments for these four countries account for a large degree of the change from estimates reported in [Sumaila and Pauly \(2006\)](#). Subsidy estimates by country are described in detail by region in the Appendix. Additionally, all data sources are listed on-line at www.seararoundus.org.

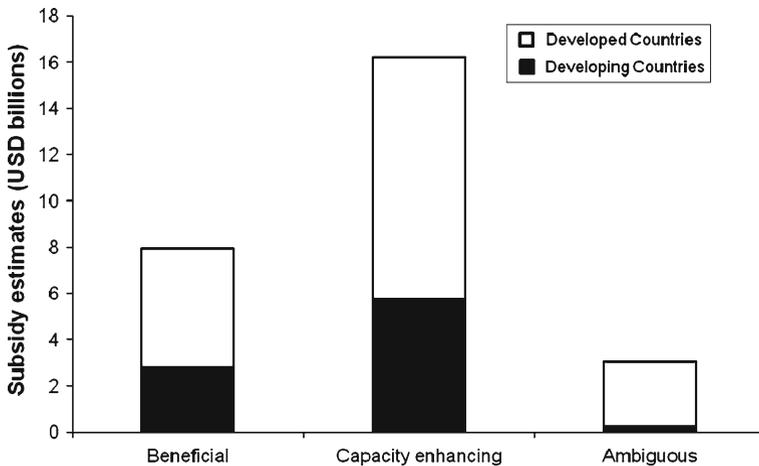


Fig. 2 Global fisheries subsidy estimates by categories for 2003

Subsidies categorized as ‘Ambiguous’ contribute the least amount to the global total (US\$ 3 billion), with more than 90% of this category provided in developed countries.

4.3.1 Beneficial subsidies

The total amount of beneficial subsidies is estimated at US\$ 8 billion. Nearly all countries provide some form of management subsidies to their fishing sectors; however, in developing countries with limited budgets, subsidies for fisheries management (including enforcement and research and development) are obtained mostly through international assistance programs. This funding is provided through numerous international fishery research and management programs, such as the R/V Dr. Fridtjof Nansen Resource Surveys (Sætersdal et al. 1999).

4.3.2 Capacity-enhancing subsidies

The total estimate for the seven subsidy types categorized as ‘capacity-enhancing’ is US\$ 16.2 billion, with fuel subsidies and boat construction and renovation programs contributing 23 and 11% of the world total, respectively. Subsidies in this category are those that are most likely to contribute to unsustainable levels of fishing capacity—a reason why the fisheries subsidy debate has been topical (Milazzo 1998; Munro and Sumaila 2002; Sumaila et al. 2007). A build up of excess fleet capacity generally results in economic waste and undermines the ability of resource managers to do their job (Sumaila 2003).

The results of this study show that fishing access payments for distant water fleets (DWF) are provided by a handful of countries/political entities with a significant share of world catches, including the EU, Japan, Russia, Korea, Taiwan, China and the USA. The world total spent subsidizing fishing access for the year 2003 was about US\$ 1 billion.

Fuel subsidies globally are estimated at between US\$ 4.1 and 8.3 billion, implying that global fishing enterprises can, in the aggregate, absorb as much as this amount in terms of increased fuel budget before fishing activity begins to decline in response to higher fuel prices. In relation to other subsidy categories, fuel subsidies represent nearly a quarter of all government transfers to the fishing industry. The single action of eliminating fuel subsidies could potentially be the most influential factor in stemming the trend of overfishing which relies on subsidized fuel to keep the profit margins for highly migratory and deep-water species positive.

4.3.3 Ambiguous subsidies

The total estimate of ‘ambiguous’ subsidies worldwide is about US\$ 3 billion, with fisher assistance programs in developed countries contributing more than 45%. Buyback programs, which are provided mostly by developed countries, are estimated to be about US\$ 1.4 billion. Rural community development programs, estimated at just \$US 200 million, are found to be the smallest category of fisheries subsidies analyzed in this study. Given the uncertain effects of ambiguous subsidies it is difficult to predict what effect these payments have for fishery resources. Ambiguous subsidies are among the most important subsidy categories in terms of the need for further research and data collection.

4.4 Regional analysis of subsidy estimates

We find large differences in subsidization of the fisheries sector across the six FAO regions of the world. Figure 3 shows that Asia provides the largest amount of fisheries

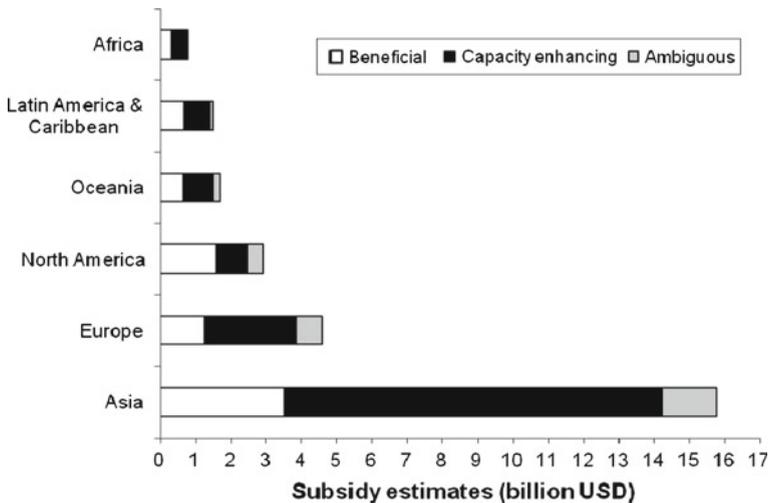


Fig. 3 2003 Subsidy estimates by major geographic region

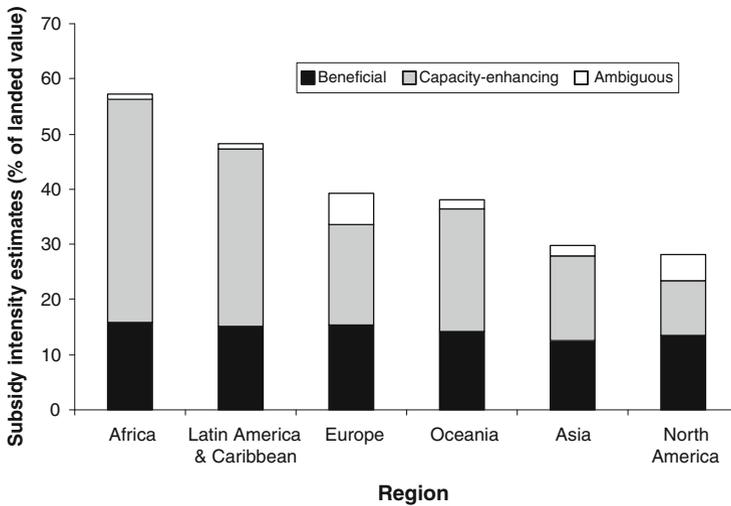


Fig. 4 2003 Subsidy intensity by major geographic region

subsidies, about US\$ 15.7 billion, while Africa has the least subsidized fisheries, with about US\$ 780 million in government funding.

The difference between the highest and lowest subsidizing regions is quite large; however, the annual catch and fleet size is also quite different across regions. We attempt to control for these differences by calculating a measure of subsidy intensity of countries and regions, i.e., the ratio of subsidy estimates to the value of catch in the year 2003. Figure 4 summarizes subsidy intensity for six major geographic regions in the world. We find that while Asia may provide the most in subsidies to its fisheries in total by a large margin, there is much more parity when subsidy intensity is considered. Indeed, both the African and Latin America and Caribbean regions, with relatively smaller annual catch values, rank highest when subsidies are expressed on a per dollar of landings scale. What is also apparent is that a main source of inter-regional variation in subsidy intensity comes from capacity-enhancing subsidies.

5 Conclusion

We have shown that the amount of subsidies provided by governments of the world to their fishing sector is quite large and that most of these subsidies lead to overcapacity and overfishing. To make progress toward halting the current decline in global fisheries, it is crucial that harmful capacity-enhancing subsidies need to be eliminated. Foregone subsidies can be re-directed towards improving the livelihoods and economic possibilities of fishing community residents in other industries or directed towards improved management that could aid in stock re-building projects in cases where the resource has been adversely affected by subsidized over-fishing.

Although our estimate of subsidies to world fishing fleets is likely to be the best and most comprehensive available, our analysis reveals that there is a need for considerable progress in terms of transparency in government transfers to the fishing industry. Above all, our study highlights the need for improved reporting in many regions of the globe, particularly among the developing world. It is through improved reporting of fisheries subsidies that we will be able to better understand how government fisheries subsidies are distributed globally. It is clear that future work on fisheries subsidies is required to both improve standards for reporting and to identify trends of government funding of this sector through time and between regions.

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Appendix

Appendix 1 African subsidy estimates for 2003 (US\$ thousands)

	Beneficial	Capacity-enhancing	Ambiguous	Total	Estimated to observed subsidy ratio
Algeria	3,026	3,233	430	6,690	0.90
Angola	10,103	63,227	1,202	74,532	0.98
Benin	1,149	5,370	69	6,588	0.06
Cameroon	4,583	4,864	0	9,447	1.00
Cape Verde	1,626	9,597	0	11,222	0.19
Comoros	399	137	142	677	0.54
Cote d'Ivoire	5,014	7,269	0	12,283	0.92
Democratic Republic of the Congo	170	2	0	172	0.99
Djibouti	26	534	2	562	0.06
Egypt	13,815	2,020	0	15,836	1.00
Equatorial Guinea	231	12	10	253	0.95
Eritrea	1,636	312	56	2,005	0.34
Gabon	5,162	7,315	140	12,617	0.66
Gambia	4,533	7,247	361	12,141	0.81
Ghana	11,308	20,733	810	32,850	0.88
Guinea	14,153	14,496	262	28,912	0.48
Guinea-Bissau	1,182	3,155	57	4,394	0.26
Kenya	931	3,901	0	4,832	0.25

Appendix 1 continued

	Beneficial	Capacity-enhancing	Ambiguous	Total	Estimated to observed subsidy ratio
Liberia	353	221	38	612	0.90
Libya	5,089	0	0	5,089	1.00
Madagascar	8,853	2,772	1,239	12,864	0.78
Mauritania	9,922	15,269	803	25,994	0.71
Mauritius	799	1,428	0	2,226	0.36
Morocco	30,982	58,362	2,394	91,737	0.91
Mozambique	3,311	17,362	863	21,537	0.19
Namibia	50,743	71,720	0	122,462	0.97
Nigeria	29,010	667	1,277	30,954	0.93
Republic of the Congo	1,841	5	0	1,846	1.00
Sao Tome & Principe	163	554	23	740	0.25
Senegal	21,863	48,246	420	70,529	0.80
Seychelles	5,131	23,243	271	28,646	0.91
Sierra Leone	4,904	8,155	599	13,658	0.57
Somalia	3,157	768	356	4,282	0.98
South Africa	36,088	33,524	0	69,612	0.99
Sudan	743	475	58	1,277	0.99
Tanzania	4,302	5,671	0	9,974	0.53
Togo	363	1,130	45	1,538	1.00
Tunisia	4,129	22,350	0	26,480	0.89
Total	300,794	465,348	11,928	778,071	0.84

An entry of '0' does not necessarily mean that subsidies are zero-could just be an indication of lack of data

Appendix 2 Asian subsidy estimates for 2003 (US\$ thousands)

	Beneficial	Capacity-enhancing	Ambiguous	Total	Estimated to observed subsidy ratio
Bahrain	5,530	5,133	1,258	11,921	0.91
Bangladesh	35,049	24,899	2,885	62,833	0.77
Brunei Darussalam	432	339	0	771	1.00
Cambodia	6,143	60	1,166	7,369	0.99
China	1,227,728	2,185,867	725,878	4,139,474	0.94
Cyprus	408	530	502	1,439	0.38
Georgia	683	264	18	965	0.46
Hong Kong (China)	7,340	1,291	0	8,631	0.69
India	182,713	851,869	35,592	1,070,174	0.86
Indonesia	178,772	787,647	23,279	989,697	0.29

Appendix 2 continued

	Beneficial	Capacity- enhancing	Ambiguous	Total	Estimated to observed subsidy ratio
Iran	96,840	138,218	8,035	243,093	1.00
Japan	591,161	3,392,093	652,769	4,636,023	0.45
Jordan	38	33	0	70	1.00
Kuwait	583	414	0	997	1.00
Lebanon	586	1	0	587	1.00
Malaysia	32,723	281,918	2,590	317,231	0.95
Maldives	49,217	15,950	0	65,167	0.75
Myanmar	112,973	35,417	9,373	157,763	1.00
Oman	26,987	49,969	2,548	79,504	0.88
Pakistan	61,819	69,705	5,188	136,712	1.00
Philippines	286,038	609,893	22,895	918,825	0.99
Qatar	2,408	751	602	3,762	1.00
Republic of Korea	77,732	798,794	17,409	893,936	0.34
Saudi Arabia	15,870	16,232	1,209	33,311	1.00
Singapore	316	0	0	316	1.00
Sri Lanka	78,662	53,689	0	132,351	0.92
Syria	776	0	0	776	1.00
Taiwan	30,942	312,312	17,226	360,480	0.35
Thailand	30,470	497,333	24,796	552,600	0.68
Turkey	36,535	60,388	135	97,058	0.71
United Arab Emirates	6,419	4,171	0	10,590	1.00
Viet Nam	283,229	414,184	0	697,413	0.93
Yemen	37,946	79,617	0	117,563	1.00
Total	3,505,066	10,688,981	1,555,354	15,749,402	0.69

An entry of '0' does not necessarily mean that subsidies are zero—could just be an indication of lack of data

Appendix 3 European subsidy estimates for 2003 (US\$ thousands)

	Beneficial	Capacity- enhancing	Ambiguous	Total	Estimated to observed subsidy ratio
Albania	425	911	0	1,336	0.69
Belgium	8,880	1,129	7,065	17,074	0.26
Bulgaria	556	186	49	791	1.00
Croatia	1,312	490	0	1,803	0.73
Denmark	77,691	55,250	35,064	168,005	0.41
Estonia	5,320	7,417	4,672	17,409	1.00
Finland	14,417	12,332	3,830	30,578	0.06
France	116,251	299,993	20,112	436,356	0.27

Appendix 3 continued

	Beneficial	Capacity-enhancing	Ambiguous	Total	Estimated to observed subsidy ratio
Germany	33,547	30,462	8,079	72,088	0.47
Greece	51,672	61,769	34,906	148,347	0.08
Iceland	28,880	115,723	156	144,760	0.67
Ireland	60,636	34,450	6,416	101,501	0.02
Israel	970	248	0	1,219	1.00
Italy	58,379	55,249	126,793	240,422	0.15
Latvia	9,062	11,183	0	20,245	1.00
Lithuania	18,324	0	0	18,324	1.00
Malta	505	765	319	1,590	0.07
Montenegro	79	82	0	161	0.49
Netherlands	8,069	8,831	7,899	24,799	0.23
Norway	72,257	197,533	16,557	286,347	0.50
Poland	8,978	20,347	7,435	36,760	0.85
Portugal	31,059	64,219	8,867	104,146	0.13
Romania	419	171	0	590	1.00
Russian Federation	323,868	1,038,943	118,947	1,481,758	0.68
Spain	85,725	341,877	246,053	673,655	0.15
Sweden	57,466	57,592	33,877	148,935	0.60
Ukraine	13,543	34,498	1,675	49,717	1.00
United Kingdom	174,781	136,585	34,313	345,679	0.54
Total	1,263,070	2,588,236	723,084	4,574,391	0.45

An entry of '0' does not necessarily mean that subsidies are zero—could just be an indication of lack of data

Appendix 4 Latin American and Caribbean subsidy estimates for 2003 (US\$ thousands)

	Beneficial	Capacity-enhancing	Ambiguous	Total	Estimated to observed subsidy ratio
Antigua Barbuda	612	3,497	0	4,110	0.21
Argentina	131,064	184,431	51,336	366,832	0.95
Bahamas	11,039	3,236	0	14,275	0.77
Barbados	324	484	73	880	0.89
Belize	1,530	6,233	119	7,881	0.21
Brazil	177,523	206,080	29,791	413,395	0.92
Chile	47,635	46,108	0	93,743	0.89
Colombia	12,625	2,211	582	15,418	1.00
Costa Rica	8,152	8,107	876	17,135	0.94
Cuba	12,963	923	0	13,886	0.93
Dominica	469	6,758	34	7,262	0.12

Appendix 4 continued

	Beneficial	Capacity-enhancing	Ambiguous	Total	Estimated to observed subsidy ratio
Dominican Republic	7,344	120	0	7,464	0.98
Ecuador	32,341	15,022	0	47,362	0.99
El Salvador	7,399	672	1,428	9,498	0.89
Grenada	740	4,662	0	5,401	0.27
Guatemala	6,422	2,025	458	8,905	0.99
Guyana	23,200	29,377	1,960	54,538	1.00
Haiti	3,762	643	0	4,404	0.98
Honduras	8,665	2,734	531	11,930	0.97
Jamaica	4,194	6,197	303	10,695	1.00
Nicaragua	8,267	6,485	0	14,752	0.66
Panama	23,675	23,555	2,827	50,057	0.98
Peru	65,744	130,741	9,004	205,490	0.94
St. Kitts & Nevis	108	973	0	1,080	0.14
St. Lucia	1,274	2,726	38	4,038	0.46
St. Vincent	1,766	3,413	112	5,291	0.73
Suriname	9,625	5,032	1,172	15,829	0.68
Trinidad & Tobago	3,477	8,006	0	11,483	0.97
Uruguay	11,143	6	0	11,149	1.00
Venezuela	32,349	28,903	3,589	64,841	1.00
Total	655,432	739,358	104,235	1,499,026	0.92

An entry of '0' does not necessarily mean that subsidies are zero—could just be an indication of lack of data

Appendix 5 North American subsidy estimates for 2003 (US\$ thousands)

	Beneficial	Capacity-enhancing	Ambiguous	Total	Estimated to observed subsidy ratio
Canada	406,856	234,407	201,038	842,301	0.40
Mexico	25,048	195,757	47,742	268,546	0.95
U.S.A.	1,155,840	440,801	201,000	1,797,641	0.00
Total	1,587,744	870,965	449,780	2,908,489	0.20

Appendix 6 Oceania subsidy estimates for 2003 (US\$ thousands)

	Beneficial	Capacity-enhancing	Ambiguous	Total	Estimated to observed subsidy ratio
Australia	181,416	137,283	163,203	481,902	0.35
Fiji	13,327	25,053	1,448	39,828	1.00
Kiribati	6,928	16,605	0	23,533	0.95

Appendix 6 continued

	Beneficial	Capacity-enhancing	Ambiguous	Total	Estimated to observed subsidy ratio
Marshall Islands	51,213	20,899	0	72,113	0.93
Micronesia	41,885	128,196	0	170,081	0.33
47,220	0.19				
Palau	472	1,025	0	1,497	0.40
Papua New Guinea	216,373	427,468	18,174	662,014	1.00
Samoa	4,728	2,243	359	7,329	1.00
Solomon Islands	23,053	8,711	3,219	34,983	0.93
Tonga	3,155	4,002	0	7,156	0.96
Vanuatu	42,758	101,229	0	143,987	1.00
Total	632,576	872,830	186,403	1,691,808	0.72

An entry of '0' does not necessarily mean that subsidies are zero-could just be an indication of lack of data

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