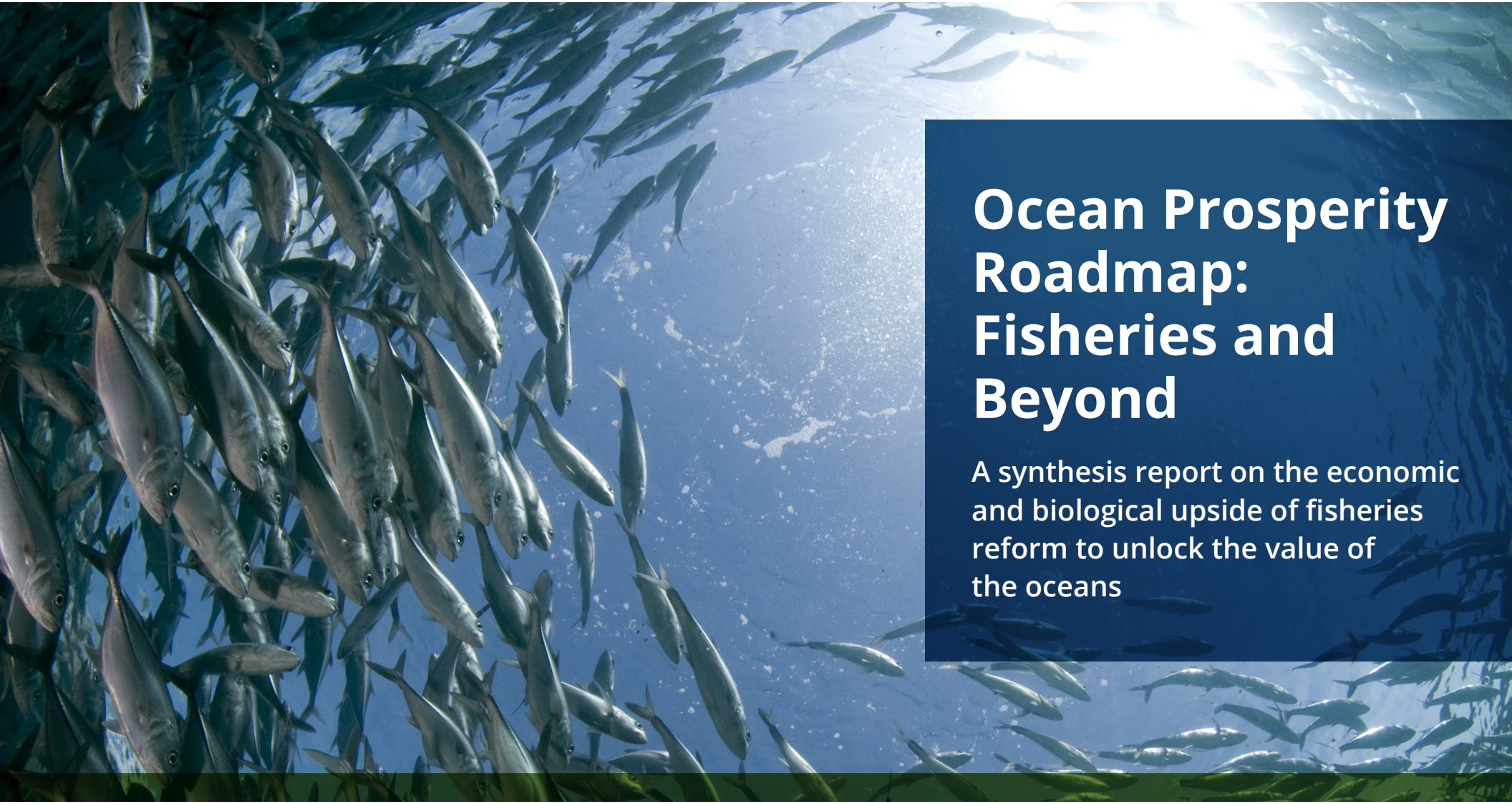

Ocean Prosperity Roadmap: Fisheries and Beyond

A synthesis report on the economic and biological upside of fisheries reform to unlock the value of the oceans

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The Economist Intelligence Unit

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Ocean Prosperity Roadmap: Fisheries and Beyond

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About the Authors

California Environmental Associates served as a coordinator for this synthesis report. This body of work represents the collective efforts of several partners. Contributing researchers to the respective studies include the following:

State of the Blue Economy: The Economist Intelligence Unit and the Gordon and Betty Moore Foundation

The Potential for Global Fish Recovery: How Effective Fisheries Management Can Increase Abundance, Yield and Value: Christopher Costello, Daniel Ovando, Tyler Clavelle, Steve Gaines, Reniel Cabral, and Cody Szuwalski (University of California-Santa Barbara), Ray Hilborn, Michael Melnychuk, and Trevor Branch (University of Washington), and C. Kent Strauss, Douglas Rader and Amanda Leland (Environmental Defense Fund)

Fisheries Governance Survey: Ray Hilborn and Mike Melnychuk (University of Washington) and California Environmental Associates

Country-Level Costs vs. Benefits of Improved Fishery Management: Chris Costello and Tracey Mangin (University of California-Santa Barbara), with advisors James Anderson, Ragnar Arnason, Steve Gaines, Ray Hilborn, Rashid Sumaila, James Wilen, and California Environmental Associates

Investing in the Blue Economy: Opportunities, Challenges and Solutions: The Economist Intelligence Unit and the Gordon and Betty Moore Foundation

Coastal Governance Index: The Economist Intelligence Unit and California Environmental Associates

Disclaimer: The findings, interpretations, and conclusions included herein are the product of each individual research project and do not necessarily reflect the views of all members of the research coalition.

Ocean Prosperity Roadmap: Fisheries and Beyond

Ocean Prosperity Roadmap: Fisheries and Beyond is a new collection of research designed to inform decision makers, including governments and investors, on effective ocean and coastal resource management strategies to maximize social, economic, and environmental benefits.

The research demonstrates how governance and management reform can create significant economic gains while reducing poverty, increasing food production, replenishing fish and conserving ocean health for future generations. This is especially true in the case of wild capture fisheries. Taken together, the collection of six studies creates a more comprehensive overview of what's possible for the ocean economy and emerging best practices on how to get there.

The collection is a result of independent work from The Economist Intelligence Unit (EIU), Environmental Defense Fund (EDF), the Gordon and Betty Moore Foundation, the David and Lucile Packard Foundation, California Environmental Associates (CEA), the University of California at Santa Barbara (UCSB), and the University of Washington (UW). The collection includes the following studies:

1. *State of the Blue Economy:* The "blue economy"—the concept of an economically and environmentally sustainable ocean-based economy—has emerged as a new approach to developing and managing ocean resources. This forthcoming report by the EIU provides an examination of the 'state of the blue economy' across the world, to inform and stimulate discussion and debate among domestic and international policymakers, businesses, civil society and academics.

2. *The Potential for Global Fish Recovery: How Effective Fisheries Management Can Increase Abundance, Yield and Value:* New research by UCSB, EDF, and UW compiles the world's most complete database on fisheries health, representing 77 percent of the world's annual harvest. The database is paired with a bio-economic model to provide comprehensive country-by-country estimates of the future economic, conservation and societal benefits of fisheries, under different fishing scenarios. The results from this study indicate that annual net economic benefits from the global marine fishery could increase by some US$75 billion annually relative to what is earned today.

3. *Fisheries Governance Survey:* To unlock the many benefits of fisheries, governments need to ensure that the appropriate policies and regulations are in place. One of the many challenges in reflecting on the state of global fisheries is that there is no timely, comprehensive information on the nature or quality of fisheries management across countries. This study, conducted by the University of Washington, employed scores of experts across the globe to assess the current nature and quality of fisheries management in the world's largest fishing nations. The authors assembled an index in order to more easily compare the status of management across countries. Unsurprisingly, those countries with the most room for improvement in their governance systems are also those with the greatest economic upside modeled in the Potential of a Global Fish Recovery analysis.

4. *Country-Level Costs vs. Benefits of Improved Fishery Management:* As the governance study confirmed, achieving the economic and biological upside of reformed fisheries requires that governments enact the appropriate management systems. But how much do these systems cost and are the costs prohibitive? This analysis led by researchers at UCSB seeks to estimate the relative costs of different fisheries management systems across the globe and compares those incremental costs against the expected economic upside of better management. While the costs of improving management can be substantial, a key finding is that benefits exceed costs in every single fishing country in the world—the average benefit cost ratio exceeds 10:1. This ratio appears to be highest in those countries with the most room to improve management systems.

5. *Investing in the Blue Economy: Opportunities, Challenges and Solutions:* The transition from a conventional resource economy in the ocean to a blue economy is a tremendous economic and investment opportunity, if it can be done right. The fisheries context highlights the need to free up resources (both public and private) to support this transition. This forthcoming paper by the EIU is intended to help investors and the private sector understand the risks and opportunities for making money from ocean resources, and where business models that embrace the thoughtful management and sustainable use of our oceans represent the best path for unlocking value into the future.

6. *Coastal Governance Index:* The Coastal Governance Index is an analysis by the EIU on the overall status of coastal governance. It represents a first-ever definition and comparison of the rigor of coastal governance 20 ocean economies. The EIU considered a wide range of factors (the strength of coastal regulation, the business climate, natural resource management) as important elements of coastal governance, and unites them in order to create a stronger framework for talking about governance and comparing across countries. The overall goal of the index is to provide governments and private investors with a sound basis for understanding the status of management and regulations in key countries to enable better decision-making and encourage investment.

Reflections: Fisheries as a Driver in the Blue Economy and Country Prosperity

The following commentary represents reflections by California Environmental Associates on a set of independent fisheries studies. The views expressed herein do not necessarily reflect the views of the study authors.

A growing body of evidence points to an untapped potential to unlock the deeper value of the oceans. Findings from the research package, "The Ocean Prosperity Roadmap: Fisheries and Beyond," suggests that fisheries governance and management reform can create significant economic gains while increasing food production, replenishing fish stocks and conserving ocean health for future generations. This opportunity could play a major role in reshaping the future of global fisheries.

Fisheries are a foundation of the emerging "blue economy." Sustainable fisheries can be a vital component of a prosperous "blue economy," an emerging paradigm describing a vision for responsible investment in a sustainable ocean economy. Marine capture fisheries are a significant piece of the blue economy, contributing more than US$270 billion to global GDP. A key source of economic and food security, marine fisheries provide livelihoods for the 300 million people involved in the sector and help meet the nutritional needs of the 3 billion people who rely on fish as an important source of animal protein. The role of fisheries is particularly profound in many of the world's poorest communities, where fish are a critical source of protein and the fishing sector provides a social safety net.

Well-managed, sustainable fisheries can generate significant economic value, well beyond their current levels. While healthy marine fisheries deliver a strong flow of economic benefits, we have known for a long time that many fisheries are depleting their stocks, resulting in a loss of both national wealth and natural capital. In 2009, the World Bank and FAO released a landmark joint study, "The Sunken Billions: The Economic Justification for Fisheries Reform," which found that global marine fisheries were incurring an annual loss of approximately US$50 billion (in 2004 prices) due to ineffective governance. The magnitude of these "Sunken Billions" underscores that the fisheries sector has the potential to contribute much more to the blue economy. Though fisheries already represent a major global economic activity and source of livelihoods, there is still substantial room for profitability gains by restoring overexploited fish stocks and improving fisheries governance.

Fisheries reform can yield triple bottom line gains in terms of greater economic profits, food security, and conservation benefits. Researchers from UCSB, EDF, and UW have compiled the world's most complete database on fisheries health (representing 77 percent of the world's annual harvest) and paired it with a bio-economic model in order to provide country-by-country estimates of the future economic, conservation, and societal benefits of fisheries, under different fishing scenarios. Results from the study, "Potential of a Global Fish Recovery: How Effective Fisheries Management Can Increase Abundance, Yield and Value," show that global fisheries profits could increase by $75 billion per year, relative to what is earned today. At the same time, sustainable global marine harvest of fish could increase by about 12 million metric tonnes, with a 36 percent increase in the biomass of fish in the sea.

The UCSB-EDF-UW joint study provides convincing evidence that rebuilding global fisheries can lead to a triple-bottom-line win for conservation, catch, and profits. While all major fishing countries stand to gain, and nearly all will obtain a triple-bottom-line, the biggest growth opportunity from fishery reforms are to be found in a handful of major fishing economies with room to improve the rigor and design of management. Further, recovery can occur quickly: with appropriate reforms, the median fishery takes only 10 years to reach recovery targets. The study provides new insights to show that fisheries recovery can lead to strong synergies between economic profits, food provision, and conservation.

To achieve these gains, the necessary policies and regulations must be implemented and enforced. Strong management requires enacting measures to prevent overfishing and, more importantly, implementing measures to reduce fishing pressure when stocks become depleted. Key practices include having a robust evaluation of the status of stocks, designing appropriate management measures to limit fishing mortality, and enforcing regulations to prevent overfishing and illegal fishing. A new survey of fishery management practices across key fishing nations by the University of Washington independently confirms that those countries with the highest upside potential could take significant steps to improve their current fisheries management. Countries that perform lower on the governance index also demonstrate the highest upside potential, highlighting the reality that fisheries management reform is a necessary initial step in unlocking social, economic, and environmental gains. Several countries identified in the study are already moving in the right direction to position themselves to reap these benefits.

Making the transition to sustainable fisheries inevitably requires investments. Unlocking the potential upside of fisheries requires investing in good science, effective monitoring, and a dynamic private sector. Understanding the scale of these costs is an important real-world consideration for implementing governments. A companion analysis by UCSB modeled the relative costs and benefits of fisheries management reform on a country-by-country basis to determine whether the potential benefits justify the likely increase in management costs. The study finds that even though the costs to upgrade fisheries management can be quite substantial, the benefits of recovery substantially outweigh the incremental costs of management. The results show that benefits exceed costs in every single fishing country in the world—the average benefit cost ratio exceeds 10:1. The ratio appears to be highest in those countries with the most room to improve management systems. Moving forward, one of the critical challenges is identifying mechanisms that can redirect part of the upside to help finance the transition.

The good news is that well-managed, sustainable fisheries also generate more value, providing an opportunity for philanthropic, public and private capital to all play a role in financing the transition to a blue economy. There is a positive feedback cycle: when governments manage their fisheries well, they experience complementary benefits to achieve lasting prosperity, poverty reduction, food production, and improved biodiversity. Investing in sustainable fisheries yields dividends across several dimensions. While fish populations are in decline in several parts of the world, regions that have invested in effective fisheries management are experiencing opposite trends, with renewed stocks, intact ecosystems, and bolstered economies. This new collection of research highlights the latent opportunities in fisheries as a case study in the broader blue economy, providing a roadmap of best practices to unlock the true potential of global fisheries.

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The Potential for Global Fish Recovery: How Effective Fisheries Management Can Increase Abundance, Yield and Value

Authors: Christopher Costello, Daniel Ovando, Tyler Clavelle, Steve Gaines, Reniel Cabral, and Cody Szuwalski (University of California-Santa Barbara), Ray Hilborn, Michael Melnychuk, and Trevor A. Branch (University of Washington), and C. Kent Strauss, Douglas Rader and Amanda Leland (Environmental Defense Fund)

Ocean fisheries are a tremendous underperforming resource

Three billion people worldwide rely on seafood as a key source of protein and about 260 million people work in ocean-related sectors, many of whom live in developing countries. Beyond food and job security, fishing economies add billions to global GDP. But this segment of the blue economy has long been overlooked because the dominant view about the future of the oceans has been so bleak: nearly a third of fish stocks that have been officially assessed are in trouble, and half produce less food, employment, economic value, and biodiversity than they could.

The oceans have tremendous potential to produce significantly more food and profits, year after year

The future does not have to be so dire. New groundbreaking research shows that poorly performing fisheries can be turned around fast. Scientists and economists from the University of California Santa Barbara, Environmental Defense Fund, and the University of Washington have teamed up to create a new “upside” bio-economic model that gives the most holistic view to date of the potential benefits to be gained from the oceans, if sustainable fishing becomes the norm. The upside model estimates the options, benefits and timing of recovery for individual fisheries, nations, ecosystems and the world.

Our preliminary results show there is great promise for the world’s oceans and those who rely on them: healthy oceans can provide more fish in the water, more food on the plate, and more prosperity for fishing communities around the world. Even more importantly, the world stands to gain all three of these benefits at the same time. Our final research will be published this summer.

A significant underpinning of the research is that it is based on a database of 4,373 fisheries worldwide, representing 77% of global catch. Previous studies aggregated trends of relatively few fisheries or represented the whole ocean as a single stock. As a result, this new research gives a much stronger understanding of the world's future with sustainable fishing.

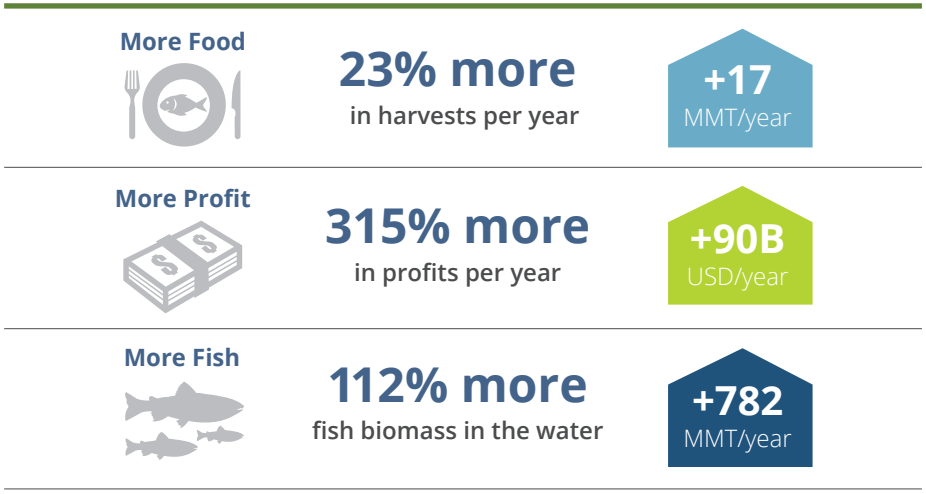
Our preliminary results find that within 10 years we could increase profits in the fishing sector by 51 billion USD (or 115 percent) a year compared to today, if fisheries were managed sustainably. Over the longer term by 2050, profits could grow by 74 billion USD (or 168 percent) each year. The research also shows that even though fisheries are being fished hard today in most countries, global fish production could rise by 14 percent, providing an additional 12 million metric tons (MMT) of seafood. At the same time, biomass, or the amount of fish left in the water for conservation, would grow by 36 percent.

On the other hand, if sustainable fisheries management is not implemented, the health of the oceans will continue to decline.

The data reveal a stark choice: manage fisheries sustainably and realize the tremendous potential of the world's oceans; or allow "business as usual" to continue to draw down the natural capital of our oceans.

Compared to business as usual, the long-term potential of the oceans is even more striking: sustainably managed fisheries could produce 17 MMT (or 23 percent) more wild fish and generate 90 billion USD (or 315 percent) more in profits each year. The biomass of fish in the water would be 112 percent greater, making our oceans healthier and more resilient and enabling fisheries to continue delivering high volumes of food and profits every year.

The Ocean's Tremendous Potential

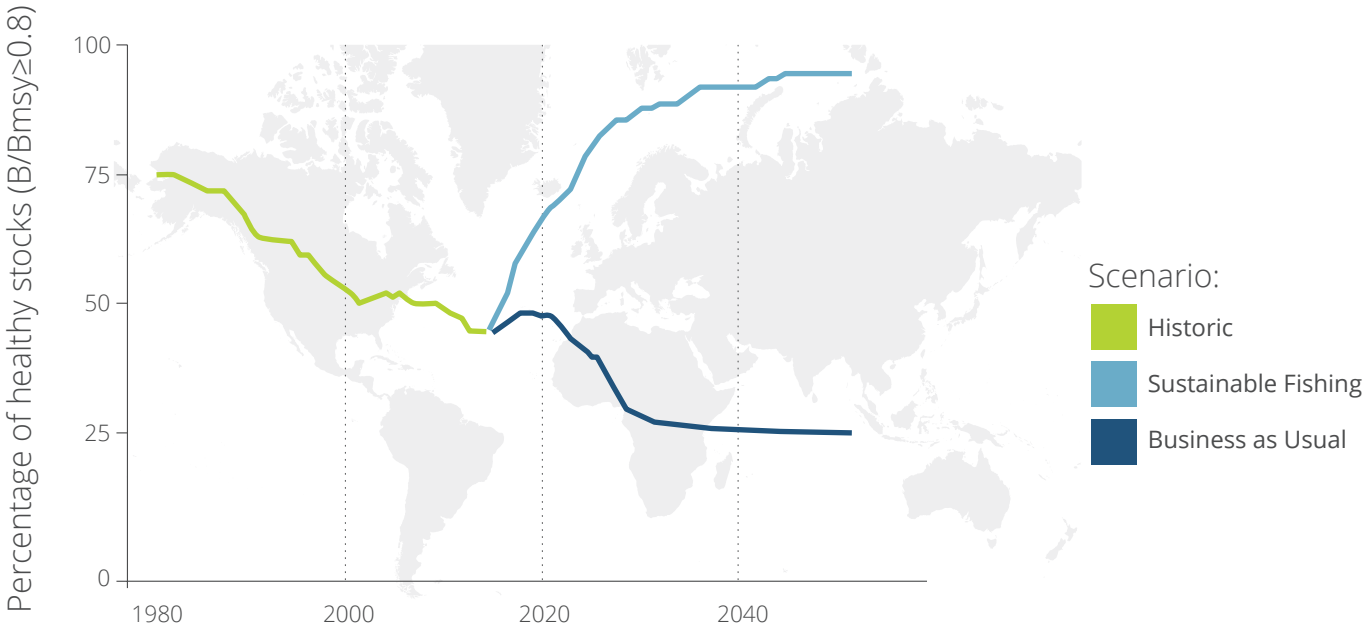


[1] The values from the model, which represent 77% of the world's catch, have been adjusted to illustrate the global potential.

Benefits can accrue quickly

While many of the world's fisheries have been on a steady downward trend for decades, the model indicates that fisheries can be made healthy again relatively quickly — even while fishing continues. For example, the typical fishery could recover in just nine years. What's more, the percentage of fisheries in the world that are considered biologically healthy would grow from around 45 percent today to 79 percent within 10 years. The vast majority (around 98 percent) of fisheries would be around biologically healthy levels by mid-century, and in a strong position to supply food and a greater prosperity for a growing global population.

Figure 1. **A Stark Choice: Sustainable Fishing vs. Business as Usual for World Fisheries**



Institutional reforms can provide a path to prosperity

Our results suggest that some of the greatest economic improvements in fisheries come from reforming institutions. For example, various approaches such as cooperatives, territorial user rights, or individual transferable quotas could be used to improve the economic results under a range of harvest policies, which are modeled in the sustainable fishing scenario above. Gains in profits under these "rights-based" approaches can occur quickly following reform since they do not rely exclusively on the biological recovery of the fishery. Rapid economic gains from rights-based approaches can help offset many of the costs associated with the transition to sustainability.

Every fishing nation stands to benefit from reform

We find that every fishing nation we examine stands to benefit by fishing sustainably. And even though management costs associated with sustainable fishing may rise, the benefits that these nations can realize by reforming their fisheries always exceed the costs — and profits grow over time. Practical experience demonstrates this to be true in countries like Australia, Belize, Chile, Denmark, Namibia, and the United States, where stakeholders are reversing overfishing, reviving coastal communities, and bringing the oceans back to life. By evaluating how much could be gained by fishing sustainably and the timing of recovery, the model can be a useful guide for investment that could help fisheries become sustainable.

This research is a call to action for governments, fishermen and investors

Within decades, a projected 9.5 billion increasingly affluent and urban people will compete for more food from maxed out resources. If effective reforms to end overfishing were put in place today, the ocean could become a sustainable and highly productive source of wild seafood that could help feed this burgeoning population. The study shows how we can make this vision a reality. We have a choice now to get wild fishing right, and make fisheries a driving force of the blue economy for the long-term.

Fisheries Governance Survey: Comparing across Countries and Stocks

Authors: Ray Hilborn and Michael Melnychuk (University of Washington)

New survey to characterize fisheries management systems

The elements of effective fisheries management are well-understood. Strong management means enacting measures to both prevent overfishing and, more importantly, implementing measures to reduce fishing pressure if stocks become depleted. Key practices include evaluating the status of fish and shellfish stocks, designing appropriate management measures to limit fishing mortality, and enforcing these regulations to prevent or reduce negative fishing impacts.

Despite awareness of what makes up strong fisheries management, there is a lack of publicly available information on the status of fisheries management globally. To address this need, Ray Hilborn and Michael Melnychuk from the University of Washington conducted an analysis to further understanding of the effectiveness of management approaches at regulating fishing mortality.

Effectiveness of fishery governance by country

The results for each country are aggregates of survey answers for multiple species, multiple fishery expert respondents, and multiple criteria within and across the four dimensions of fisheries governance shown below. These answers, represent a country-level index of the effectiveness of fisheries governance systems. Although only 28 of the world's countries were covered by the study, together they represent more than 80% of the world's total catch.

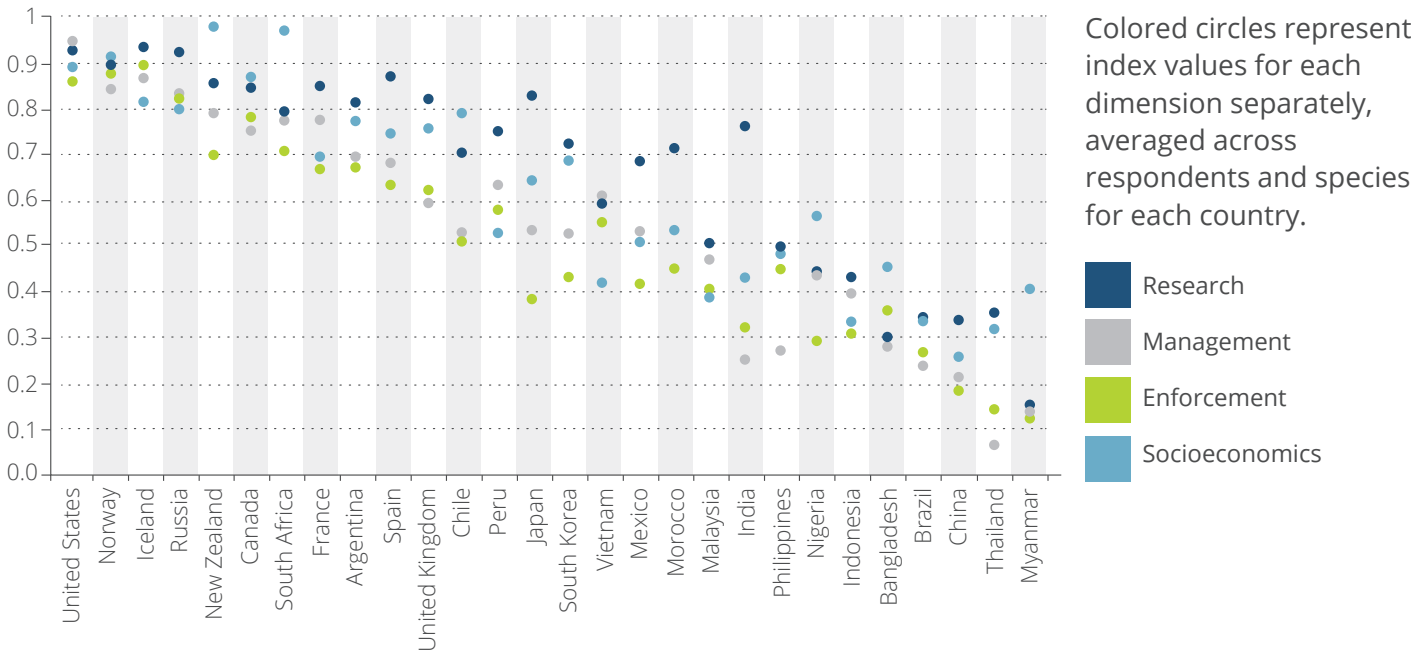
Results by dimension

Though the countries with the lowest index values—including China, Thailand, and Myanmar—currently have low assessments across all dimensions (Figure 2), these results highlight the opportunity for comprehensive improvements in fisheries management.

Further, countries that fall towards the bottom of the index—including Indonesia and Brazil—are in the midst of introducing large reforms that could help tip the scales toward more positive rankings in the coming years. In Brazil, new leadership and a commitment to implement an ambitious fisheries management plan positions the country to improve its governance system in the areas of management and enforcement. Similarly, Indonesia is introducing measures intended to improve fisheries governance, such as fighting illegal fishing, particularly targeted at foreign fleets.

Country	Index figure
United States	0.91
Norway	0.88
Iceland	0.88
Russia	0.85
New Zealand	0.83
Canada	0.81
South Africa	0.81
France	0.75
Argentina	0.74
Spain	0.73
United Kingdom	0.73
Chile	0.63
Peru	0.62
Japan	0.60
South Korea	0.59
Viet Nam	0.54
Mexico	0.54
Morocco	0.54
Malaysia	0.44
India	0.44
Philippines	0.42
Nigeria	0.39
Indonesia	0.37
Bangladesh	0.35
Brazil	0.30
China	0.25
Thailand	0.22
Myanmar	0.20

Figure 2. **Governance index by dimension and country**



What the results mean

A major benefit of this study is the ability to identify in which specific areas, and for which species, countries are performing well, and where they stand to improve. For instance, Japan and India have relatively strong research capabilities, but there are opportunities for improvements in management and enforcement dimensions. One caveat of the methodology is that results are susceptible to potential biases of self-reporting, since individuals most commonly responded for the countries in which they work and reside. Moreover, countries with poor regulation of corruption may rank higher, as the assessors may have rated the systems more in theory than in practice.

Among emerging markets, four countries that performed well in the survey are South Africa, Argentina, Chile, and Peru. South Africa, with an especially high index value in the socioeconomic dimension, has strong regulation of industrial fleets and has recently introduced policies to benefit previously disenfranchised coastal communities. Chile is also frequently cited as a model for its well-crafted artisanal fishing policies, which empower local communities to develop their own management strategies for high-value shellfish. The survey questions did not distinguish community-based management from centralized government management systems, but instead focused on how effective the system was at limiting fishing pressure irrespective of the level of centralization.

Project methodology

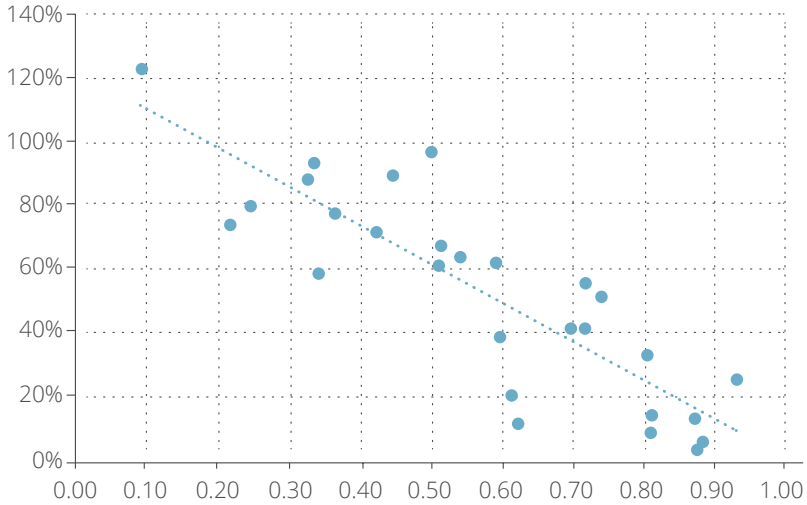
The study included an independent survey completed by experts of a country's fisheries, providing an initial rapid assessment of fisheries management and governance systems. A total of 129 surveys across 28 countries were returned, including the 20 countries that catch the most fish in the world. For each country, respondents were presented with a list of ten species: four with the highest volume of landings, four with the greatest estimated landed value, and the remaining 2–6 species were sampled randomly in proportion to their landings and landed value.

The fisheries management survey characterized four dimensions of fisheries governance. Within each dimension, between 8–14 questions were asked about the use and effectiveness of specific management strategies and tactics employed.

Figure 3. **Opportunities for improvement in fisheries governance**

The survey results indicated opportunities for improvement in these four key dimensions of fisheries governance.

Figure 4. **Correlation between governance score and upside potential**



Countries with high governance scores have reasonably little potential to increase the profitability of their fisheries, whereas countries with low governance have great potential.

As a whole, the new governance index provides important insights in identifying the specific areas in which countries are performing well and in which areas they can improve their fisheries management systems to unlock ocean prosperity.

Country-Level Costs vs. Benefits of Improved Fishery Management

Authors: Christopher Costello and Tracey Mangin (University of California-Santa Barbara)

Advisors: Jim Anderson (University of Florida), Ragnar Arnason (University of Iceland), Steve Gaines (University of California-Santa Barbara), Ray Hilborn (University of Washington), Rashid Sumaila (University of British Columbia), Jim Wilen (University of California- Davis), and Matt Elliott and Emily Peterson (California Environmental Associates)

Background

While analyses of fisheries often demonstrate the potential biological, economic, and social benefits of fisheries recovery, few studies have incorporated the costs associated with the design and implementation of the management systems needed to achieve recovery. Available data and anecdotes suggest that the current cost of fishery management may be quite substantial and that additional costs arising from major upgrades in management could be prohibitive in some countries. A careful analysis comparing the country-level benefits of fishery management improvements to the additional costs of doing so has never been undertaken. Therefore, a study focusing on the current and incremental costs of fishery management upgrades could have important implications for policy design to efficiently rebuild global fisheries.

This analysis has three objectives. The first is to estimate the current cost of managing fisheries in the top fishing countries of the world. The second is to estimate, for a range of alternative management approaches, the concomitant change in cost, also at the country level. Finally, we combine these cost estimates with recent estimates of the economic benefits of fishery recovery to arrive at a cost-benefit calculation of improved fishery management around the world. This comparison determines if the expected economic benefits of a suite of fishery management reforms are greater than the management costs associated with those reforms. The analysis is decidedly practical: our goal is to derive ballpark estimates of these values to ultimately inform the question of whether the potential benefits can justify the likely increase in management costs.

Methodology

There are five major steps to completing this analysis. First, we estimate the cost of managing fisheries for all major fishing countries in the world and standardize by the cost per metric tonne (MT). This step is accomplished by developing a cost database including as many countries as possible and then imputing cost, based on the available data, for countries with limited data. We then focus on the 25 countries with largest fish catch. Second, we categorize the landings in each country by management type. The third and fourth steps are developing and implementing a model of incremental management cost parameterized with cost data, fishery management data, and a survey of global fishery management experts to estimate the future costs of alternative management interventions using. Finally, using projected profits in the year 2050 associated with different management interventions (these are extracted from a companion study[2]), we compare the economic benefits of management reform with the estimated costs associated with the new management in each country.

Results

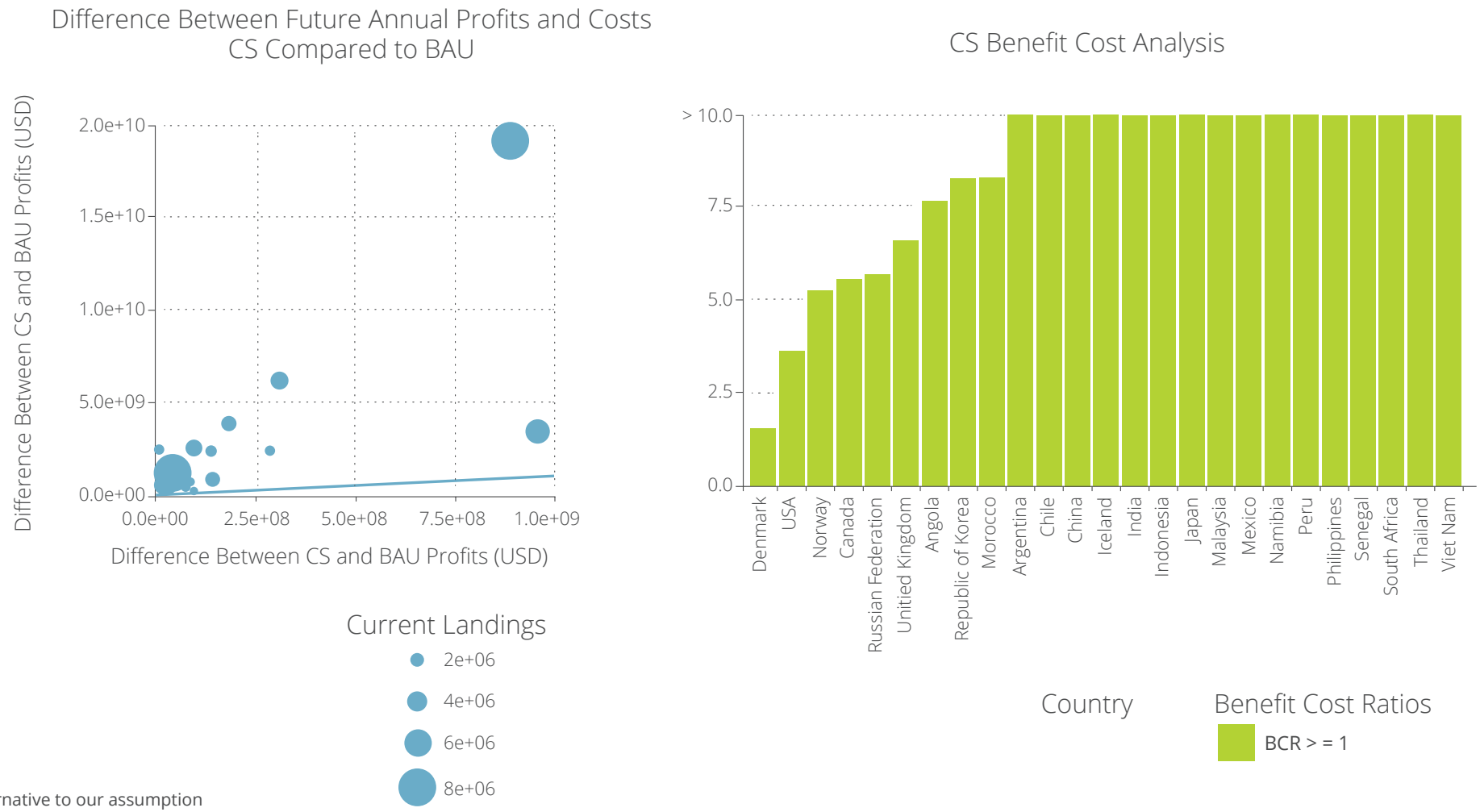
We find substantial variation in current management costs across countries (approximately an order of magnitude difference in management cost per MT) and that incremental costs of upgrading fishery management can be quite substantial (in some countries, this could involve a doubling or tripling of management cost). Despite these results, our overall finding is that in every country examined, the benefits of reform substantially outweigh the incremental costs in management. This result holds across a wide range of assumptions and is consistent with empirical data, new case studies, and ad hoc interviews conducted with fishery managers in countries that have already undergone these welfare-improving transitions.

OC and CS Scenarios Compared to BAU, 2050

Figure 1 shows the incremental cost vs. the incremental benefit of fishery management reform, where each country is represented by a single point. The size of the point indicates the size of the fishing sector in that country measured in total harvest (in MT) for 2012. Therefore, larger dots represent counties with higher annual landings in 2012. The top panels provide results for CS vs. BAU and the bottom panels provide results for OC vs. BAU.

2. Costello et al., 2015. Have your fish and eat them too. Under Review.

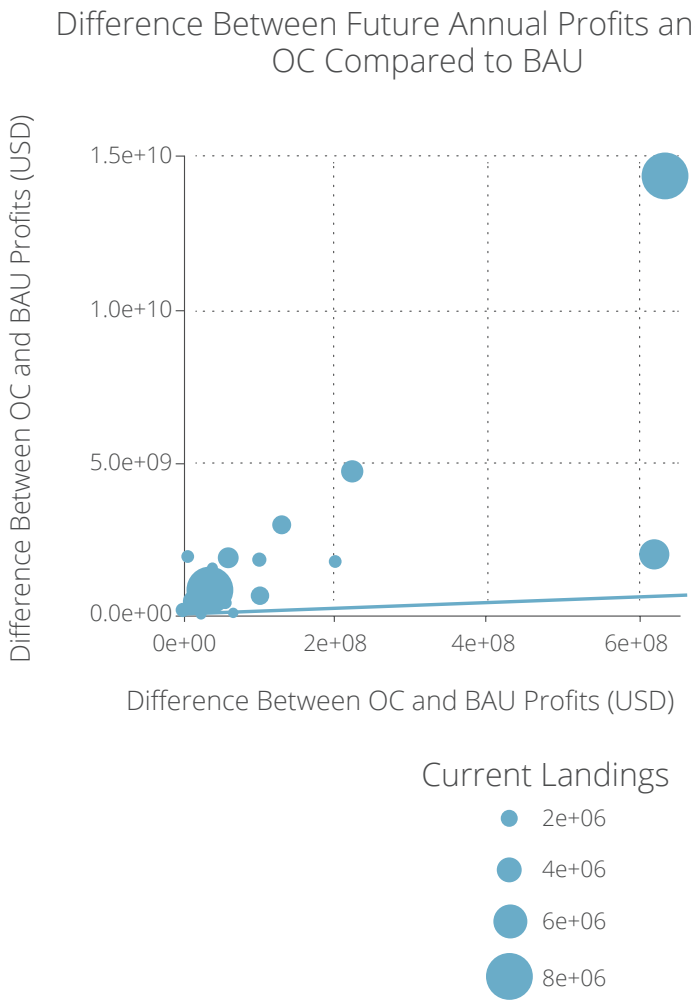
Figure 2. **Difference between future profits and management costs: CS Scenario and OC Scenario compared to BAU. Benefit-cost-ratios are capped at 10 in the figures on the right.**

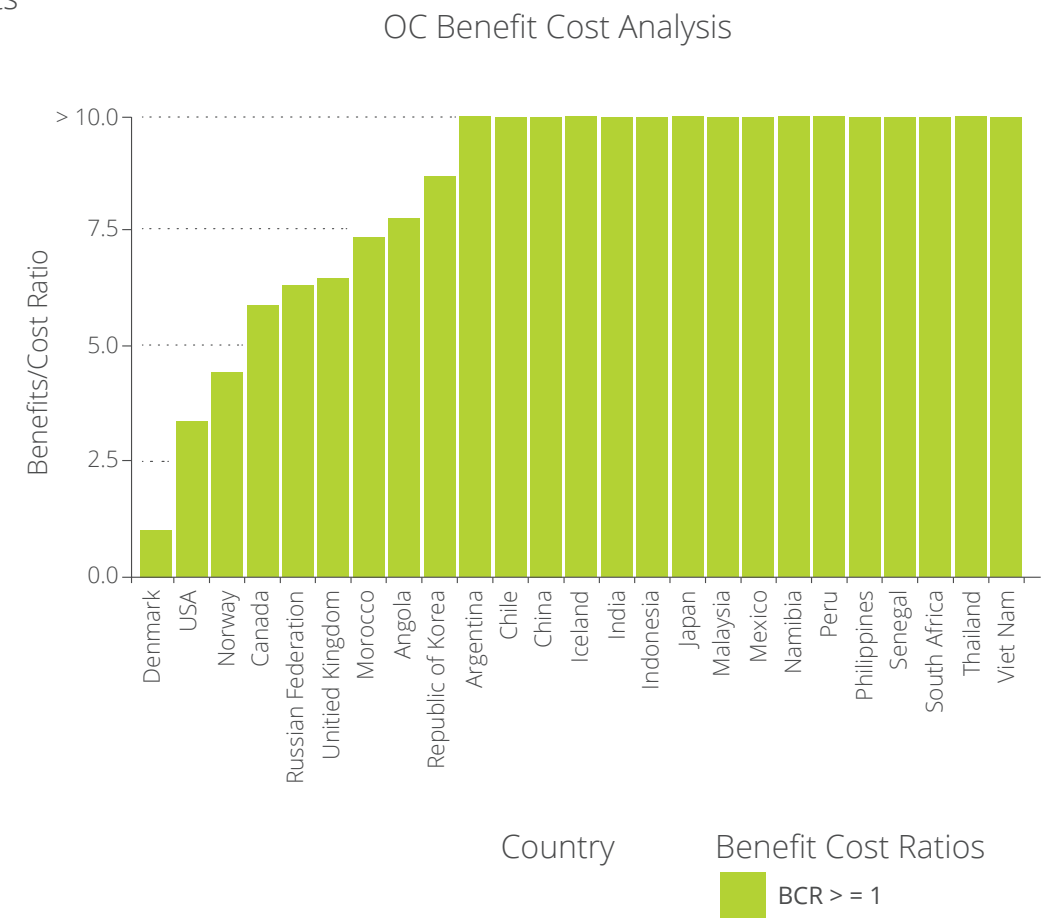


Three results immediately pop out. The first is that when considering reforming all fisheries in a country to some form of CS, we find that the cumulative benefits always exceed the costs (all dots are above the 1:1 line on the top left panel and all benefit cost ratios exceed 1.0 on the top right panel). Indeed, the benefit cost ratios range from just over 1.0 up to 82 or more, averaging at about 29. The global benefit cost ratio average for catch share management is 34. These results are at the country level and do not necessarily imply that the benefits of switching to catch share management will outweigh the costs in each fishery. Instead, this result compares the aggregate benefits of moving to CS against the aggregate costs of doing so.

[3] As an alternative to our assumption that management cost scales with raw landings, we also repeated the entire analysis assuming that management cost scales with fishery revenue. Under that alternative assumption, benefit cost ratios for the top twenty five countries were qualitatively similar: Under the CS scenario all countries had a benefit cost ratio exceeding one; under the OC scenario, all countries (except Chile) had a benefit cost ratio exceeding one.

Figure 2. **Difference between future profits and management costs: CS Scenario and OC Scenario compared to BAU. Benefit-cost-ratios are capped at 10 in the figures on the right.**





The second result is that the large fishing countries tend to also have the largest benefit cost ratios – it turns out that the larger a country's catch, the more it stands to gain from aggressive fishery management reforms.[4]

The third result is that while the numerical results are somewhat muted when moving from BAU to OC, most countries would still benefit from such a shift. The global cost of managing all fisheries in our database under catch share management in 2050 is about USD 11.09 billion, which is not quite double the global cost of BAU (USD 6.21 billion) and 2012 current global management costs (USD 5.76 billion).

4. This result is not a foregone conclusion – it could easily have turned out that benefit cost ratios showed no, or an inverse, relationship with fishing volume.

Discussion

Two interpretations emerge from this study: First, while adopting effective catch shares is likely to entail the largest incremental increases in management cost, it is also likely to lead to even more significant increases in economic rent or profit. In fact, expert opinion suggests that depending on how well fisheries are already managed, the cost of switching to catch share management might even lower costs relative to BAU, which would further strengthen our main results. If some of that increase in profit can be captured to pay for the change in management cost (indeed, only a small fraction of it would be required in most countries), then the policy reform would be win-win.

A key question that comes up when considering management costs is who should pay. It has been argued because the fishing industry benefits from management services, it should pay the costs associated with that management. Generally, taxpayers end up paying for these services, which are in turn provided by the government.

Importantly, the benefits depicted in these results do not reflect individual fisheries, but the generalized benefits at the national level. Specific fisheries might benefit differently from management changes, and effective catch shares will surely require careful design tailored to each fishery.

In addition, while this study suggests that those directly employed by the fishing industry could experience an increase in profits with a shift from less effective management to catch shares, and to a lesser extent, strong output controls, it does not investigate the implications of management reform down the supply chain. The value of this sector could potentially decrease with management that requires decreases in harvests. More research is needed to determine the economic implications of improved management on other related sectors.

The finding that adopting OC is still beneficial, but not as beneficial as adopting CS, is not too surprising, particularly given our assumption that securing long-run economic profit is still possible under OC. While output controls alone can be effectively implemented to regulate catch and achieve conservation objectives, there is a strong theoretical argument that they cannot ensure significant long-run profits, because rents will be dissipated by excessive effort on unregulated margins. Thus, we regard the OC scenario as an intermediate case between open access and fully rent-capturing catch shares. As such, the profit upside from OC will always be lower than the profit upside from CS. While it is also true that our results suggest lower management costs under OC (than CS), they are not sufficiently low to make OC more attractive than CS.

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2. Costello et al., 2015. Have your fish and eat them too. Under Review.

Future work

There are a number of ways in which this study could be built upon to further examine the relationship between costs and fisheries management. First, while this study focused on the annual cost of management after management reform has been implemented, studies and interviews indicate that transition costs can be significant. During the transition period, the reform is designed and planned. This stage can be labor intensive and take a substantial amount of time, thus incurring significant fixed costs. In addition, it may require expensive research efforts to guide reform design. Including this expense would capture a more comprehensive cost of fisheries management.

Second, future studies could expand on this work by developing a more precise model for determining changes in management cost, for example by incorporating complexities in rules and regulations such as bycatch regulations, limits on days at sea, gear restrictions, and required reporting and analysis likely to influence the costs of administration, research, and enforcement services.

Finally, while the country-level approach used in the current study is useful for making decisions at the national level, a fishery level-approach might provide key insights for managers working on the reform of individual fisheries. This approach would require fishery-level data on the cost associated with management attributes specific to fishery type. Importantly, improved data on the cost of managing fisheries at both the country and fishery level would facilitate more precise analyses.

Conclusion

As this collection of research highlights, there is substantial value to unlock in setting global fisheries on a more sustainable and profitable path.

Fisheries can represent a bright spot in the "blue economy," yielding substantial social, economic, and environmental benefits. Relative to what is earned today, annual net economic benefits from global fisheries could increase by approximately US$80 billion if global reform efforts were undertaken at scale and in a timely manner.

The research highlighted here demonstrates that when governments implement and enforce strong policies and regulations to manage their fisheries sustainably, the benefits are mutually reinforcing: fish production increases; economic profits rise; and fish stocks recover and rebuild. The path to sustainable fisheries will require not only reform by government, but also accompanying practices such as an improved business environment, increased transparency, and sound science and careful monitoring. Collectively, these practices create a synergy that helps enable the transition to sustainable fisheries management.

One of the remaining challenges is determining how best to finance the comprehensive costs of reform, particularly during the transition period. We believe there are emerging opportunities for all sectors to contribute to the transition to sustainable management, from the private sector and public finance playing an innovative role in financing the transition, to the research community providing critical and timely data as well as innovative technologies that can enable smart policy decisions.

The rewards of sustainable management have never been higher—and the costs of inaction have never been more clear—in unlocking the underlying potential of global fisheries.