Catalysing Ocean Finance

Volume I
Transforming Markets to Restore and Protect the Global Ocean

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Caption: Indonesia: Hardy head silversides (Atherinomorus lacunosus) are abundant shoals of fish living in shallow water reef flat seagrass meadows throughout the Indo-Pacific. These fish species that feed primarily on zooplankton and small benthic invertebrates are an important part of the seagrass food web. They make an excellent food source for larger fish species.

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FOREWORD

The world's oceans and coastal areas are an integral part of life on earth. They are the source of a variety of essential goods and services – including food, transport, oil, gas, and minerals, to name but a few, and also deliver vital ecosystem services such as climate regulation and oxygen production.

It is therefore of tremendous concern that our oceans are under significant threat, whether that be from pollution, overexploitation, habitat loss, invasive species, or climate change.

While a number of important commitments have been made to the protection and restoration of oceans, their health is still in decline. This underscores the need to take decisive action without delay.

This publication - *Catalysing Ocean Finance* - demonstrates that, far from being an intractable problem, sustainable ocean management could become a successful legacy of today's generation of decision-makers. It shows how the challenges facing the ocean stem from widely understood market and policy failures - failures which can be addressed through the application of appropriate mixes of market and policy instruments.

As early as the mid-1990s, the Global Environment Facility (GEF) and its partners recognised and began to address threats to marine ecosystems and associated livelihoods and economies. In so doing, the GEF acknowledged that the sheer size and multi-country nature of most of these marine systems, and their linked river basins, as well as the global nature of some of the threats they are faced with, called for coordinated, multi-country approaches. With its focus on transboundary waters, this positioned the GEF as a potential catalyst to demonstrate and scale up effective strategies to address ocean challenges.

Over the past twenty years, the United Nations Development Programme (UNDP) and the GEF have successfully developed a range of strategic planning tools aimed at assisting governments to put in place enabling policy environments to catalyse investment for restoring and protecting the marine environment. In several cases, catalysed public and private financial flows have exceeded the initial GEF investment several hundred-fold. In some cases, these instruments have helped to shift sizeable ocean industries, such as shipping and tuna fisheries, to a more environmentally sustainable path.

Catalysing Ocean Finance takes stock of how effective these instruments have been in helping countries to address challenges facing the oceans and explores how they could be successfully scaled up. It estimates that an initial public investment – on the order of $5 billion over the next ten to twenty years – could be sufficient to catalyse several hundred billion dollars of public and private investment, and thereby foster global transformation of ocean markets towards sustainability.

The Global Environment Facility and the United Nations Development Programme, working in partnership with partner countries and initiatives, such as the recently launched World Bank Global Partnership for Oceans and the UN Secretary General's Oceans Compact, look forward to building on the successful approaches demonstrated in *Catalysing Ocean Finance* to sustainably utilise our oceans, for the benefit of present and future generations.

Sincerely,

Helen Clark
Administrator
United Nations Development Programme

Naoko Ishii
Chief Executive Officer
Global Environment Facility

ACRONYMS

$	US dollar
ABNJ	Areas Beyond National Jurisdiction
ACUMAR	Autoridad de Cuenca Matansa Riachuelo
BOD/COD	Biochemical Oxygen Demand/Chemical Oxygen Demand
BSERP	Black Sea Ecosystem Recovery Project
BWM	Ballast Water Management
CARP	Comisión Administradora del Río de la Plata
CBD	Convention on Biological Diversity
Chl a	Chlorophyll a
CO_2	Carbon Dioxide
CP	Cleaner Production
CTMFM	Comisión Técnica Mixta del Frente Marítimo
DDT	Dichlorodiphenyltrichloroethane
DIN	Dissolved Inorganic Nitrogen
DRP	Danube Regional Project
EBRD	European Bank for Reconstruction and Development
EcoQOs	Ecosystem Quality Objectives
EcoQWROs	Ecosystem Quality or Water Resource Objectives
EEDI	Energy Efficiency Design Index (for ships)
EEZs	Exclusive Economic Zones
EIB	European Investment Bank
EU	European Union
FAO	Food and Agriculture Organization of the United Nations
FFA	Forum Fisheries Agency
FSA	United Nations Fish Stocks Agreement
GBP	GloBallast Partnerships
GEF	Global Environment Facility
GHG	Greenhouse gas
GIA	Global Industry Alliance for Marine Biosecurity
GloBallast	Global Ballast Water Programme
GPA-LBA	Global Programme Action to Protect the Marine Environment from Land-based Activities
HCFC	Hydrochlorofluorocarbons
ICM	Integrated Coastal Management
ICPDR	International Commission for the Protection of the Danube River
IOC/UNESCO	Intergovernmental Oceanographic Commission of UNESCO
IFNR	Investment Fund for Nutrient Reduction
IMC	Inter-Ministerial Committees
IMO	International Maritime Organization
IMTA	Integrated Multi-Trophic Aquaculture
IPCC	Intergovernmental Panel on Climate Change
ITQs	Individual Transferable Quotas
IUCN	World Conservation Union
IW	International Waters
IWRMP	Integrated Water Resource Management Plan
JAP	Joint Action Programme
JPOA	Johannesburg Plan of Action
LME	Large Marine Ecosystem
LPC/PC	Lead Partner Country/Partner Country
M&E	Monitoring and Evaluation
MARPOL	International Convention for the Prevention of Pollution From Ships
MDG	Millennium Development Goal
MEPC	Marine Environment Protection Committee (of the IMO)
MHLC	Multilateral High Level Conference
MPA	Marine Protected Area
MRV	Measurement, Reporting and Verification
MSC	Marine Safety Committee
MSY	Maximum Sustainable Yield
Mt	Metric Tons
N	Nitrogen
NAP	National Action Plan or Programme
NGO	Non-governmental organisation
NIMRD	National Institute for Marine Research and Development (Romania)
NOAA	National Oceanic and Atmospheric Administration
ODI	Overseas Development Institute
ODS	Ozone Depleting Substances
OECD	Organisation for Economic Co-operation and Development

OFMP	Oceanic Fisheries Management Project
OPRC	International Convention on Oil Pollution Preparedness, Response and Cooperation
P	Phosphorus
PA	Precautionary approach
PCB	Polychlorinated Biphenyls
PEMSEA	Partnerships in Environmental Management for the Seas of East Asia
PIC	Pacific Island Countries
POPs	Persistent Organic Pollutants
PPPs	Public Private Partnerships
QA/QC	Quality Assurance/Quality Control
R&D	Research and Development
REDD	Reducing Emissions from Deforestation and Forest Degradation
RFMO	Regional Fisheries Management Organisation
RPMF	Rio de la Plata & its Maritime Front
SAP	Strategic Action Programme
SDCA	Sustainable Development of Coastal Areas
SDS-SEA	Sustainable Development Strategy for the seas of East Asia
SEEMP	Ship Energy Efficiency Management Plan
SIDS	Small Island Developing States
SOC	State of the Coasts
SPC	Secretariat of the Pacific Community
SSTs	Sea Surface Temperatures
STAP	Scientific and Technical Advisory Panel
TDA	Transboundary Diagnostic Analysis
TSC	Train-Sea-Coast
UN	United Nations
UNCED	United Nations Conference on Environment and Development
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNFCCC	United Nations Framework Convention on Climate Change
WCMC	World Conservation Monitoring Centre
W/C	Western and Central
WCPFC	West & Central Pacific Fisheries Commission
WCPO	West & Central Pacific Ocean
WHO	World Health Organization
WSSD	World Summit for Sustainable Development
WTO	World Trade Organization
WWTP	Wastewater Treatment Plant
YSFRI	Yellow Sea Fisheries Research Institute
YSLME	Yellow Sea Large Marine Ecosystem

EXECUTIVE SUMMARY

Marine and coastal resources directly provide at least $3 trillion annually in economic goods and services plus an estimated $20.9 trillion per year in non-market ecosystem services (Costanza, 1997). Unfortunately, coasts and oceans are exposed to increasing threats such as pollution, overfishing, introduced species, habitat and species loss, and poorly planned and managed coastal infrastructure development. The cumulative economic impact of poor ocean management practices is at least $200 billion dollars per year. In the absence of pro-active mitigation measures, climate change will increase the cost of damage to the ocean by an additional $322 billion per year by 2050 (Noone, 2012). The ocean is estimated to have absorbed 25-30% of anthropogenic carbon dioxide emissions. While this has served to mitigate atmospheric warming to a sizeable extent, it has increased the acidity of the ocean by 30%, with significant threats to calcium carbonate fixing organisms that serve as the foundation for many ocean food chains upon which hundreds of millions depend for food protein and livelihoods. Climate change is already affecting surface ocean temperatures, driving fish stocks to migrate to more favorable waters and reducing upwelling of vital nutrients to key fisheries areas, further threatening fisheries yields (Sherman and McGovern, 2012). In addition, sea level rise, due to the thermal expansion of seawater, glacial melt and groundwater extraction, endangers millions living in the coastal zone and island states, mostly in the world's least developed countries

The key finding of this publication, however, is that it is still possible to restore and sustainably develop the ocean's full potential for present and future generations. A common driver behind the accelerating degradation of the marine environment is the inability of markets to sustainably utilise open-access resources such as the global ocean. As a result of these market failures, both the private and the public sectors have tended to under-invest or not invest at all in activities necessary to sustain the marine environment (wastewater treatment, coastal habitat protection, etc.) and to over-invest in activities detrimental to the marine environment (over-exploitation of fish stocks, chemically intensive agriculture, etc.). These market failures have often been further compounded by policy failures (perverse subsidies, etc).

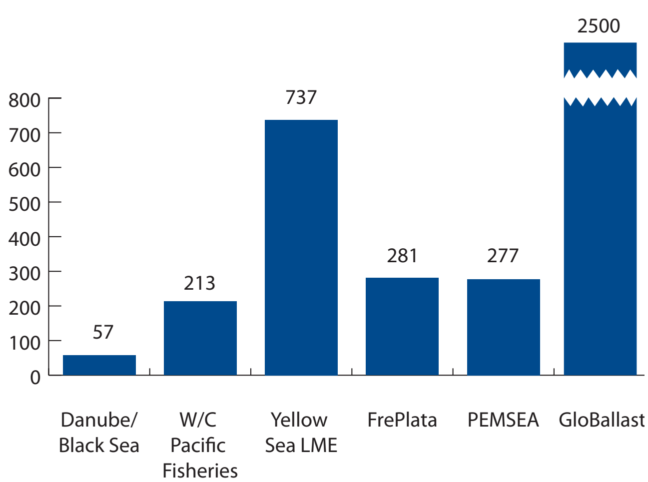
In recent years, decision-makers throughout the world have designed and implemented a wide array of instruments to identify and remove these market and policy failures. These instruments have helped governments put in place clear incentives to all market players to restore and protect coasts and oceans. The objective of this publication - *Catalysing Ocean Finance* - is to take stock of these achievements and explore how they could be scaled up to address key ocean challenges with only modest additional public funds. Notably, *Catalysing Ocean Finance* presents three major instruments that have proven highly effective at promoting science-based, long-term integrated planning and barrier removal to transform markets and create sustainable productive use patterns of coastal and ocean resources over the past 20 years. These instruments include:

- Transboundary Diagnostic Analysis/Strategic Action Programme (TDA/SAP)
- Integrated Coastal Management (ICM)/Framework for Sustainable Development of Coastal Areas (SDCA)
- Global or Regional Ocean Legal Frameworks

Drawing from the portfolio of International Waters projects financially supported by the Global Environment Facility (GEF) and implemented by the United Nations Development Programme (UNDP) in 31 of the world's most important transboundary marine and freshwater ecosystems, six case studies have been selected to illustrate the application of these three market transformation instruments to promote sustainable coastal and marine resource development: (i) Danube River/ Black Sea; (ii) Yellow Sea Large Marine Ecosystem; (iii) Rio de la Plata/Maritime Front; (iv) Seas of East Asia; (v) West/Central Pacific Fisheries; and (vi) Global Ballast Water Programme.

By advancing ocean governance reform at local, provincial, national, regional and/or global scales, each planning instrument used in these six case studies has proven highly effective at leveraging large public and/or private financial flows, leveraging the GEF public grant finance several hundred-fold. In specific cases, these initiatives have catalysed sufficient financial flows to restore large marine ecosystems severely degraded by pollution, move some of the world's largest fisheries towards sustainability, and reduce global risks from the transfer of invasive aquatic species. Strikingly, in the six case studies reviewed, the ratios of catalysed finance to initial GEF grant support range from 57 to 1 to 2,500 to 1, averaging 458 to 1. For an order of comparison, UNDP regards as satisfactory a leveraging ratio of 4 to 1 for off-grid clean energy access (Glemarec, 2012).

Figure 1: Leveraging Ratio of Six Coastal and Ocean Market Transformation Initiatives



What specific lessons can be learned from these methodologies and case studies that can inform their replication and scaling up in other ocean and coastal contexts? We believe that seven key lessons can be derived from *Catalysing Ocean Finance*.

The **first** lesson is that **correcting market and policy failures through application of science-based integrated ocean planning and barrier removal instruments can not only act catalytically to restore and protect coasts and oceans, but can also generate sizeable business activity and jobs when job creation activities are deliberately built into ocean management reforms**. No country has ever truly developed based on a green growth model and the materiality of green markets at large scale remains a subject of debate. However, *Catalysing Ocean Finance* provides strong evidence for effective 'blue economy' approaches to ocean management that generate substantial jobs in support of marine ecosystem restoration and protection. As such, allocating programme resources for job creation as well as documenting and communicating the impact of coastal and ocean reforms on business activity and jobs will be critical to foster the political support needed to scale up the effective ocean actions described in this publication.

The **second** lesson is the **importance of investing in capacity development for ocean policy makers and other stakeholders**. In each of the six case studies examined, enhancing the policy development and implementation capacity of decision-makers played a substantial role in accelerating the formulation of new policy and the adoption and implementation of new regulatory and economic instruments at local, national, regional and global levels.

The **third** lesson is the **need to reach consensus among all stakeholders about the most effective mix of public instruments to remove barriers to investment and market transformation**. In general, the engagement of four main groups of stakeholders will always be required to transform a market: communities; ocean-impacting industries, policy makers; and financiers. Each of these groups typically encounters a number of specific barriers that prevent them from using ocean and coastal resources in a sustainable manner. Policies that bring benefits to one group of stakeholders can penalise another and lead to a policy deadlock.

The **fourth** lesson is that **public policies are not for free. Whatever the policy mix that is selected, there will be a cost for industry, consumers, tax payers and**

shareholders. As a general rule, everything that can be done to first reduce systemic investment risks — such as long term and transparent policies, streamlined administrative processes, or improved consumer information — needs to be a first-order priority, before resorting to more expensive public policy instruments to increase investment-specific rewards such as subsidies or concessional finance.

The **fifth** lesson is the **importance of dedicating adequate public resources to investment pre-feasibility work during the policy analysis and development stage of market transformation efforts**. Much greater leveraging ratios are observed in programmes having committed adequate resources to assist stakeholders in preparing priority investment portfolios. With a few exceptions, this is an area that has received insufficient attention in the GEF International Waters portfolio and represents an opportunity to enhance the likelihood of large financial flows being successfully catalysed by GEF-financed ocean and coastal initiatives.

The **sixth** lesson relates to the **value of combining two or even all three of the market transformation methodologies - TDA/SAP, ICM and global/regional legal frameworks – in the design and implementation of ocean governance programmes**. This approach can generate multiple, synergistic benefits by strategically building on the comparative advantage of each instrument at different geographic scales. It also increases their flexibility and can enhance the impact of these instruments on a broad range of existing and emerging ocean challenges, including overfishing, hypoxia, coastal habitat loss, invasives species, and ocean acidification.

Our **seventh** and final lesson is probably the most important. The time frames to transform ocean markets through science-based integrated planning, barrier removal and market transformation are long, typically 15-20 years or more. In contrast, the present rate of increase of the majority of ocean issues including hypoxia, acidification, overfishing, and coastal habitat loss, is geometric. **The combination of the geometric pace of ocean degradation with the long time frames needed to facilitate catalytic and transformative changes in ocean sectors underscore the urgency of taking immediate action on the key ocean challenges.**

For each of the six case studies reviewed in this publication, while stress on marine ecosystems has been reduced and, in some cases, measurable environmental improvements realised, globally coasts and oceans remain on a negative trajectory and are likely to continue to degrade at an increasing pace if the drivers of degradation are allowed to continue unabated. Building on these findings and financial and environmental data generated by the UNDP-GEF portfolio of International Waters projects over the past 20 years, Volume I of *Catalysing Ocean Finance* sets forth a roadmap to restore and protect our ocean over the next 20 years. It reviews the environmental status of the four main threats to the world ocean: (i) Ocean Hypoxia; (ii) Ocean Acidification; (iii) Introduced Species; and (iv) Overfishing, with important cross-linkages to coastal habitat loss and degradation.

For each threat, the publication presents the main drivers of degradation and provides recommendations on how scaling up the market transformation methodologies and approaches described in *Catalysing Ocean Finance* can foster policy reform and catalyse investment to mitigate/eliminate these drivers and preserve the socio-economic benefits provided by coastal and ocean resources. Then, it estimates the approximate public costs, benefits and total catalysed finance of a global effort to dramatically reduce the impact of each of these four threats to ocean ecosystems.

Catalysing Ocean Finance estimates that reducing and in some cases arresting the degradation of coastal and ocean resources would require an initial public investment of about $5 billion over the next 10-20 years. The methodologies and assumptions used to reach this estimate are summarised in Figure 2. The cost breakdown and expected financial flows to be catalysed by this initial public investment for each of the four main threats are consolidated in Table 1. The bulk of the financial flows catalysed will come from the private sector or commercial utilities, not the public sector. For ocean hypoxia, ocean acidification, overfishing and marine invasive species, catalysed ocean finance ratios range from 8 to 1,000, comparable to the ranges observed in the six case studies presented in Volume II of this publication.

Table 1: Public Costs, Catalysed Finance and Ratios for Scaled Up Actions to Sustain the Global Ocean

Issue	(1) One-time public cost ($ m.)	(2) Additional and Recurring Public Costs ($ m./yr)	(3) One-time Catalysed Finance ($ m.)	(4) Recurring Catalysed finance ($ m./yr)	(5) Catalysed Finance Ratio (1-time costs) =(3)/(1)	(6) Avoided Costs ($ m./yr)
Hypoxia	2,500	-	76,000	-	30:1	200,000-790,000
Ocean Acidification	820	-	20,000	300-5,100	24:1	104,000-182,000
Overfishing	29,048	21,000	232,000	56,000	8:1	50,000
Marine Invasive Species	20	-	20,000	-	1000:1	10,000-90,000

Source: Data from Chapter 4 and also summarised in Figure 2

For fisheries, 98% of the initial public costs would be for the establishment and operation of a global system of Marine Protected Areas (MPAs) that met the CBD's Aichi target of 10% of ocean area by 2020 and would accelerate recovery of depleted fish stocks. The bulk of these initial costs could be met from innovative private financing mechanisms ($40 billion/year from ITQ proceeds) and budget neutral fiscal reform ($16 billion/year from redirected 'bad' fisheries subsidies).

All the cost and benefit estimates given in this publication are rough and probably accurate to no more than a factor of about 2-3. However, this uncertainty does not alter the overall conclusion of *Catalysing Ocean Finance*: the amounts of catalysed public and private ocean finance that could be realised through the scaling up of the strategic planning and existing and emerging policy instruments described in *Catalysing Ocean Finance* would be many times the initial publicly funded investments, and the realised benefits/avoided costs would exceed the initial public costs by even higher ratios. The initial investment in public grant funds required to support the planning and governance reforms needed to catalyse these financial flows would be on the order of $4-5 billion. This amount would represent an average annual allocation of about $250 -$500 million per year if programmed over 10-20 years. This financial effort is well within the reach of existing financing mechanisms such as the Global Environment Facility and possible new and emerging mechanisms such as the World Bank's Global Partnership for Oceans or the Green Climate Fund.

In conclusion, this analysis underscores that the deterioration of coastal and ocean resources is not an intractable problem. We have the policy tools required to reverse these global degradation trends and a concerted programme of highly catalytic public and private investments to sustain the world ocean lies well within our financial reach. However, the window of opportunity to restore and sustainably develop coastal and resources for present and future generations is closing very fast, as the ongoing degradation of these assets is occurring at a geometric rate and could become irreversible beyond certain tipping points.

Figure 2: Scaling up Actions to Restore Ocean Ecosystems

	Ocean Hypoxia	Ocean Acidification	Overfishing	Marine Invasive Species
	Reduce nutrient over-enrichment of coastal areas	**Energy efficient shipping Protect & restore coastal carbon sinks**	**Reduce unsustainable fishing practices**	**Reduce aquatic species transfer via ship hull fouling**
Strategic Planning Methodologies	• Scale up TDA/SAP in 20 remaining LMEs (& linked river basins) facing hypoxia • Scale up ICM in same LMEs as tool to leverage nutrient pollution reduction investments and protect nutrient sinks	• Build on UNFCC – Ocean pH target (minimum) – Adoption of Blue Carbon • Build on new IMO ship energy efficiency guidelines • ICM, TDA/SAP to help promote scaling up local and national Blue Carbon initiatives	• Build on Global & Regional Legal & Institutional Frameworks – Complete WTO negotiations to phase out negative fisheries subsidies – Strengthen RFMOs & LME institutions • TDA/SAP: Scale up in ~50 LMEs/fisheries areas facing depletion/overexploitation • ICM as cross sectoral tool to promote sustainable fishing & aquaculture	• Build on anticipated international instrument on Ship Hull Fouling • Incorporate hull fouling issue into LME TDA/SAPs where invasives are priority issue
Policy Instruments	• Nutrient management regulations • Nutrient emissions cap and trade in river basins (national, regional) • Fertiliser subsidy reform • Subsidies to agricultural nutrient reduction practices & technology • Subsidies to wastewater and industrial nutrient recovery & re-use • Global nutrient reduction fund capitalised by innovative financial mechanism(s)	• Amend UNFCCC to incorporate safe ocean acidity limit & catalyse action on low carbon economy • Blue carbon inventory methodologies • Tools, methodologies, standards & guidelines to promote uptake of IMO energy efficiency guidelines – Ship management plans (SEEMP) – Ship design standards (EEDI) – Facilitate private sector R&D	• Shift negative fisheries subsidies $16 billion/yr to sustainable aquaculture & MPAs • Scale up Individual Transferable Quotas (ITQ), $ to MPA, aquaculture, management • CBD Aichi Biodiversity Target 11-10% oceans under MPAs • Ensure sound science, EBA, data sharing, precautionary principle in RFMO & LME commission mandates • UN Fish Stocks Agreement, FAO Code of Conduct, Port State Measures, etc.	• Tools, methodologies, standards & guidelines on hull fouling management • Support to negotiations and enhanced capacity for implementation of possible new international agreement • Facilitate private sector technology R&D
Costs, Benefits & Catalysis	• Public costs: – TDA/SAP LMEs: $1.0 billion (1 time) – ICM global: <$1.5 billion (1 time) • Benefits (avoided costs): $200-790 billion/year • Catalysed Finance: – TDA/SAP LMEs: $60 billion – ICM global: <$16 billion	• Public costs: $420-820 million (1 time) • Benefits (avoided costs) – Shipping on CC: $88 billion/yr (2050) – Blue Carbon on CC: $16-94 billion/yr (2050) – Shipping $90-310 billion/yr (fuel savings) by 2030 • Catalysed Finance: – Blue Carbon $0.3 - 5.1 billion/yr – Shipping ~$20 billion (1 time)	• Public costs: – RFMOs/LMEs: $496-600 million (1 time) – MPAs @ 10% ocean: – Establish $28 billion (1 time) – Operation $21 billion/yr • Benefits (avoided costs): $50 billion/yr • Catalysed Finance: – Shifted subsidies: $16 billion/yr – ITQ sales: $40 billion/yr – RFMOs/LMEs: $232 billion (1 time)	• Public costs: $20 million (1 time) • Benefits (avoided costs): $10-90 billion/yr • Catalysed Finance: $10-30 billion

INTRODUCTION

Coasts and oceans are being degraded at a rate that will have significant social and economic implications worldwide if allowed to continue unabated. Over the last twenty years, UNDP-GEF has successfully developed and applied a series of ocean and coastal market transformation methodologies that have proven very effective at removing barriers and putting in place an enabling policy environment that can catalyse sizeable quantities of public and private sector financial flows for ocean restoration and protection.

The ambition of *Catalysing Ocean Finance* is to codify and share the lessons learnt by UNDP-GEF in transforming markets to restore and protect the global ocean. It is intended for government policy makers tasked with creating incentives for the protection, restoration and sustainable development of coastal and ocean resources vital to the economic future of the world's coastal nations. *Catalysing Ocean Finance* is divided into two volumes.

Volume I of this publication, titled "Transforming Markets to Restore and Protect the Global Ocean", summarises, through a series of six case studies, the effectiveness of each of these instruments in catalysing financial flows and presents options for scaling them up to address present and future threats to coastal and ocean resources. Volume I is organised into four chapters. Chapter 1 explores the main causes of coastal and ocean degradation and presents a new paradigm to sustainably utilise open access resources such as the global ocean: using scarce grant funds to promote integrated, science-based ocean and coastal planning and policy reform, remove investment barriers, and catalyse large public and private flows for sustainable ocean resource management.

Drawing from six case studies, Chapter 2 briefly describes the application of three major planning instruments used to foster sustainable productive use patterns of coastal and ocean resources over the past 20 years. Chapter 3 considers the lessons learnt from these case studies and methodologies over the past 20 years that can inform their transfer and replication in other ocean and coastal contexts. Lastly, Chapter 4 sets forth a roadmap to restore and protect our ocean over the next 20 years via the combination and scaling up of these planning instruments to address four principal ocean sustainability challenges.

Volume II of this publication, titled "Methodologies and Case Studies", comprehensively reviews each of the three methodologies and six case studies used to further substantiate several of the main conclusions reached in Volume I. It is divided into three chapters. Chapter 1 provides a detailed description of the TDA/SAP methodology as a strategic planning tool for management of Large Marine Ecosystems and their linked drainage basins. This is followed by three case studies – Danube/Black Sea Basin, Yellow Sea Large Marine Ecosystem, and Rio de la Plata/Maritime Front – documenting how TDA/SAP created the necessary enabling environment to deliver sizeable levels of investment for ocean restoration and protection in each of these waterbodies. Chapter 2 describes Integrated Coastal Management as a very effective tool for promoting sustainable use of coastal resources at local, municipal and provincial scales, and highlights the UNDP-GEF East Asian Seas PEMSEA programme as a case study documenting how effective ICM can be at creating an enabling environment that can leverage large sums of environmental investment, both public and private. Lastly, Chapter 3 describes how an approach involving building on emerging or anticipated global or regional legal frameworks can deliver significant new and additional financial flows for ocean sustainability, and can literally transform entire markets such as shipping and fisheries.

Catalysing Ocean Finance also builds on the findings of two companion UNDP-GEF publications (Sherman and McGovern, 2012; UNDP-GEF, 2012): The first publication, *Frontline Observations on Climate Change and Sustainability of Large Marine Ecosystems*, reviews climate change and other threats to ocean ecosystems, and the steps UNDP and other GEF agencies are taking to address these threats in 10 LMEs. The second, *International Waters – Delivering Results*, highlights the substantial progress made in addressing these threats through twenty years of UNDP-GEF support to advancing the sustainable management of 31 of the world's most important transboundary marine and freshwater ecosystems. *International Waters – Delivering Results* documents the much broader ongoing application of *Catalysing Ocean Finance's* three planning instruments across a wide range of waterbodies, both marine and freshwater. The two companion volumes provide a wealth of technical information for further research and action.

1. A NEW PARADIGM TO ADDRESS THE MAIN DRIVERS OF OCEAN DEGRADATION

1.1 The Ocean – An Engine for Economic Development under Threat

The ocean covers three-fourths of the earth's surface, contain 97% of the earth's water, and represent 99% of the living space on the planet by volume. The ocean contains nearly 200,000 identified species but actual numbers may lie in the millions. The ocean serves as a major source of protein for the world's growing population; one in six of the earth's seven billion people depend on the ocean for their primary source of protein. Fisheries and aquaculture represent about a $100 billion per year contribution to the global economy. Marine fisheries directly or indirectly employ over 200 million people. In some parts of the world, such as West Africa and the Pacific islands, fisheries represent 30 to 80% of export earnings and provide local livelihoods for hundreds of thousands of coastal fishermen. Ninety percent of all internationally traded goods are transported via shipping. The shipping industry contributes around $435 billion per year to the global economy and supports nearly 14 million jobs. The tourism industry represents 5% of global GDP, 6% of global jobs, and ocean and coastal tourism represents a major portion of this. Thirty percent of global oil production now occurs from offshore sites not land-based. Overall the number of people engaged in ocean-related livelihoods is estimated to exceed 500 million. In sum, marine and coastal resources directly provide at least $3 trillion in annual (market) economic goods and services plus an estimated $20.9 trillion per year in non-market ecosystem services, about 63% of the value of all such services (Costanza, 1997).

Unfortunately, our coasts and oceans remain under assault from a variety of pressures, including pollution (mostly land-based), overfishing, introduced species, habitat and species loss, and poorly planned and managed coastal development. Around half of global fish stocks are fully exploited, and a quarter are depleted, over-exploited or recovering from depletion. The World Bank and FAO estimate economic losses due to overfishing at $50 billion per year (Arnason et al., 2008). An estimated 20% of global mangroves have been lost since 1980, 19% of coral reefs have disappeared, and 29% of sea grass habitat has vanished since 1879. Less than 1.4% of marine habitats are protected -- compared with 11.5 per cent of global land area. The occurrence of low oxygen 'hypoxic'[1] dead zones, caused by excess nutrient pollution to coastal zones, has been expanding at a geometric pace in recent years, with associated losses to ecosystems and the livelihoods and economies that depend upon them in the many tens of billions of dollars per year. Invasive marine species, especially those carried in ship ballast water and on ship hulls, cause an estimated $100 billion each year in economic damage to infrastructure, ecosystems and livelihoods. Thus the cumulative economic impact of poor ocean management practices is at least $200 billion dollars per year, a tremendous drain on human economic progress.

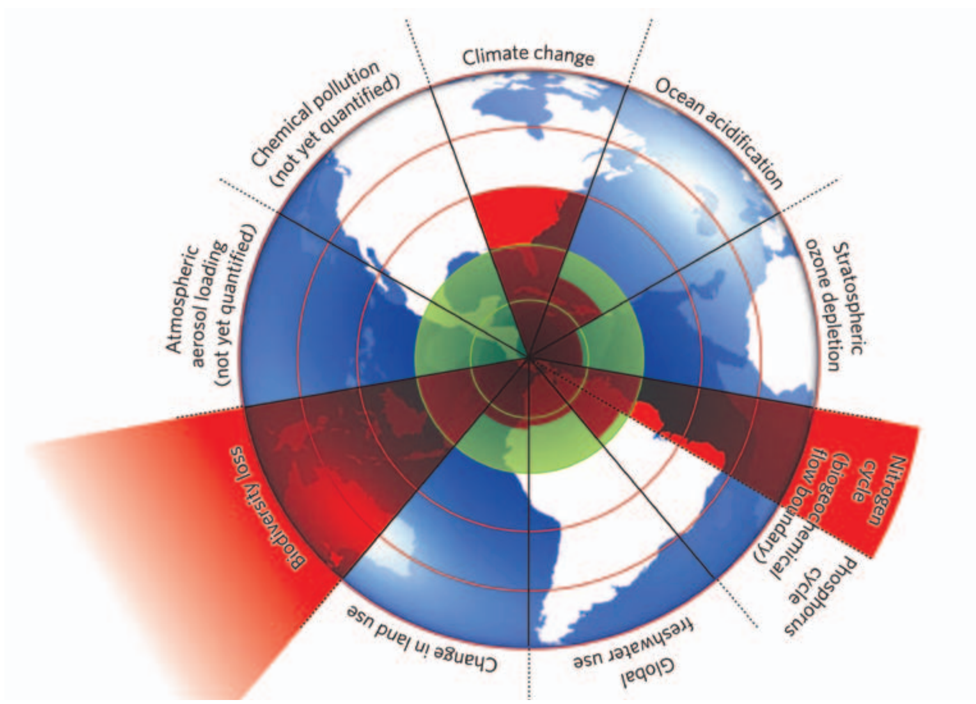
Climate change driven by greenhouse gas emissions only complicates an already challenging ocean management situation. Most of the earth's available carbon is in the ocean which holds fifty times more carbon than the atmosphere.

1 Hypoxia, or oxygen depletion, is a phenomenon that occurs in aquatic environments with high organic carbon loadings as dissolved oxygen is depleted by bacteria consuming the organic carbon and becomes reduced in concentration to a point where it becomes detrimental to aquatic organisms living in the system.

About half of earth's net primary production, the conversion of water, carbon dioxide, sunlight, and inorganic nutrients into oxygen and hydrocarbons, occurs in the ocean, the remainder on land. Climate change is already affecting surface ocean temperatures and both horizontal and vertical ocean circulation, driving fish stocks to migrate to more favorable waters and, with warming surface waters increasing ocean stratification, reducing upwelling of vital nutrients to key fisheries areas, threatening fisheries yields (Sherman and McGovern, 2012). The ocean is estimated to have absorbed 25-30% of cumulative anthropogenic carbon dioxide emissions but at the same time its capacity to absorb more CO_2 is slowly declining. While this has served to mitigate atmospheric warming to a sizeable extent, it has had the negative effect of increasing the acidity of the ocean by 30%, with significant threats to calcium carbonate fixing organisms such as corals, but also plankton species that serve as the foundation for many ocean food chains upon which hundreds of millions depend upon for protein and livelihoods. Sea level rise, due to the thermal expansion of seawater, glacial melt and groundwater extraction, threatens millions living in the coastal zone and island states, mostly in the world's least developed countries. In the absence of pro-active mitigation measures, the cost of damage to the ocean could rise by an additional $322 billion per year by 2050 as a result of climate change (Noone, 2012), bringing the total damage to over $0.5 trillion per year, a sizeable drain on global economic development and poverty reduction.

Four of the 9 'planetary boundaries' (Figure 3) recently proposed (Rockstrom, 2009) by a group of eminent earth system and environmental scientists relate wholly or in part to the ocean – biodiversity loss, nitrogen and phosphorus loads, chemical pollution and ocean acidification.

Figure 3: Earth's Planetary boundaries



Source: Rockstrom et al., 2009

These planetary boundaries represent thresholds beyond which the risk of "irreversible and abrupt environmental change" to planetary life support systems would make Earth less habitable. Of these, nitrogen burdens to the ocean are already estimated to be exceeding the planetary boundary by a factor of 3.5, and the ocean acidification boundary will be crossed very soon in the 'business as usual' fossil fuel energy use scenario.

1.2 Market failures drive ocean degradation

A common driver behind the accelerating degradation of the marine environment is the inability of markets to sustainably develop and manage open-access resources such as those found in the ocean. This is a similar open access challenge faced by other global commons such as the atmosphere. As stressed by a recent study from the Stockholm Environment Institute (Noone et al., 2012) "*the ocean is the victim of a massive market failure. The true worth of its ecosystems, services, and functions is persistently ignored by policy makers and largely excluded from wider economic and development strategies…*". For the main degradation challenges affecting the ocean, these market failures, compounded in several cases by perverse subsidy policies, can briefly be summarised as follows:

- Nutrient over-enrichment of the ocean and associated coastal eutrophication and hypoxia reflect the lack of internalisation of the cost of the nutrient damage to the coastal and ocean environment into the price of industrially produced fertiliser and wastewater treatment. Consequently, the agricultural and wastewater sectors have no financial or policy incentives to invest in improving fertiliser use efficiency or in sufficient levels of human and animal wastewater treatment to remove (and ideally, recover) most nutrients before they reach the ocean. This issue is further exacerbated in many cases by subsidies to agriculture including for fertiliser;
- Marine invasive species reflects the lack of internalisation of the financial damage of invasive species on aquatic ecosystems and linked economic activity into the operations of the shipping industry. As a result, until recently the shipping industry has had no incentive to incorporate the cost of preventing such invasions into shipping operations and to stimulate remedial actions that can ensure 'clean' ship ballast water and hulls via treatment and management;
- Loss of coastal habitats (especially coral reefs, mangroves, seagrasses) reflects the lack of proper valuation of the ecosystem services such habitats provide such as nurseries for fisheries, protecting coasts from storm surges, tourism, nutrient and carbon sinks, etc.;
- Ocean acidification is wholly driven by the increase in anthropogenic carbon dioxide in the atmosphere, 25-30% of which has already entered the ocean and will only continue to increase as long as atmospheric levels of CO_2 continue to rise. The market failure behind ocean acidification is simply the lack of a proper price on carbon which incorporates the massive environmental externalities of climate change and ocean acidification;
- Overfishing reflects the lack of internalising the social and environmental costs of overfishing (estimated at $50 billion/year by World Bank/FAO (Arnason et al., 2008) into (sustainable) fisheries management. This market failure is compounded by policy failures including 'negative' global subsidies of about $16 billion per year to the fishing industry (such as fuel subsidies, tax breaks, etc.) leading to fleet overcapitalisation and overexploitation.

As a result of these market and policy failures, both the private and the public sectors are likely to under-invest or not invest at all in activities necessary to sustain the marine environment (wastewater treatment, coastal habitat protection, etc.) and to over-invest in activities detrimental to the marine environment (over-exploitation of fish stocks, chemically intensive agriculture, etc.). This important finding presents a powerful argument in favor of governance reforms that put in place clear policy and regulatory incentives to all market players to prevent the degradation of the ocean and create sustainable productive use patterns.

1.3 A new paradigm for ocean restoration and protection – Catalysing public and private finance

Over the last twenty or more years, the international community has made numerous commitments which aim to protect and restore our ocean back to sustainability. These include commitments and targets under Agenda 21, the World Summit for Sustainable Development (WSSD), the Global Programme of Action to Protect the Marine Environment from Land-Based Activities (GPA-LBA), the FAO Code of Conduct for Responsible Fisheries, the FAO Straddling Stocks Agreement, the Convention on Biological Diversity, and others. While some progress has been made in each of these initiatives, significant gaps remain in the implementation of a wide range of ocean commitments and the overall level of financial commitments has been woefully inadequate (Global Ocean Forum, 2011); consequently, the overall health of the ocean has continued to deteriorate including all of the primary threats listed earlier. The gravity and accelerating pace of the threats to ocean ecosystems and associated livelihoods, the increasing scale of the economic damage, and the mixed record on implementing agreed commitments, together underscore the need to identify and rapidly scale up new and innovative approaches to reversing ocean and coastal degradation.

In an era of increasingly scarce financial resources, it becomes even more critical to strategically use limited public grant resources to influence the direction of much larger volumes of public and private investment for ocean restoration and protection. In addition to providing additional financial flows, the private sector possesses the skills and knowledge critical to developing and scaling up clean technology and resource management solutions to reduce pollution loads, invasive species risk, overfishing and habitat loss. Hence, a key focus of governance reforms to protect and restore the ocean should be on addressing market and policy failures in a manner that can catalyse both private and public sector financial flows.

Box 1: Catalysing Finance

The dictionary definition of 'catalyse' is "the causing or accelerating of a chemical change by the addition of a catalyst"; (chemical) catalysts are essential to many industrial processes and, more fundamentally, to the functioning and survival of most living creatures. Catalysts enable chemical reactions that would otherwise be blocked or slowed by a kinetic barrier (insufficient speed of the involved molecules to allow the reaction to proceed). For the purposes of this volume, we can substitute 'ocean finance' for 'chemical change'; the principal catalyst that is acting is the improved enabling environment, which helps remove many of the barriers (information, institutional, regulatory, technical, financial, etc.) to public and private sector investment.

In recent years, coastal and ocean decision-makers, from a wide geographic range and facing one or more of the key ocean challenges summarised earlier, have successfully applied a key suite of ocean planning instruments to remove ocean market and policy failures and catalyse additional finance. These instruments have helped governments put in place clear incentives to all market players to restore and protect coasts and oceans. The objective of this publication - *Catalysing Ocean Finance* - is to take stock of these achievements and discuss how they could be scaled up globally to address key ocean challenges with only modest additional public funds. *Catalysing Ocean Finance* presents three major instruments that have been used to promote science-based, long-term integrated planning and barrier removal to transform markets and create sustainable productive use patterns of coastal and ocean resources over the past 20 years:

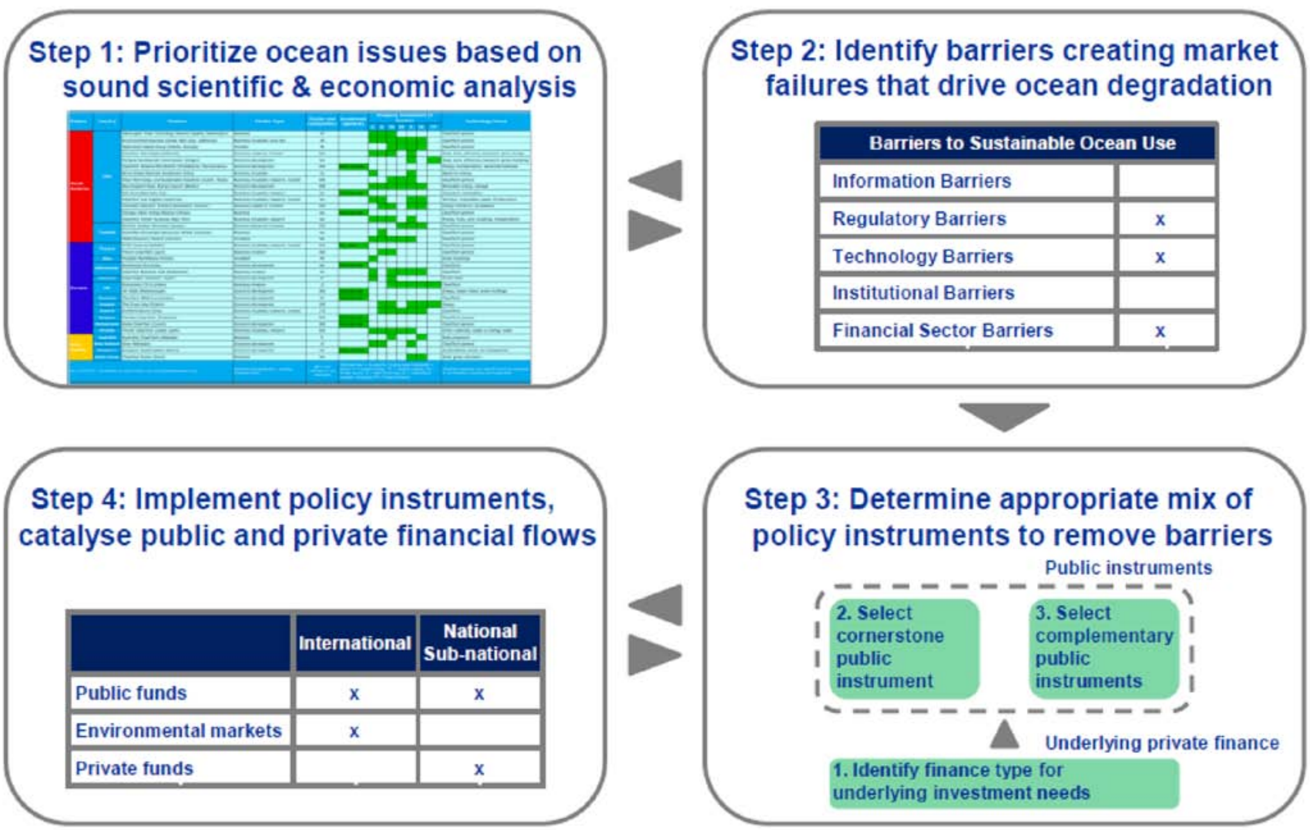
1. *Transboundary Diagnostic Analysis/Strategic Action Programme (TDA/SAP)*: TDA/SAP is a multi-country, long-term integrated planning approach that helps governments to prioritise issues, identify barriers, and to agree upon and implement both regional and national governance reforms (policy, legal, institutional) and investments aimed at addressing the roots causes of aquatic ecosystem degradation. The principal biogeographic planning unit the GEF has adopted for application of the TDA/SAP process and the ecosystem-based approach in the marine environment is the Large Marine Ecosystem (LME). TDA/SAP can and has been applied in both highly degraded and relatively pristine marine systems; not surprisingly, the case studies for TDA/SAP in this volume focus on the former where investment needs to reduce pollution and other threats are often quite sizeable. TDA/SAP has also proven to be a useful tool to maintain the health of relatively 'clean', undegraded marine ecosystems by putting in place the necessary 'preventive' enabling environment that can reduce environmental risk from increased ocean exploitation, future development, population growth, etc.;
2. *Integrated Coastal Management (ICM):* Whereas TDA/SAP can be viewed as a more 'top-down' planning tool for promoting ocean governance reform at regional and national scales, ICM takes a more 'bottom-up' approach which focuses on improving marine resource management at provincial or municipal scales, and promoting replication by feeding local experience and best practice into national ICM frameworks. By facilitating local, provincial and national governance reform for sustainable ocean management, ICM also helps

to remove barriers and create the necessary enabling environment for catalysing public and private sector investment, particularly at the municipal level;

3. *Fostering Global and Regional Multilateral Agreements*, aims to effect governance reform at the level of large scale ocean regions or the global ocean as a whole. The approach described involves building on existing or anticipated processes of negotiating and adopting regional and global ocean legal frameworks as a means to catalyse public and private financial flows.

Each of these three types of strategic instruments uses a similar four-step methodology to guide decision-makers in the design and implementation of ocean restoration and protection policies, as shown in Figure 4:

Figure 4: Four-Step Approach to Catalysing Ocean Finance



The first step of each methodology is to promote a science-based analysis of threats and drivers of degradation. The second step consists in identifying the information, regulatory, technology, institutional and financial barriers preventing investment in sustainable coastal and ocean resource management. The third step is to determine an appropriate mix of information, policy, regulatory and economic instruments to remove these barriers. The fourth and last step is to implement these market transformation measures.

Drawing on the portfolio of International Waters projects financially supported by the Global Environment Facility (GEF) and implemented by the United Nations Development Programme (UNDP) in 31 of the world's most important transboundary marine and freshwater ecosystems, six case studies have been selected to illustrate the application of these three market transformation instruments to promote sustainable coastal and marine resource development: (i) Danube River/Black Sea; (ii) West/Central Pacific Fisheries; (iii) Yellow Sea Large Marine Ecosystem; (iv) Rio de la Plata/Maritime Front; (v) Seas of East Asia, and (vi) Global Ballast Water Programme.

1.4 The challenge of assessing the leveraging ratio for Ocean Finance

Each of the six case studies reviewed in this publication includes a discussion of the investment flows/financial data used to calculate the ocean finance leveraging ratio and its catalytic impact.

Assessing the effectiveness of interventions to transform markets to restore and protect ocean ecosystems requires common performance metrics. The leveraging ratio is increasingly becoming the key performance metric for a public sector intervention, similar to the role of the bottom line for the private sector. In the corporate world, the leveraging ratio most commonly refers to the the debt-to-equity ratio - the debt which can be raised against a given equity contribution. For example, if a company has $20 million in debt and $10 million in equity, it has a debt-to-equity ratio of 2 to 1.

However, there is no universally accepted definition of the term when it is applied to a set of public policy instruments used by a national or international development agency to catalyse other public and private investment (Brown et al., 2011). For the purpose of this publication, we will follow the Global Environment Facility's approach and distinguish three types of leveraged finance:

1. *Incremental*: expands the resources available from the Global Environment Facility to cover part of the incremental cost of the GEF intervention, to transform an initiative with primarily national benefits into one also with global environment benefits; and
2. *Substitutional*: redirects the non-incremental part of the financing from one type of activities to another; or
3. *Additional*: new and additional financing arises as a direct result of the enabling environment established by the GEF intervention.

The leveraging ratio typically includes these three types of leveraged finance. For example, a government might decide to invest in a demonstration wind power station costing $250 million rather than in a coal fired power station costing $200 million for the same power amount and quality; this is an example of (a) substitutional financing above. This pilot project is then replicated throughout the country for a total wind power investment of $1 billion; this is the additional financing deriving from the enabling environment for upscaling created by the demonstration. The agreed GEF contribution to this intervention is $25 million. In accordance with the above definition, the leveraging ratio of the GEF intervention is $1,250 million/$25 million or 50 to 1. It breaks down as follows: $25 million co-financing to cover half of the $50 million incremental costs; $200 million transformational as it shifts investment from fossil fuels to renewable energy; and $1 billion of additional investment attracted by the enabling environment established by the GEF to attract and drive investment towards renewable energy.

While calculating the leveraging ratio is relatively straightforward for a fossil fuel substitutional project such as described above, a slightly different leverage paradigm is required for ocean protection and restoration investments. In the GEF International Waters focal area, the financial leverage will instead primarily be obtained through the additional investment and other financial flows catalysed by the improved enabling environment and removal of key barriers which the GEF intervention helped to put in place. This enhanced enabling environment would increase the likelihood of required investments being prioritised among competing needs for public and/or private capital. For example, a government/industry might decide to invest $1 billion in water pollution reduction infrastructure as the result of the enabling environment created by a $20 million GEF International Waters project ($10 m. GEF, $10 m. co-finance). $500 million was already programmed (e.g., the pre-GEF project 'baseline') and $500 million is additional, as a result of incentives enabled by the GEF project (agreed action programmes, policies, regulations, etc.) that create a more favorable climate for investment. With the GEF contributing $10 million to this intervention, the investment finance leveraging ratio is $500 million/$10 million or 50 to 1.

2. UNDP-GEF STRATEGIC PLANNING INSTRUMENTS FOR CATALYSING OCEAN FINANCE

The presentation of UNDP-GEF instruments and approaches to *Catalysing Ocean Finance* is divided into three sections: (1) Transboundary Diagnostic Analysis/Strategic Action Programme (TDA/SAP); (2) Integrated Coastal Management (ICM); and (3) Building on Global and Regional Multilateral Agreements. Each section summarises the key elements of each ocean planning instrument and the consolidated results of the case studies. A more comprehensive description of each planning instrument and case study can be found in Volume II of this publication.

2.1. Applying the TDA/SAP methodology to restore the world's Large Marine Ecosystems (LME)

Introduction

Large Marine Ecosystems (LMEs) are relatively large areas of ocean space of approximately 200,000 km^2 or greater, adjacent to the continents in coastal waters where primary productivity (e.g., production of ocean phytoplankton (microscopic plants)) is generally higher than in open ocean areas. The world's LMEs represent a major source of protein for human consumption; LMEs produce about 80% of the world's annual marine wild fisheries catch and contribute an estimated $12.6 trillion in (non-market) goods and services annually to the world economy (Costanza et al., 1997) (the authors acknowledge that this estimate was subject to controversy and criticism as being overinflated but, at the same time, few would question the critical importance and sizeable economic value of the broad suite of non-market ecosystem services provided by the ocean). Due to their proximity to the continents and the sizeable fraction of the human population that lives near the coasts, LMEs are centers of coastal ocean pollution and nutrient over-enrichment, habitat degradation (e.g., sea grasses, corals, mangroves), overfishing, invasive species, biodiversity loss, and climate change effects. Since a sizeable fraction of human economic activity derives from LME goods and services, most of the economic losses highlighted for the ocean as a whole in the Introduction are taking place in LMEs.

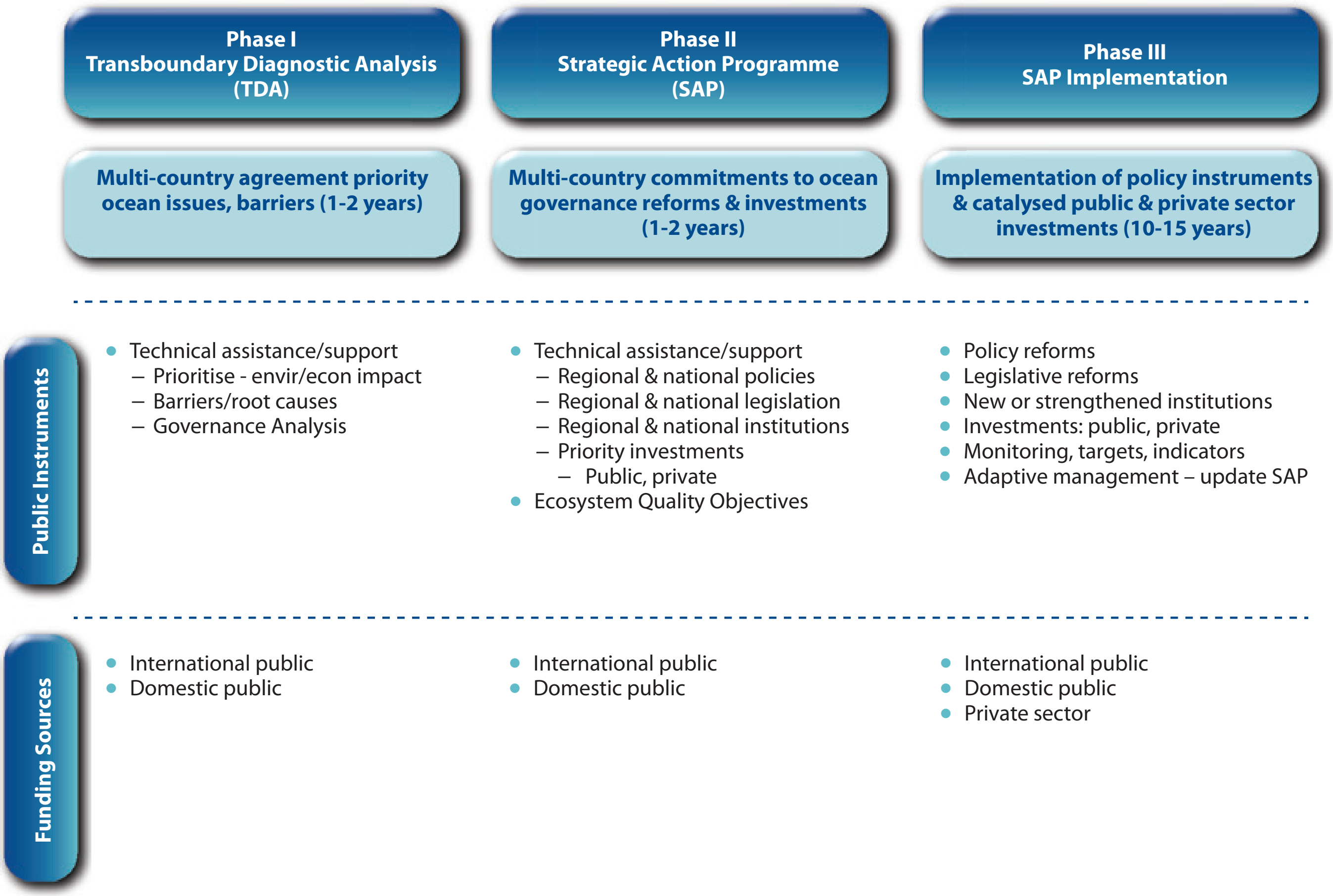
As a consequence of climate change, 62 of the world's 64 LMEs show warming trends and more than one-quarter are warming at a very fast rate (Sherman and Hempel 2008); this is already forcing fish stocks to move, often to cooler waters in nearby countries, representing a direct threat to food and national security for some coastal communities, including the loss of investments and jobs. Climate change and warming of ocean surface waters is also leading to increased ocean stratification, particularly in temperate and tropical regions often highly dependent on marine resources for sustenance and livelihoods. This stratification reduces the upwelling of deep, nutrient-rich ocean waters which can reduce ocean primary productivity (plankton growth) and associated biomass production in higher trophic level ecosystems (including fisheries) that ultimately depend on these nutrient supplies.

Methodology - Tranboundary Diagnostic Analysis/ Strategic Action Programme (TDA/SAP)

Over the last 15 years, UNDP has played a lead role in the GEF International Waters focal area in developing, piloting, and replicating a consistent methodological approach

(TDA/SAP), endorsed by the GEF, aimed at fostering the restoration and protection of over a dozen of the world's most important transboundary LMEs (e.g., LMEs whose boundaries include waters lying within multiple national jurisdictions) through a sequential approach of diagnostic and barrier analysis, strategic planning and implementation support, including investments. In several cases, where UNDP-GEF support has helped to put in place an enabling framework (particularly new policies and legislation, as well as pre-investment support) conducive to investment, sizeable quantities of public and private sector investment for ocean restoration and protection have been catalysed. The TDA/SAP approach is schematically summarised in Figure 5.

Figure 5: Summary of TDA/SAP Approach



Volume II, Chapter 1 of *Catalysing Ocean Finance* summarises the TDA/SAP approach as a proven methodology for advancing regional and national ocean governance reform that, through the improved enabling environment, can also catalyse substantial sums of public and private sector investment. The chapter provides three case studies documenting the sizeable levels of investment that commitments made under regionally adopted SAPs for the Danube River/Black Sea, Rio de la Plata, and the Yellow Sea, have catalysed.

In the **Danube/Black Sea**, in parallel to the negotiation, adoption and ratification of regional conventions for both the Danube River (Sofia Convention) and the Black Sea (Bucharest Convention), between 1991 and 2007, UNDP-GEF supported regional and national governance reform and capacity building aimed at addressing the agreed priority transboundary issue for both water bodies, nutrient over-enrichment and associated hypoxia in the Black Sea. The collapse of the Soviet Union in the early 1990's and the subsequent accession process of several Danube and Black Sea countries to the European Union, which required compliance with the EU's comprehensive "Water Framework Directive", combined with the support from UNDP-GEF to create a 'perfect storm' of drivers for governance reform and investment, including those targeting nutrient pollution. With UNDP-GEF support, each of the Danube/Black Sea countries took steps to reform policies and legislation to address both point (wastewater, manure storage, certain industries) and non-point (agricultural run-off of fertiliser and manure) sources of nutrient pollution to waterways. The UNDP-GEF Pollution Reduction Programme, and similar efforts for the Black Sea, identified nearly 500 projects totaling nearly $5 billion in needed nutrient reduction investments (UNDP-GEF Danube Pollution Reduction Programme, 2006-2009); to date, over 60% of those investments have been completed or are underway leading to sizeable reductions in Danube and Black Sea pollution loads and to measurable improvements in the ecosystem status of the Danube and, most notably, the reversal of the major hypoxic zone in the northwest shelf of the Black Sea (STAP-GEF, 2011). Total catalysed investment for the Danube/Black Sea was $2.98 billion compared to a cumulative GEF investment of $51.9 m., representing a catalytic ocean finance ratio of 57 to 1.

In the **Yellow Sea**, the multi-country TDA also identified nutrient reduction as a major transboundary threat, as well as overfishing and loss of key coastal habitat. The Yellow Sea SAP committed the governments of China and the Republic of Korea to a series of governance reforms and investments targeting these agreed priority issues (Yellow Sea Strategic Action Programme, 2009). Notably, the Yellow Sea SAP committed these countries to reduce nutrient discharges to the Yellow Sea by 10% every 5 years through 2020, to reduce fishing pressure by 25-30% through reduction of fisheries overcapitalisation and scaling up sustainable mariculture, and to establish a regional network of Marine Protected Areas. These commitments represent cumulative investments totaling $10.86 billion compared to a GEF investment of $14.744 million or a catalytic ocean finance ratio of 737 to 1.

In South America, UNDP-GEF has supported the governments of Argentina and Uruguay in joint preparation of a Transboundary Diagnostic Analysis, and the adoption and subsequent implementation of a Strategic Action Programme for the **Rio de la Plata and its Maritime Front** (RPMF) (FrePlata Strategic Action Programme, 2007). The TDA identified nutrient pollution, certain industrial effluents, and coastal habitat degradation as priorities and the SAP committed both countries to a set of policy and legislative reforms on pollution control and integrated water and coastal resources management. UNDP-GEF helped both countries to prepare an investment portfolio of 20 priority projects totaling $2.62 billion, focused on reducing releases of untreated sewage and industrial pollutants into the basin, as well as on reducing nutrient discharge in key wetland protected areas. Many of these investments have been completed or are underway; the total GEF investment in the FrePlata programme is $9.31 million, delivering a catalytic ocean finance ratio of 281 to 1.

2.2. Applying the Integrated Coastal Management (ICM) methodology to catalyse finance for coastal and ocean management

Introduction

About 60% of the world's population lives within about 100 km of the coast and this level is expected to increase with continued trends towards urbanisation and coastal migration. Coastal populations rely on the ocean for food, transportation, recreation, aquaculture, energy resources (both renewable and non-renewable), building materials and other amenities. Coastal habitats provide important market and non-market ecosystem services including spawning grounds and nurseries for commercial fish species, protection from storm surges, nutrient and carbon sinks, etc. The associated high densities of human populations and economic activity in the world's coastal areas exert particularly acute pressure on the marine ecosystems found in the coastal zone such as coral reefs, kelp forests, mangroves and seagrasses. Coastal areas represent some of the major pollution and habitat loss hot spots on earth and are often subject to intense fishing pressure.

In particular, the East Asian Seas region has been facing increasing stress over the past few decades as a consequence of rapid economic growth coupled with the expansion of maritime trade and global and domestic demand for marine products, as well as population increases and large scale migration of people and commerce to coastal areas. As a consequence, 11% of the region's coral reefs have collapsed in the last 30 years, while 48% are listed in critical condition. Mangroves in the region have lost 70% of their cover in the last 70 years and the loss of seagrass beds in the region ranges from 20% to 60%. Only 11% of the region's sewage receives any form of treatment. Perhaps most important, in East Asia, the contribution of the marine economy to national economies is much higher than in other parts of the world. For several nations in the East Asian Seas region, the contribution of the marine economy to the national economy is in excess of 5%, and may reach 20% in two countries, Indonesia and Vietnam. This very high dependence of East Asian economies on marine resources underscores the critical importance of integrated management of coastal and marine ecosystems for this region if livelihoods are to be maintained and a sustainable development pathway followed. Maritime industries, shipping and shipbuilding, are also a major component of the economies of several East Asian Seas countries, especially China, Japan, Singapore and Republic of Korea. The role of shipping in supporting and enabling economic growth in China in particular is significant, both in the export of products, but also for the import of raw materials and commodities– iron ore, etc.

Methodology – Integrated Coastal Management (ICM)

While TDA/SAP works at the scale of multi-country Large Marine Ecosystems (and their drainage basins) in supporting groups of governments in joint diagnostics, barrier analysis, strategic planning, governance reform and investment, a complementary approach, Integrated Coastal Management (ICM), has been developed in the East Asian Seas region that focuses on action primarily at municipal and provincial scales and upscaling via replication and mainstreaming into national development policy. This effort has built on the thirty plus years of international experience in applying ICM as a tool to promote marine ecosystem protection and restoration through improved ocean and coastal governance. The objective of ICM is to increase the efficiency and effectiveness of coastal governance towards the sustainable use of coastal resources and of the services generated by ecosystems in coastal areas. It aims to do this by protecting the functional integrity of these natural resource systems while allowing economic development to proceed.

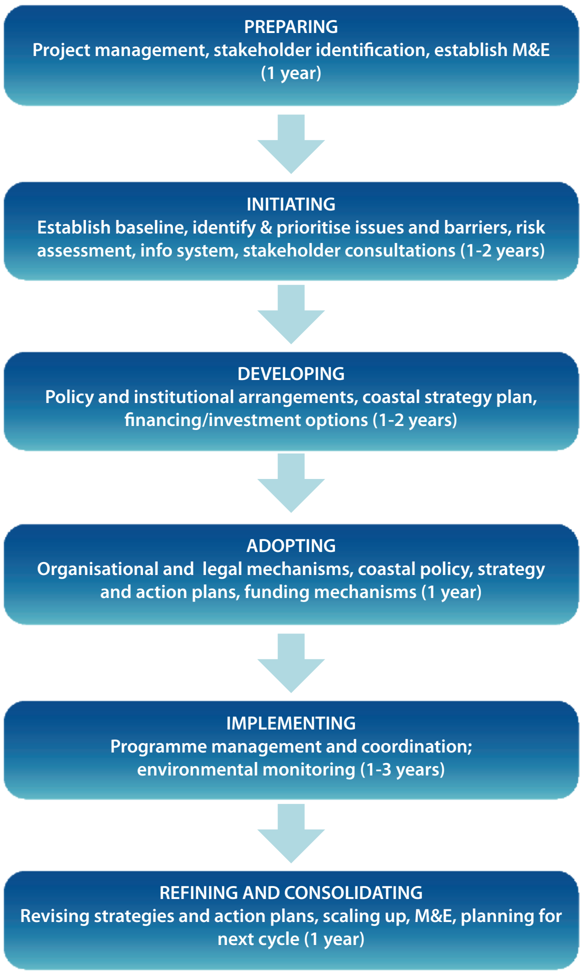
The WSSD JPOA called for the "promotion of integrated coastal and ocean management at the national level and encouragement and assistance to countries in developing ocean policies and mechanisms on integrated coastal management." Although the JPOA did not specify any explicit deadline for achieving this goal, much progress has been made, including new ICM initiatives by national and local governments, the development of new ocean and coastal knowledge, data, and information systems, and the creation of new ocean and coastal management funding initiatives. As of around 2002, estimates indicated that over 700 ICM programmes have been implemented in over 100 countries, driven in part by ICM being recommended for ocean and coastal management in key international frameworks such as UNCED/Agenda 21, UNFCCC, CBD, GPA/LBA and the Barbados Programme of Action for the Sustainable Development of Small Island States.

The East Asian Seas - PEMSEA

Since 1993, UNDP-GEF has supported a programme now called "PEMSEA" or Partnerships in Environmental Management for the Seas of East Asia. PEMSEA has facilitated the development and implementation of two important methodological frameworks: (1) the Framework for Sustainable Development of Coastal Areas (SDCA) and (2) the ICM cycle, both of which serve as a conceptual map and an analytical/decision-making tool that enable how ICM is operationalised and institutionalised in the sites.

PEMSEA has pioneered the application of these approaches into successful, replicable and highly scalable methodologies for the nine GEF-eligible participating countries in East Asia (Cambodia, China, DPR Korea, Indonesia, Malaysia, Philippines, Republic of Korea (now no longer GEF-eligible), Thailand, Timor Leste and Vietnam); Japan, Brunei Daressalam, Singapore and, most recently, Republic of Korea, also participate at their own expense. With PEMSEA support, dozens of ICM sites have been established and sustained in East Asia; 26,829 km of East Asian coastline now have ICM programmes active or initiated which represents 11% of the region's coastline against a near zero baseline in the early 1990's. Countries of the East Asian region have further agreed to achieve a target of 20% ICM coverage by 2015. As with TDA/SAP, PEMSEA's ICM/SDCA approach has facilitated diagnosis and prioritisation of provincial and local marine environmental issues; barrier analysis; local, national and regional strategic planning (through national ICM policies and local ICM plans); and implementation and monitoring of ICM plans including agreed governance reforms and required investments. The combined SDCA/ICM approach has played a key role in East Asia in putting in place the necessary enabling environment to catalyse a wide range of investments needed to protect and restore the marine environment. PEMSEA's ICM approach is generically summarised in Figure 6.

Figure 6: The ICM Development and Implementation Cycle *



(Source: PEMSEA)

* ICM is a continuous process, which addresses unresolved as well as emerging issues arising from coastal development. The first "cycle" of the process can take up to 5 years. With the first cycle experience, subsequent cycles can take less time, depending on the issue(s) being addressed.

Through PEMSEA and its scaling up and implementation of ICM programmes in dozens of sites throughout the East Asian Seas region, some $9-11 billion in public and private sector finance for environmental investments has been catalysed. This represents a 277 to 1 'return' on the cumulative GEF investment of $36.1 million since 1993, underscoring the tremendous value and impact of ICM as a tool that can put in place the necessary enabling environment and remove barriers to catalyse ocean finance from the "bottom-up". Volume II, Chapter 2 of *Catalysing Ocean Finance* summarises the ICM/SDCA methodology and provides an in-depth case study of PEMSEA as a mechanism that has successfully applied ICM to put in place local, provincial and national governance reforms that created the necessary enabling environment to catalyse the public and private sector investments needed to protect and restore coastal ecosystems and associated livelihoods.

2.3 Transforming industries to address global and regional ocean issues

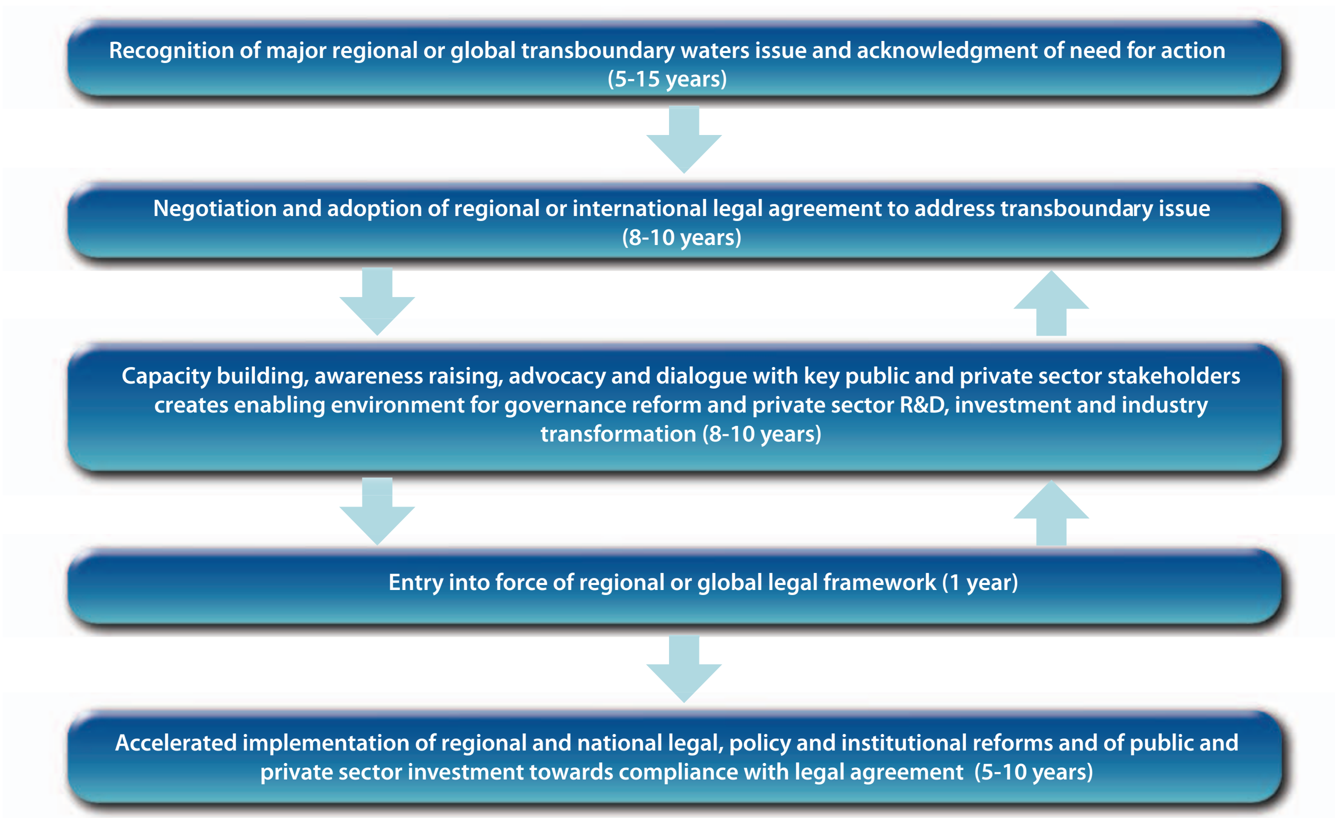
Introduction

Some environmental and natural resource management issues threaten ocean sustainability at large regional and even global scales. These include unsustainable exploitation of highly migratory fish stocks, persistent organic pollutants, ocean acidification, marine plastics pollution, pollution from ships, and marine invasive species. The international community has negotiated and adopted a number of regional and global instruments targeting several of these ocean issues including the UN Straddling Stocks Agreement, various regional fisheries management agreements, and global shipping treaties through the International Maritime Organization (IMO) such as MARPOL, OPRC, etc. The Stockholm Convention on Persistent Organic Pollutants (POPs) and the UN Framework Convention on Climate Change (UNFCCC), while not specifically targeting ocean issues, have very important ramifications for ocean protection and restoration: POPs, which can act as endocrine disruptors, have been widely demonstrated to bioaccumulate in higher trophic level marine organisms (large fish, marine mammals, seabirds) and anthropogenic emissions of CO_2 are the principal driver of ocean acidification. While these diverse treaties have realised a range of compliance and associated impact, it is generally acknowledged that properly defined and broadly supported ocean environmental legal agreements can have very positive effects in terms of reducing stress on the ocean. For example, largely as a result of successful implementation of several IMO conventions, the occurrence of ship-related oil spills has declined significantly over the last 30 years, with spills of 700 tonnes or more declining by 85% since the 1970's (while the volume of shipping has more than tripled over the same time period). Similarly, the recent IMO ban on tributyl tin (TBT) paint for ships' hulls should dramatically reduce the endocrine-disrupting impacts of these toxic substances on marine organisms. Notably, of the 53 maritime conventions adopted through the IMO, 21 or 40% are related to environmental protection.

Approach – Building on Regional and Global Multilateral Agreements

Whereas Chapters 1 and 2 of Volume II review and document via case studies the effectiveness of two very clearly defined strategic planning methodologies (TDA/SAP, ICM) that help to remove barriers and create an enabling environment which can catalyse ocean finance, Chapter 3 explores a less formalised but equally successful approach that UNDP-GEF has applied in two somewhat different contexts. The approach involves building upon and helping to advance an existing or anticipated intergovernmental process of negotiating a new regional or global legal framework to address a major ocean issue and is summarised generically in Figure 7:

Figure 7: Generic approach to building on global or regional legal framework to remove barriers and put in place enabling environment for catalytic public and private ocean finance



For the two case studies examined, UNDP-GEF interventions were designed to provide capacity building, advisory, awareness raising and advocacy support that supported and helped advance the negotiation, adoption and actual or anticipated coming into force of the respective regional or global conventions. The enhanced public and private sector capacities for and commitment to compliance with the new legal regimes created the necessary enabling conditions that helped to catalyse ocean finance and to measurably transform two major industries, international shipping and West/Central Pacific tuna fisheries.

Both case studies document catalysis of sizeable private sector financial flows but in notably different ways. For Case Study #5, the W/C Pacific Fisheries, the principal source of catalysed finance is the substantially increased revenue – over $3 billion over 14 years - enjoyed by the Pacific Island Countries fishing fleets as a result of their increased engagement in the W/C Pacific Fisheries Convention negotiation and implementation processes, their strengthened capacity for ecosystem-based fisheries management, and their enhanced ability to apply catch monitoring, control and surveillance measures to both their own fisheries and those of foreign fleets. Case Study #6, Ballast Water Management, documents how UNDP-GEF capacity building support to both governments and the private sector, in parallel to a process of negotiating a new global legal agreement on ship ballast water and sediments, not only helped dozens of countries put in place the necessary policy, legal and institutional structures to enable compliance with the anticipated new convention, but, through private sector partnerships, also played a major role in helping to create a whole new ballast water treatment and management industry, now valued in the tens of billions of dollars.

West/Central Pacific Fisheries

The Western and Central Pacific Ocean contains some of the most important fisheries resources in the world via its widespread tuna and other billfish stocks. Through 1994, there were no international arrangements in place to comprehensively manage the fishery resources of the region which represents some 20% of the earth's total surface area. Up to that time, the Pacific Island countries worked collaboratively through the Forum Fisheries Agency (FFA) to harmonise management efforts in their exclusive economic zones, but no arrangements existed for conserving and managing fishing throughout the range of the stocks including in international waters or high seas. In addition, a multilateral treaty between the United States and 16 independent Pacific Island countries had been in operation for more than 10 years, but the treaty was primarily a fisheries access treaty and an avenue for fisheries development in the Pacific Islands with minimal focus on conservation and sustainable use.

In 1994, a series of seven negotiating sessions known as the Multilateral High Level Conference (MHLC) began aimed at creating a framework to sustainably manage the W/C Pacific's vital fisheries resources. Not until the second MHLC and the adoption of the Majuro Declaration in 1997 did the international negotiations gain impetus and direction for moving forward. The Majuro Declaration was pivotal in that it reflected basic principles on which to base the ensuing negotiations. These included principles from the 1995 United Nations Fish Stocks Agreement such as the application of the precautionary approach, management decisions to be based on the best available science, ecosystem considerations and recognition of special requirements of Small Island Developing States. The provisions on straddling and highly migratory fish stocks were particularly important to Small Island Developing States because they represent a primary source of achieving national food security, supporting livelihoods and sustainable economic development. The final MHLC took place in Honolulu, Hawaii in 2000 where the Convention was adopted and opened for signature. The WCPFC came into force on June 19, 2004 and now has 25 parties to the Convention.

In parallel to the WCPFC process, beginning in 1996, UNDP-GEF initiated a partnership with the Forum Fisheries Agency (FFA) and the Secretariat of the Pacific Community (SPC) through a first GEF International Waters project aimed at supporting the participation of Pacific Island governments in the WCPFC process, building regional and national PIC capacities for fisheries management, and contributing to the scientific knowledge base for sustainable management of fish stocks. There is wide agreement that the GEF intervention, by ensuring full participation of the PICs in the MHLC process, contributed to both the adoption of the WCPFC and inclusion in the Convention of the special needs and requirements of the Pacific Island countries. A second UNDP-GEF International Waters project, running from 2005 through 2011, supported national realignment of laws, policies and institutions, enhancement of scientific assessment and monitoring, and knowledge management and advocacy all aimed at enhancing the capacity of the PICs to meet their obligations under the Convention.

Since the series of UNDP-GEF interventions began in 1997, concurrent with the major strides in moving the regional tuna fishery towards sustainability and internalising management costs, overall tuna landings by Pacific SIDS fishing fleets have roughly tripled as have the dockside dollar value of landed fish. These enhanced landings and economic benefits to the Pacific Island Countries have been catalysed to a sizeable degree by the two UNDP-GEF interventions which have increased country capacities to fully participate in all WCPFC processes, to apply fleet and catch monitoring, control and surveillance, and to apply ecosystem-based approaches to fisheries management. Over the 1997-2010 period, the cumulative economic benefits to the PICs totaled $3,214 million in terms of the additional value of tuna catch by the Pacific SIDS fleets against the 1997 baseline. With GEF investment in the Pacific fisheries totaling $15.1 million, this represents a catalytic ocean finance ratio of 222 to 1.

Ship Ballast Water/Invasive Species

Since the introduction of steel hulled vessels around 120 years ago, water has been used as ballast to stabilise vessels at sea. While ballast water is essential for safe and efficient modern shipping operations, it can pose serious ecological, economic and health problems due to the multitude of marine species carried in ships' ballast water. Scientists first recognised the signs of an alien species introduction after a mass occurrence of the Asian phytoplankton algae Odontella (Biddulphia sinensis) in the North Sea in 1903. But it was not until the 1970s that the scientific community began reviewing the problem in detail. In the late 1980s, Canada and Australia were among countries experiencing problems with invasive species, and they brought their concerns to the attention of IMO's Marine Environment Protection Committee (MEPC). The spread of invasive species is now recognised as one of the greatest threats to the ecological and the economic well being of the planet. These species are causing enormous damage to biodiversity and the valuable natural riches of the earth upon which we depend; recent estimates by the UNDP-GEF GloBallast programme put the annual damage from ship-related invasives at upwards of $100 billion per year.

The UN Convention on the Law of the Sea provides the global framework by requiring States to work together "to prevent, reduce and control human caused pollution of the marine environment, including the intentional or accidental introduction of harmful or alien species to a particular part of the marine environment." In 1991 the MEPC adopted Guidelines for preventing the introduction of unwanted organisms and pathogens from ships' ballast water and sediment discharges (MEPC resolution 50(31)); while the United Nations Conference on Environment and Development (UNCED), held in Rio de Janeiro in 1992, recognised the issue as a major international concern.

In November 1993, the IMO Assembly adopted resolution A.774(18) based on the 1991 Guidelines requesting the MEPC and the MSC to keep the Guidelines under review with a view to developing internationally applicable, legally-binding provisions. While continuing its work towards the development of an international treaty, the Organization adopted, in November 1997, resolution A.868(20) - Guidelines for the control and management of ships' ballast water to minimise the transfer of harmful aquatic organisms and pathogens, inviting its Member States to use these new guidelines when addressing the issue of IAS.

After more than 14 years of complex negotiations between IMO Member States, the International Convention for the Control and Management of Ships' Ballast Water and Sediments (BWM Convention) was adopted by consensus at a Diplomatic Conference held at IMO Headquarters in London on 13 February 2004. Once in force, the Convention will require all ships to implement a Ballast Water and Sediments Management Plan. All ships will have to carry a Ballast Water Record Book and will be required to carry out ballast water management procedures to a given standard.

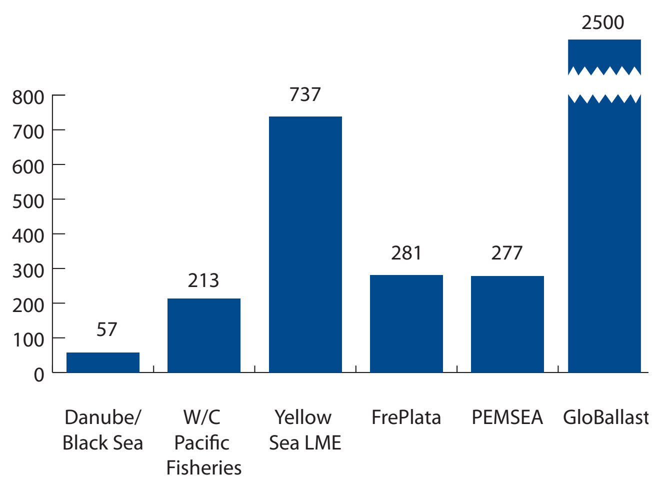
In its 1995 Operational Strategy on International Waters, the GEF ranked aquatic invasive species as one of the four most significant threats to transboundary waters and noted ballast water as a principal vector for such invasions. This recognition created a unique opportunity for what has emerged as one of the most successful interagency and public/private partnerships on ocean protection in United Nations history, with transformative impacts on governance reform at global, regional and national levels, and, notably, on the shipping industry. The partnership, entitled 'Global Ballast Water Management Programme' or 'GloBallast', has through two GEF International Waters interventions build the capacity of over 50 developing nations to address the ballast water invasives threat through support to reform of national ballast water management policies, legislation and institutions, global advocacy and awareness raising, ballast water risk assessment and training.

As Chapter 3, Case Study #6 of Volume II demonstrates, the GEF/UNDP/IMO GloBallast partnership has played a pivotal catalytic role in bringing the Ballast Water Convention both to the adoption stage and to its expected entry into force, possibly as early as 2013. Through the establishment of strategic alliances (such as the Global Industry Alliance and Ballast Water R&D Symposia) with the shipping, shipbuilding and emerging ballast water treatment industries, GloBallast has also helped to catalyse a major transformation in the shipping industry as it anticipates the coming into force of the Convention. Over $100 million has already been committed by the private sector in ballast water treatment R&D and testing facilities, and the market for ballast water treatment to meet the obligations of the Convention – for 57,000 vessels globally - is estimated to grow to $35 billion over the next ten years. Based on the total GEF grant commitment to GloBallast of $14 million over its two phases, this represents a catalytic ocean finance ratio of 2,500 to 1.

3. LESSONS LEARNED

Catalysing Ocean Finance presents a suite of three strategic planning instruments to support ocean market transformation – TDA/SAP, ICM and building on regional/global legal frameworks – and a series of six case studies detailing the results of applying each methodology in a variety of geographical and thematic ocean contexts. In each case, the respective planning instruments, by advancing ocean governance reform at local, provincial, national, regional and/or global scales, put in place an enabling environment that proved highly conducive to catalysing substantial public and/or private sector financial flows, often leveraging the GEF public grant finance several hundred-fold. The six case studies in the Danube/Black Sea, Yellow Sea, Rio de la Plata, East Asian Seas, West/Central Pacific Ocean and global (ship ballast water) provide conclusive evidence for the highly catalytic impacts of such approaches (Figure 8) in creating an enabling environment that can mobilise substantial quantities of public and/or private finance for ocean restoration and protection.

Figure 8: Catalytic Ocean Finance Ratio (Catalysed Public & Private Finance: UNDP-GEF Finance) for the six case studies



Application of the TDA/SAP methodology to promote barrier removal and policy reform in the Danube/Black Sea, Yellow Sea and Rio de la Plata, catalysed investments of $2.983 billion, $10.863 billion, and $2.62 billion, respectively. Application and scaling up of ICM in the East Asian Seas region through the UNDP-GEF PEMSEA programme catalysed $9-11 billion in public and private sector finance. Building on a regional fisheries convention in the W/C Pacific, and on a new global instrument in the case of GloBallast, leveraged $3.214 billion and $35 billion in actual or projected financial flows, respectively, the latter two examples almost wholly from the private sector. In total, over a twenty year period, $141 m. in GEF grant resources to these six programmes leveraged public and private sector investment totaling $64.68 billion for a combined catalytic ocean finance ratio of 458 to 1.

What lessons can be learned from these methodologies and case studies that can inform their transfer, replication, and upscaling in other ocean and coastal contexts? We believe that seven key lessons can be derived from *Catalysing Ocean Finance* to inform efforts to scale up action to reverse the deterioration of the global ocean.

The **first** lesson is that **correcting market and policy failures through application of new policy instruments can not only help restore and protect oceans and coasts but in many cases can also generate sizeable business activity and 'green' jobs.** *Catalysing Ocean Finance* illustrates how new and enhanced local, national, regional or global regulation of ocean sectors can contribute to what Joseph Schumpeter called the "creative destruction" of capitalism. Just as new knowledge, technology, and changing consumer preferences can drive rapid and dramatic shifts (including elimination) in industries and the allocation of capital, ocean policy instruments which create new or altered compliance regimes can have similar impacts on ocean-related industries.

For example, the *Global Convention on Ships' Ballast Water and Sediments*, supported by the GEF-UNDP-IMO Globallast project, sent a clear signal to the private sector on the need to comply with forthcoming ballast water treatment requirements. This new international regime gave birth to a new ballast water treatment industry, ultimately expected to grow into a $35 billion market globally. In a relatively short period of time, a whole new maritime industry and supply chain has been catalysed, creating whole new companies and divisions within existing companies and, importantly, new job opportunities, at very little cost to the tax payer.

Similarly, the UNDP-GEF Danube, Black Sea, Yellow Sea, FrePlata and PEMSEA programme catalysed billions of dollars in public investment in municipal and industrial wastewater treatment, habitat restoration and other pollution reduction activities. While these investments in many cases represented sizeable new costs for local, provincial and national governments, they also generated an equivalent level of business activity in the water treatment and management industries (many national and regional) that were awarded contracts for provision of infrastructure and services. These investments created sizeable job opportunities and helped to strengthen private sector experience and capacity in each region. This example also underscores a not often acknowledged social benefit of environmental regulation in general: that while regulation can and often does lead to financial and job losses in regulated industries, regulation also often serves to create whole new industries and job categories.

No country has developed based on a truly green growth model yet and the materiality of green markets at large scale remains a subject of debate. *Catalysing Ocean Finance* provides strong evidence that effective 'blue economy' approaches can generate substantial new job opportunities. However, UNDP-GEF experience also shows that employment creation activities must be deliberately built into marine ecosystem restoration and protection initiatives to minimise job losses and ensure that the net result of Schumpeter's creative destruction process on jobs is positive. As such, allocating programme resources that promote and facilitate job creation as well as documenting and communicating the gross and net impacts of coastal and ocean reforms on business activity and jobs will be critical to foster continued ocean action. With a few exceptions, this is an area that has received insufficient attention in the GEF International Waters portfolio and represents an opportunity for the GEF to mobilise greater political support to restore the global ocean in the coming years.

A **second** major lesson is the **importance of investing in capacity development for ocean policy makers and other stakeholders**; this was a component of each of the UNDP-GEF International Waters programmes reviewed in the case studies and a key ingredient of the successes achieved by these projects in advancing ocean governance reform and catalysing investment. A key challenge for policy makers aiming at leveraging public and private finance to reverse ocean degradation is to identify the specific policy levers required to remove existing investment barriers. Numerous policies and programmes have been adopted worldwide aimed at protecting the ocean and catalysing financial flows but their impact has in many cases been limited. Designing effective policies requires economic, financial and technical expertise, deep knowledge of local economy and good understanding of successful international practices. Effective ocean and coastal policies will enable countries to achieve multiple development wins - boost economic growth, reduce poverty, create new jobs, improve local environment and heath conditions, and mitigate global environmental risks. Poorly designed policies will not achieve these multiple goals, but they will absorb time, political, financial and institutional resources (OECD, 2012). To make matters even more challenging, policy design is a highly dynamic process and even effective policies will need to be regularly revised to reflect changes in national and international development conditions.

Each of the six reviewed interventions targeted programme resources towards enhancing the policy development and implementation capacity of decision-makers. For example, by developing capacities of the countries and institutions involved in negotiating the global ballast water convention, the UNDP-GEF intervention played a substantial role in accelerating the adoption and ratification of the Convention and its anticipated coming into force. In addition, through capacity building support to governments, inter-governmental organisations and the private sector, the UNDP-GEF intervention helped prepare each of these stakeholders for compliance with the anticipated new legal regime which should lead to rapid implementation once it enters into force. PEMSEA provided a broad range of capacity building support through training of local and national policy makers in Integrated Coastal Management, Information Management, Environmental Impact Assessment, etc. The Pacific Fisheries projects built capacities of national PIC stakeholders in monitoring, control and surveillance, international fisheries legislation, fisheries administration, etc.

This leads us to a **third** key lesson learnt. A crucial step in any intervention to catalyse finance will be to reach a consensus among all stakeholders about the most effective mix of policy instruments. A common element of the three sets of successful methodologies reviewed in this publication is the **focus on multi-stakeholder approaches for ocean policy change**.

Ocean protection and restoration initiatives that can foster mobilisation of public and private finance typically involve four main groups of stakeholders: communities; ocean-impacting and using industries, policy makers; and financiers. Each of these groups typically encounters a number of barriers that prevent them from using ocean, coastal and upstream (ocean affecting) resources in a sustainable manner. Table 2 summarises a generic suite of barriers encountered across the four main stakeholder groups; each case study in Volume II presents a specific barrier analysis for the waterbody and ocean issues being addressed. As for policy makers, it shows that ocean industries represent a group often affected by all of the barriers to sustainable ocean management, underscoring the critical importance of engaging industry in ocean protection and restoration.

Table 2: Generic suite of barriers to ocean and coastal sustainability

Type of Barrier	Barriers/Stakeholders	Consumers/ Users	Policy Makers	Local & Multi-lateral Financiers	Industry
Regulatory	Non-existent or insufficient policies and legislation	✓	✓		✓
	Poor enforcement of existing legislation and regulations	✓	✓		✓
Institutional	Non-existent or weak local, national regional and/or global river and ocean governance institutions		✓	✓	✓
	Low public sector capacity (individual, institutional, national)		✓		x
Financial	Lack of suitable financial instruments and/or skills to access and apply them		✓	✓	✓
Technical	Market failures that result in non-sustainable ocean and river basin practices (overfishing, pollution, invasive species, etc.)	✓	✓		✓
Information	Insufficient (and/or poor access to) data and information for sustainable river basin and ocean management	✓	✓	✓	✓
	Insufficient knowledge of available financial and economic instruments for sustainable river basin and ocean and management		✓	✓	✓
	Lack of sufficient awareness of ocean and river issues by public, policy makers and the private sector	✓	✓	✓	✓

This means that none of these stakeholders alone can leverage an investment or transform a market. The support of a single one of the stakeholder groups is a necessary but not sufficient condition for scaling up a given technology or management practice. Financial de-risking instruments (partial loan guarantees, political risk insurance, etc.) aimed at encouraging public and/or private investment in waste-water treatment or other ocean restoration investment needs will have little impact in the absence of strong population awareness, local technical capacity and supportive regulatory instruments. The severity of these different barriers will vary with location, technologies and consumer groups, and a unique mix of information, regulatory and economic policies will be required to remove them in each situation. Each of the projects in the six featured case studies recognised the need to identify and work with diverse stakeholder groups unique to each project's context and established various stakeholder consultation and involvement mechanisms to ensure that the interests and needs of different stakeholder groups were addressed. Table 3 shows a generic mix of ocean policy instruments that will affect different stakeholders. .

Table 3: Generic Public Policy Mix to Remove Key Barriers to Ocean Protection and Restoration

Public Instruments	Consumers/ Users	Policy Makers	Local & Multi-lateral Financiers	Industry
Pollution Reduction instruments (pollution taxes, tradable emission permits, emission limits, etc.)		✓	✓	✓
Fisheries management tools (gear limitations, individual transferable quotas, marine protected areas, etc.)		✓		✓
Shipping standards (ballast water treatment standards, air pollution emission limits, oil pollution prevention, etc.)		✓	✓	✓
Public awareness and advocacy campaigns (e.g., low phosphorus detergents, advice on consuming sustainable fish, etc.)	✓	✓		✓
Coastal zone policies (zoning, marine spatial planning, MPAs, blue carbon schemes, etc.)	✓	✓	✓	✓
Financial Instruments (removal of subsidies to overexploited fisheries, subsidies to promote scaling up of sustainable mariculture, loan guarantees on pollution reduction investments, blue carbon, etc.)		✓	✓	✓

A **fourth** lesson is that **public policies are not for free**. Whatever the policy mix and implementation scheme that is selected, there will be a cost for industry, consumers, or both. As a general rule, everything that can be done to first reduce investment risks — such as simplifying and shortening administrative processes, or improving consumer information — needs to be a first-order priority, before resorting to more expensive public policy instruments such as subsidies, soft loans or loan guarantees. In addition, it is generally more efficient to raise the cost of unsustainable activities through regulation or fiscal instruments that help price them at their true cost than to subsidise sustainable activities.

This is a recurring theme of *Catalysing Ocean Finance*. As explained in detail in Volume II, Chapter 3.3, Case Study #6, the GEF-UNDP-IMO GloBallast partnership is a case in point. Through a very targeted programme of advocacy and capacity development activities, this intervention played a pivotal role in bringing the Ballast Water Convention both to the adoption stage and to its expected entry into force. The Ballast Water Convention is expected to result in a total investment of $35 billion in ballast water treatment technology by the shipping industry over the next ten years. The $14 million GEF intervention essentially relied on comparatively inexpensive information, capacity building and regulatory tools and could ultimately achieve an unprecedented leveraging ratio of 2,500 to 1.

In contrast, the lowest leveraging ratios were recorded by interventions (such as Danube/Black Sea) which had to rely on more costly financial de-risking instruments such as loan guarantees, below market interest rates and grant subsidies (including from the GEF through a partnership with the World Bank), as well as a nearly four-fold higher cumulative GEF grant investment to create the necessary enabling environment for investment in the 17 countries of the Danube/Black Sea basin.

This selection of policy instruments with a lower leveraging potential was driven by the nature of the barriers faced. Hence, a lower leveraging ratio does not necessarily reflect a less optimal policy mix but a required response to a different set of conditions. It shows that the leveraging ratio is a critical but not sufficient indicator to assess the performance of a public intervention to catalyse finance for ocean protection and restoration. Additional decision-making support indicators, such as benefits and avoided costs of interventions, are also needed to prioritise action to restore and protect the global ocean. Programme resources should be allocated to develop, monitor and report on these indicators.

A **fifth** lesson is the **significant catalytic value added from dedicating resources to investment pre-feasibility work during the policy analysis and development stage**. While many GEF International Waters projects have conducted inventories of pollution and other environmental degradation 'hot spots' as part of the TDA phase, only a few have taken these analyses to the next step of investment pre-feasibility analysis. The UNDP-GEF Danube, Black Sea, FrePlata and PEMSEA programmes each committed financial resources to assist the countries in preparing priority investment portfolios. In the Danube case, these resources were quite substantial, $3.9 m., under the UNDP-GEF Danube Pollution Reduction Programme which identified and characterised upwards of $5 billion in required investments. In the most advanced of the case studies in terms of overall time frame, Danube/Black Sea, a sizeable majority – over 60% - of the investments identified through the pre-feasibility work were ultimately committed to with national, EU, EIB, World Bank and other financing.

Similar progress has been observed in implementation of priority investments identified by PEMSEA through both its regular UNDP-GEF programmes of support and a special UNDP-GEF Medium-Sized Project devoted to piloting and promoting public-private partnerships (PPPs); this project alone helped to leverage $78.65 million and $99.103 million in private and public sector resources, respectively. Lastly, while GloBallast did not dedicate specific grant resources to the development or testing of specific ballast water treatment technologies, it instead played a highly facilitative role by supporting the private sector through convening a series of R&D symposia, creation and maintenance of R&D directories, dissemination of IMO standards and technical guidelines, and establishment of the Global Industry Alliance. By promoting the sharing of information, best practice and healthy competition in a rapidly emerging new industry, these activities clearly contributed to the dramatic growth, already exceeding $100 million, in private sector spending on ballast water treatment research and development (R&D).

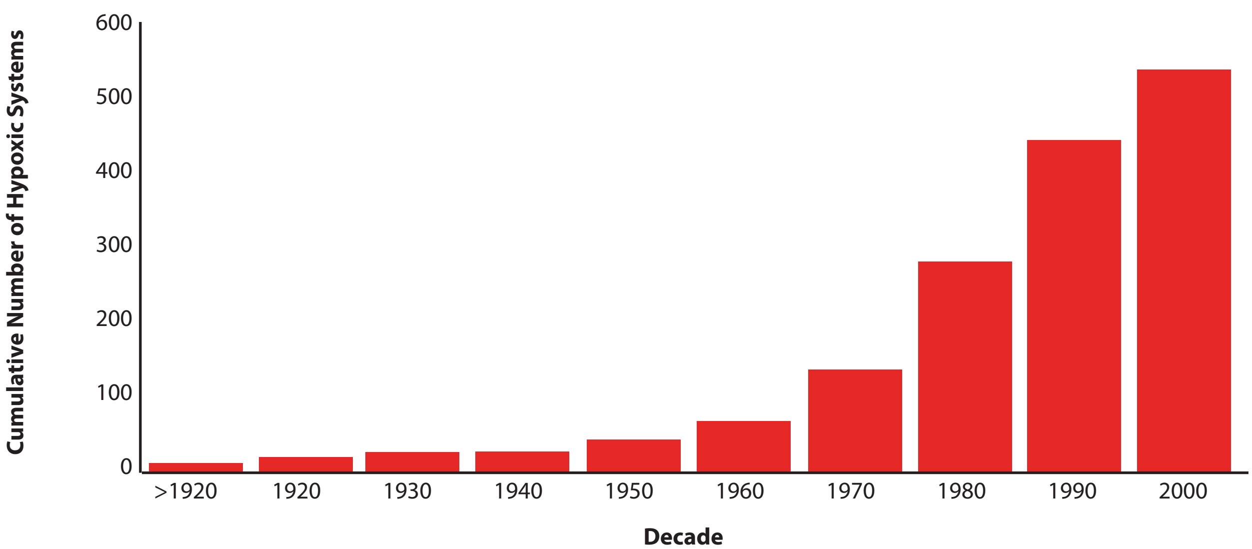
With the exception of these and perhaps one or two other GEF International Waters programmes, targeting programme resources towards investment identification is, as for job creation, an area that has received insufficient attention in the GEF International Waters portfolio and represents an untapped mechanism for the GEF and other ocean donors to enhance the likelihood of large scale catalytic finance emerging from these kinds of ocean governance barrier removal programmes.

A **sixth** lesson relates to the value of **combining two or even all three of the proven barrier removal methodologies - TDA/SAP, ICM and global/regional legal frameworks – in the design and implementation of ocean governance programmes**, building on the geographic, legal, technical and other 'comparative advantage' of each instrument. The case studies presented in this publication underscore the multiple, synergistic benefits that can be realised by strategically building on the catalysing 'power' of each of the methodologies at different geographic scales. The PEMSEA programme and countries have undertaken such an approach via negotiation and multi-country adoption of the Sustainable Development Strategy for the Seas of East Asia (SDS/SEA), equivalent to a regional 'framework' SAP, which complements the national, provincial and local ICM programmes which continue to be scaled up and replicated. Several Large Marine Ecosystems programmes have supported development and adoption of ICM protocols to regional seas conventions, to promote adoption and implementation of ICM, complementing policy commitments through TDA/SAP. The GloBallast programme has also worked closely with several LMEs and Regional Seas programmes to embed ballast water management policy reform into the SAPs and protocols of these multi-country ocean governance programmes, further underscoring the value of 'cross fertilisation' of these strategic planning instruments. Combining two or three methodologies also increases their relative flexibility and should enable policy makers to expand their application to new ocean challenges (see Chapter 4).

Our **seventh** lesson is that the **time frames to transform ocean markets through barrier removal, policy implementation and catalysed investment are long**, typically 15-20 years or more. Each of the case studies reviewed describes programmes that began in either the early or mid-late 1990's. The initial GEF programmes in the Danube and Black Sea were among the first International Waters projects approved by the GEF during its pilot phase (1991-1994), as was the first phase of what became PEMSEA, the East Asian Seas Marine Pollution Prevention (EAS-MPP) project. The first stage of UNDP-GEF support to the W/C Pacific fisheries process begin in 2000 through the Pacific SIDS SAP Project, while initial UNDP-GEF support to Argentina and Uruguay through the FrePlata programme began in 1999, to the Yellow Sea in 2002, and to the Ballast Water Programme in 1999. Only the two most mature GEF International Waters programmes – Danube/Black Sea, and PEMSEA, have shown measurable reductions in environmental stress on the concerned ecosystems with local (PEMSEA) and regional (Danube/Black Sea) ecosystem recovery now clearly in evidence. 5-10 more years may still be required in the other examples for investments to be completed and management practices reformed, to see comparable evidence of stress reduction and improvements in overall ecosystem health. Similar time frames have been observed in developed countries working collaboratively to restore shared marine and aquatic systems, such as in the Great Lakes (US/Canada), the Baltic Sea, and the North Sea, and even these waterbodies, surrounded by some of the world's most advanced economies, have continued needs in terms of effective policy implementation and investment to reverse several remaining degradation trends.

In contrast, the present rate of increase of several ocean issues including hypoxia, acidification, overfishing, and coastal habitat loss, is geometric – globally, the number of hypoxic areas has doubled roughly every 10 years (Figure 9). Similarly, mangroves and seagrass are disappearing at 1% and 7% per year, respectively; and ocean acidity is increasing at an exponential rate in direct proportion to anthropogenic carbon dioxide emissions to the atmosphere.

Figure 9: Global increase in frequency of hypoxia

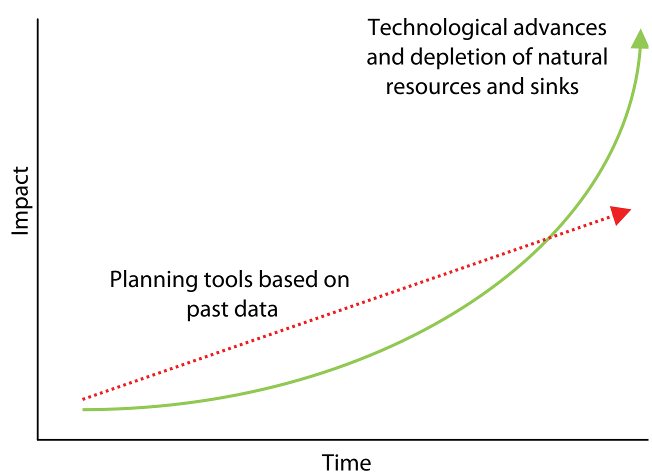


Source: Diaz and Rosenberg, 2008

The proportion of fish stocks classified as collapsed or over-exploited has increased inexorably since the early 1960's and there is ample evidence that overexploited fisheries that pass certain 'tipping points' in terms of ecosystem restructuring may be unable to recover even if fishing pressure is drastically reduced. Geometric changes are particularly difficult to anticipate as they often behave as gradual, linear processes until their explosive phase takes on unexpected turns and consequences.

The late economist Kenneth Boulding used to say "*we make our tools, and then they shape us*". As visualised in Figure 10, our economic, social and engineering planning tools rely essentially on a linear extrapolation of past physical and economic data to manage exponential phenomenon. Hence it is critical to incorporate during the diagnostic phase of TDA/SAP, Global/Regional Conventions and ICM, the potential impacts of possible abrupt non-linear environmental changes on coastal and ocean assets. The combination of the geometric pace of ocean degradation with the long time frames required to facilitate catalytic and transformative changes in ocean sectors also underscore the urgency of **taking immediate action on the key ocean challenges**.

Figure 10: Forward Exponentially, Looking Backward



Source: Adapted by authors from M. Ford, 2009

In 1971 testimony to the US Congress, famed ocean explorer, documentarian and advocate Jacques Cousteau warned Congress (Chandler, 2007) that the world faced destruction of the ocean from pollution, overfishing, extermination of species, and other causes. He called for immediate action on several fronts to reverse the situation. It is now over 40 years since Captain Cousteau's admonition and his words were clearly prescient; unfortunately, similar inaction for the next 40 years and continued geometric degradation, will almost certainly lead to irreversible damage to ocean ecosystems and severely impact the lives of the billions of people who depend upon the ocean for food security, livelihoods and a wide range of vital ecosystem services.

For each of the six case studies reviewed in this publication, while stress on marine ecosystems has been reduced and, in some cases, measurable environmental improvements realised, globally the ocean remains on a negative trajectory and is likely to continue to deteriorate at an increasing pace if the drivers of degradation are allowed to continue unabated.

Building on the above findings, the next and final chapter of Volume I of *Catalysing Ocean Finance* reviews the present and emerging ocean challenges, and explores a menu of ocean policy measures that could enable ocean policy makers to address these challenges at a global level. It discusses the relevance of the three proven barrier removal methodologies described above - TDA/SAP, ICM and global/regional legal frameworks – in the design and implementation of these policy measures and uses this discussion as the building block to estimate the costs and benefits of action.

4. A ROADMAP TO RESTORE AND PROTECT THE GLOBAL OCEAN

Scaling up and replicating *Catalysing Ocean Finance* to address existing and emerging ocean challenges

Catalysing Ocean Finance presents a series of three market transformation methodologies – TDA/SAP, ICM and building on regional and global legal frameworks – that have proven highly effective at removing barriers and putting in place the necessary enabling environment to leverage sizeable sums of public and private sector finance, and to transform large scale ocean sectors, such as fisheries and shipping, towards sustainability. Their proven effectiveness and their flexibility in isolation or in combination to address the principal ocean threats described in *Catalysing Ocean Finance* suggest a number of key follow-up questions:

- Where do opportunities lie to replicate these methodologies and policy instruments to address similar ocean issues in different regions of the world?
- What level of scaling up would be required to address some of the key global ocean challenges comprehensively?
- Lastly, which new and emerging ocean issues could these methodologies be successfully applied to and what level of public financial resources might be required to scale up catalytic impacts?

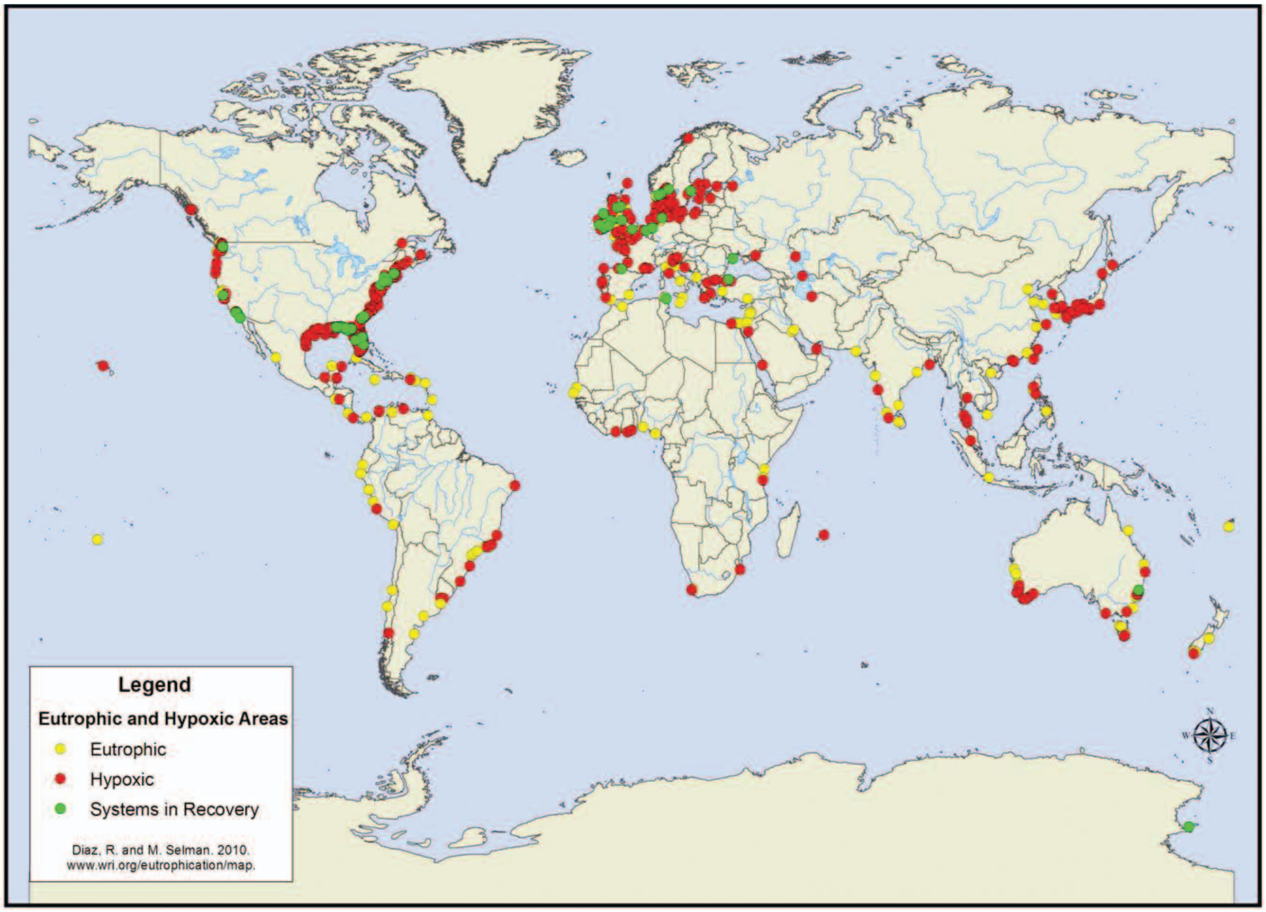
Chapter 4 of Volume I addresses these questions and sets forth a roadmap to restore and protect our ocean over the next 20 years. First, it reviews the environmental status of the four main threats to the coastal and ocean environment: (i) Ocean Hypoxia; (ii) Ocean Acidification; (iii) Introduced Species; and iv) Overfishing, with important cross-linkages to aquaculture and coastal habitat loss and degradation. For each threat, the publication then presents the main drivers of degradation and provides recommendations on how scaling up the market transformation methodologies described in *Catalysing Ocean Finance* can foster policy reform and catalyse investment to mitigate/eliminate these drivers and preserve the socio-economic benefits provided by coastal and ocean resources. Based on this analysis, it estimates the approximate public costs, benefits and total catalysed finance of a global effort to dramatically reduce the impact of each of these four threats to ocean sustainability. These financial estimates are derived from the findings and financial data generated by the UNDP-GEF portfolio of International Waters projects over the past 20 years as well as from a review of specialised literature. The large uncertainties associated with each of these estimates are acknowledged; their main ambition is to provide a reference point for policy discussion.

4.1 Nutrient Over-enrichment/Eutrophication/Ocean Hypoxia

The Danube/Black Sea basin case study (Volume II, Chapter 1.3) demonstrates that eutrophication and associated hypoxia in large scale ocean areas can be reversed through a TDA/SAP facilitated process of policy, regulatory and institutional reforms that can remove barriers and catalyse the required investments and management reforms for nutrient pollution reduction, wetland restoration and agriculture. The reversal and near elimination of the Black Sea dead zone is considered to be one of the first major reversals of such a large scale dead zone in history; unfortunately, globally the occurrence of ocean hypoxic zones has continued to grow at a geometric pace over the last

30 years with the number of known hypoxic areas now numbering over 500 (Figure 11). Nutrient burdens from land to the ocean have roughly tripled since pre-industrial times and are projected to double or triple again by 2050 in the 'business as usual' scenario (Seitzinger, 2010), with the majority of increases occurring in the developing world. As noted in Chapter 1 of Volume I, nutrient over-enrichment is one of a handful of 'planetary boundaries' that are already considered to be exceeded, with calls for a 70% reduction in the level of reactive nitrogen that is presently reaching our ocean to return within the boundary.

Figure 11: Global map of Hypoxic Areas



Source: Diaz et al. 2010

A global paradigm shift is required in how we manage nutrients if we are to slow down and ultimately reverse the hypoxia trend. Drawing from the instruments reviewed in this publication, two approaches, potentially complementary, could be considered to foster this paradigm shift. Recognising that the issue of coastal and ocean hypoxia is now a global one in terms of its scale, frequency and rate of increase, the first approach would aim at fostering a global multilateral agreement to mandate policy reforms and investment needed to reduce nutrient loads to receiving waters, both national and international. At present, the principal global agreement targeting reduction of nutrient and other pollution loads from land to ocean is the Global Programme of Action to Protect the Marine Environment from Land-Based Activities (GPA-LBA). The GPA-LBA, while voluntary and not legally binding at a global level, has made meaningful progress in a number of areas such as adoption of Land-Based Protocols in (7) Regional Seas Programmes, promoting National Programmes of Action, and the Global Partnership on Nutrient Management (GPNM). Nevertheless, globally the occurrence of ocean hypoxia continues to grow and the number of systems in recovery due to successful interventions remains a small minority, limited mostly to OECD countries (see systems in recovery in Figure 11).

The ‘root cause’ behind a sizeable portion of nutrient over-enrichment of the world’s coastal zones over the last fifty years is the massive increase (particularly since the early 1950’s) in the production (using the high energy Haber-Bosch process) of nitrogen fertilisers by converting non-reactive atmospheric nitrogen into manufactured reactive nitrogen. As a result, a cumulative amount of about two billion mt of new reactive nitrogen has been added to the earth system and the amount of reactive nitrogen now entering the global environment each year is about eight times its pre-industrial levels. The GloBallast/ship ballast water case study #6 demonstrated that a global legal framework can have truly transformative impacts on industries such as shipping. Could a corresponding global approach be applied to the nitrogen issue and the involved industrial sectors (agriculture, fertiliser manufacture, wastewater management)? This could range from giving the GPA more ‘teeth’ by making it or relevant new global protocol(s) legally binding, to more radical approaches such as a global cap and trade on manufactured nitrogen fertiliser. The latter, by raising manufactured fertiliser prices under a global cap on production, would of course send powerful economic signals to fertiliser users to improve use efficiency, and could (if the signals were strong enough) begin to financially incentivise wastewater managers to recover an increasingly valuable product – nitrogen and phosphorus ‘waste’ – from the human and livestock wastewater streams. However, such a framework would likely be controversial with regard to (at least near-term) impacts of higher fertiliser prices on food prices and food security. Although policy reforms could be introduced incrementally and cost neutral policy approaches could be applied whereby the net financial impact on farmers of higher fertiliser prices was offset by reductions in other input costs such as property and other taxes, it is unlikely that a global consensus could be reached fast enough to address the global hypoxia crisis in a timely manner.

In the absence of any overarching mandatory global framework on nutrients, an alternative could be to foster a bottom up approach, combining TDA/SAP and ICM planning instruments. Municipalities, countries and regional river basin and ocean management bodies, through regional TDA/SAP and local and national ICM approaches, can apply a number of existing policy, economic and financial tools to internalise the nutrient externality and reduce nutrient burdens to their coastal areas, including:

- Nutrient emission taxes on point sources (WWTP, industrial sources);
- Regional and national catchment level nutrient management plans and budgets;
- Subsidies to promote good nutrient management practices and technology;
- Nutrient emissions cap and trade system for national and/or international river basins;
- Feed-in tariffs to incentivise fertiliser recovery from nutrient waste (human, livestock);
- National regulations that reduce nutrient pollution through improved practices (caps on fertiliser/ha, agriculture buffer zones, manure management requirements, etc.);
- Strengthen nutrient management institutional capacity at local, national, regional, global scales.
- And others

Under the UNDP-GEF Yellow Sea programme through the YSLME Strategic Action Programme, the governments of China and Republic of Korea committed to reduce nutrient loads to the Yellow Sea by 10% every five years through 2020. Similarly, Argentina and Uruguay, through their SAP process, committed sizeable financial resources - $2.62 billion – in investments to reduce nutrient and other pollution loads to the Rio de la Plata/Maritime Front system. Other river basin and linked LME and regional seas programmes for which coastal eutrophication and hypoxia emerges as a priority issue can gain from the experience of these GEF programmes in addressing basin-level nutrient pollution. Lastly, the PEMSEA case study demonstrates how effective local, provincial and national ICM policy development and implementation can be at removing barriers and leveraging the pollution reduction investments and management actions required to reduce pollution hot spots including those for nutrients and BOD/COD that cause hypoxia.

What would be the approximate costs, benefits and total catalysed finance of such a comprehensive bottom up global effort to dramatically reduce the incidence of ocean hypoxia?

Public Costs: An estimate for the public costs of addressing ocean hypoxia at a global level can be derived based on scaling up Danube/Black Sea TDA/SAP experience to LMEs (and linked river basins) impacted by hypoxia, and by scaling up PEMSEA’s success at reducing hypoxia hot spots through ICM approaches. Around 38 of the world’s 64 LMEs have areas of eutrophication or hypoxia (analyses done by UNDP-GEF for this volume by comparing NOAA LME map (www.lme.noaa.gov) with hypoxia work of Diaz et al., Figure 11); GEF has been active in 18 of these (18 of the 21 GEF-supported LMEs have hypoxia issues) leaving a total of about 20 LMEs requiring nutrient reduction interventions. 20 LMEs x $50 million each (total GEF grants to Danube/Black Sea) = $1 billion in required catalytic public finance to reverse global hypoxia; this is clearly an upper limit given the severity of the nutrient issue in the Danube/Black Sea basin, historically one of the most intensely fertilised basins in the world.

Through PEMSEA, 26,829 km. of coastline in East Asia now have ICM programmes in place. Total world coastline length is estimated by WRI as 1,634,701 km (WRI, retrieved from Wikipedia). However, much of this lies in extremely low population density regions of countries with sizeable coastlines like (northern) Russia, (northern) Canada, Chile and Australia where introducing ICM would have little added value due to extremely low anthropogenic pressures on coastal resources. For purposes of this calculation, 90, 80, 20 and 50%, respectively, of Canada, Russia, Australia and Chile coastlines are excluded from requiring ICM. This reduces the total global coastline with sufficiently high population densities to merit ICM to about 1,166,369 km. Using this simple metric, scaling up ICM globally would require roughly 1,166,369 km/26,829 km x $36 m. PEMSEA grant finance = $1.56 billion. Clearly this is an upper limit as many countries, particularly in developed regions such as the United States, Canada, Australia, Japan and European Union, already have ICM programmes in place (with admittedly varying degrees of success vis a vis implementation).

Benefits/Avoided Costs: Total European exports of anthropogenic reactive nitrogen to the ocean are about 1.9 million mt/year compared to a global amount of about 15 million mt/year (Seitzinger, 2010). The socioeconomic impacts of hypoxia on European aquatic systems are estimated at $25 - 100 billion/year (European Nitrogen Assessment, 2011). Based on these figures, the avoided costs of addressing hypoxia at a global scale are estimated as the ratio of global to European anthropogenic nitrogen emissions to the ocean (= (15/1.9) = 7.9) multiplied by $25 - $100 billion/year, resulting in a global figure of $200 - $790 billion/year.

Catalysed Finance: The Danube/Black Sea programme catalysed over $3 billion in public and private sector finance for nutrient reduction. Using the above metric, scaling up TDA/SAP to address hypoxia in 20 LMEs would catalyse approximately 20 LMEs x $3 billion = $60 billion in nutrient reduction investments. This is clearly an upper limit as few if any areas of the world are subject to the extreme levels of nutrient overenrichment and hypoxia as were evident in the Danube/Black Sea basin. PEMSEA catalysed $369 million in pollution reduction investments which also supported reduction of nutrient pollution and associated hypoxia; scaling this up as above using the global to PEMSEA/ICM coastline ratio delivers an estimate for catalysed finance for global scaling up of ICM of (1,166,369 km/26,829 km) x $369 million = $16 billion.

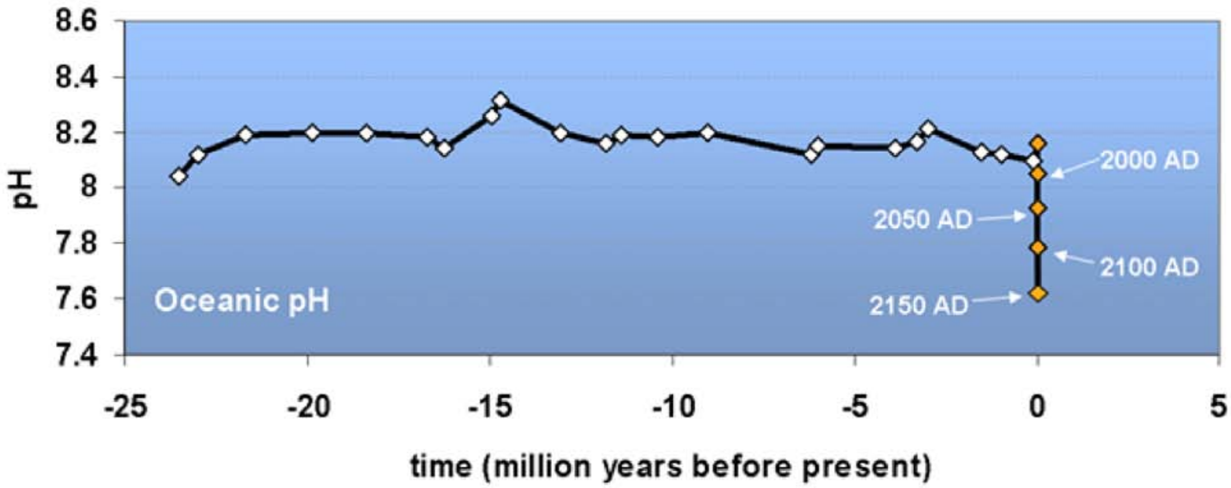
4.2 Ocean Acidification

An estimated 25-30% of the anthropogenic carbon dioxide that humans have emitted through the combustion of fossil fuels over the last 200 years or so has dissolved in the ocean as carbonic acid. While uptake by the ocean has helped to delay and mitigate the impacts of climate change on the atmosphere to a sizeable degree, it has resulted in a change to ocean carbonate chemistry through lowering the average pH of the ocean by 0.1 units, this represents an increase in ocean acidity of about 30% (pH uses a logarithmic scale). In a business as usual fossil fuel use scenario, by the late 21st century ocean pH would drop by another 0.3-0.4 pH units, or an increase in acidity of over 200%. Marine organisms spend a lot of their energy maintaining their internal pH and as external seawater pH decreases, they will likely have to divert more of the energy away from other parts of their physiology (e.g., growth and reproduction) to continue to do this. As a result of acidification, the concentration of carbonate ions in the ocean has also decreased significantly and will continue to do so with increased CO_2 emissions to the atmosphere. The calcium carbonate concentration directly influences the saturation, and consequently the rate of dissolution, of calcium carbonate minerals in the ocean. The degree of calcium carbonate mineral saturation is important in the formation of shells and skeletons by numerous planktonic and benthic organisms. As saturation levels decline further, shell forming organisms will find it increasingly difficult to form their shells and some may face possible extinction.

Under the 'business as usual' climate change and CO_2 emission scenario, by 2100 virtually all Arctic and Southern

Ocean waters become 'undersaturated' with respect to the two forms of calcium carbonate (aragonite, calcite), basically bringing into question the survival of many calcifying organisms – and the broader ecosystems that depend upon them - in these ocean areas. Towards the end of this century, saturation levels of calcium carbonate will not yet be corrosive to calcium carbonate on coral reefs. However it is likely that the rate of reef calcification will decline to a level such that coral reef erosion will exceed reef growth and reef habitat and the great biodiversity provided by them will no longer be sustained in many areas of the world. To further put this issue in perspective, ocean pH is already changing at a rate not seen on earth for at least *60 million* years (Figure 12) and in the earth's geological record there is a strong correlation between mass extinctions and major ocean acidification events.

Figure 12: Changes in Ocean pH over the last 25 million years and projections in 'business as usual' fossil fuel use scenario



Source: Turley et al, 2006

Initial estimates of the economic costs of ocean acidification by 2100 amount to $1.2 trillion per year (Brander, 2011)), about 0.16% of global GDP, and represent about 10% of the overall projected damages due to climate change. However, these preliminary estimates only include impacts on coral reefs and mollusks and don't begin to account for the potentially catastrophic impacts on ocean ecosystems if the functioning and survival of calcareous plankton, the basis of much of the oceanic food chain, is impacted.

Ocean acidification – increasingly referred to as 'the other CO_2 problem' – is driven wholly by increasing levels of fossil fuel CO_2 in the earth's atmosphere. As a truly global issue, ocean acidification lends itself to a global approach through the kinds of legal mechanisms reviewed in Chapter 3 of Volume II. As illustrated above, there are few if any adaptation strategies for the marine organisms projected to be impacted by ocean acidification and for the human societies that depend on these marine ecosystems. As such, the primary means of reversing ocean acidification and avoiding its serious impacts is to dramatically reduce CO_2 emissions as quickly as possible, through a transition to a low carbon energy economy. Given the speed, severity and urgency of the acidification issue, this could present an opportunity to more formally embed ocean acidification within the United Nations Framework Convention on Climate Change (UNFCCC). For example, in addition to existing UNFCCC indicators and targets that seek to cap the increase in the average temperature of the atmosphere, additional targets could be added committing to not exceeding a lower limit on ocean pH, within the tolerance of most marine ecosystems. In addition, UNFCCC could be adjusted to ensure mitigation strategies that could exacerbate ocean acidification (such as some artificial ocean iron fertilisation schemes which would draw down massive amounts of additional CO_2 into the ocean), are not pursued, as well as recognise that ocean acidification would continue to be driven by increases in atmospheric CO_2 if climate control strategies aimed at solar radiation management (vs. greenhouse gas reduction) were implemented. (Williamson and Turley, 2012).

Rather than serving as a testing ground for geoengineering theories, *Catalysing Ocean Finance* believes that key ocean sectors can play a critical role in mitigating climate change through 1) increasing the energy efficiency of shipping operations and 2) leveraging the substantial carbon sequestration potential of coastal habitats such as mangroves and seagrasses (see upcoming 'Shipping' and 'Blue Carbon' sections). In addition, unlike open ocean iron fertilisation, effective coastal habitat protection and restoration can provide multiple development benefits to local communities and align climate change efforts with national development goals.

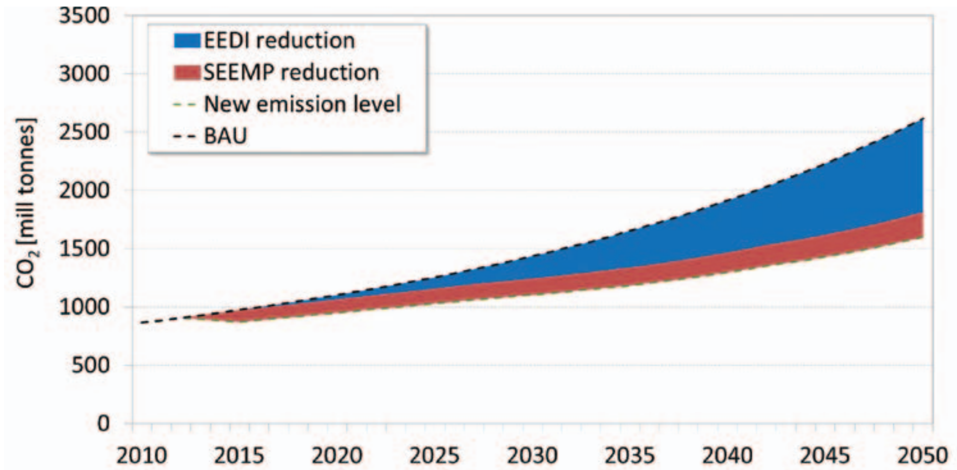
As discussed below, the avoided CO_2 emissions from the shipping industry deriving from successful implementation of the new IMO ship energy efficiency standards, would prevent shipping emissions from rising to around 5% of global emissions, limiting it to about 3.3% of present day emissions by 2050 or about 1.6 $GtCO_2$/year. In parallel, successful efforts to mainstream and scale up 'blue carbon' schemes (see below) to protect and restore key coastal carbon sinks could deliver net CO_2 emissions reductions ranging from 0.15-1.0 $GtCO_2$/year or the equivalent of about 0.38-1.8% of projected "BAU" emissions in 2050. The approximate consonance of the high end (1.0 $GtCO_2$/year) blue carbon CO_2 reduction estimate with the projected shipping contribution to global emissions under SEEMP/EEDI implementation scenario (1.6 $GtCO_2$/year) suggests that the ocean sectors which contribute to climate change could in effect move towards overall climate neutrality. This scenario is wholly achievable if the required methodologies and policy signals are put in place over the next twenty years. Of course, ocean acidification (and climate change) can only be successfully mitigated if land-based sectoral sources of CO_2 (power, transport, agriculture, buildings, etc.) also move towards a low carbon pathway. This presents an important opportunity for ocean sectors to show leadership in demonstrating that addressing climate change remains well within the realm of possibility, and *Catalysing Ocean Finance* provides an initial roadmap for approaching climate neutrality in the ocean sectors.

The first set of measures, building on the GloBallast model and our third instrument, would be fostered through implementation of recent international agreements on ship energy efficiency measures while the second would be achieved by including blue carbon in the new market mechanisms for climate mitigation.

Shipping Contributions to Greenhouse Gas Emissions & Climate Change

At the present time, international shipping contributes about 2.7% of anthropogenic greenhouse gas emissions, primarily as CO_2 from the burning of ship bunker fuels. However, in the 'business as usual' scenario, ship emissions are projected to increase by 200% or more (from 2007 levels) by 2050 (Figure 13) at which point they could constitute 5% or more of global CO_2 emissions, depending on the world's overall future carbon trajectory. Recent efforts by IMO to limit the carbon footprint of shipping include development of ship design (Energy Efficiency and Design Index - EEDI) and operational energy efficiency (Ship Energy Efficiency Management Plan - SEEMP) measures which have already been adopted by IMO member states. If implemented, these energy efficiency measures would lead to avoided shipping CO_2 emissions of 1 billion mt/year (as CO_2) by 2050 (1.7% of projected (UNFCCC A1B 'balanced' illustrative scenario) global CO_2 emissions of about 58.7 $GtCO_2$/year in 2050) and prevent shipping from becoming a more significant component of global GHG emissions. Furthermore, through implementing these energy efficiency measures, the industry would enjoy annual fuel savings of $90-310 billion/year by 2030 alone (Bazari, 2011).

Figure 13: Impact on shipping CO_2 emissions of implementation of IMO Ship Energy Efficiency Management Plans (SEEMP) and Energy Efficiency Design Index (EEDI) measures, 2010-2050



Source: IMO Marine Environment Protection Committee 63/INF.2 31 October 2011.

Developing countries account for the largest portion of the world's fleet by tonnage, the majority of the world's shipyards and 90% of the busiest ports. At the same time, the knowledge base, legal/policy framework and technical and institutional capacity required to give effect to any international regime for GHG emissions from shipping pose severe constraints for most of the developing countries. The barriers/root causes behind these constraints include:

- International and cross-boundary character of the shipping industry;
- Existing institutional and legal arrangements are insufficient or inadequate to address GHG issues;
- Lack of a global carbon market incorporating shipping contribution to GHG emissions;
- Lack of readily available, cost effective and viable technologies to address the issues;
- Broad lack of awareness regarding GHG emissions, its potential impacts and options for management; and,
- Poor and inconsistent regional cooperation on this issue.

Not surprisingly, these barriers are quite similar to those that initially faced the international community when the ship ballast water issue was starting to be assessed. A similar suite of stakeholders needs to be targeted including policy makers and national maritime and port administrations; ship and port operators; and ship designers and shipbuilders. A concerted technical and institutional capacity building programme for these target groups could ensure that developing countries are able to meet the new IMO energy efficiency obligations and make a sizeable contribution to global efforts to mitigate climate change. As another example that applies our third methodology/approach, fostering regional and global legal frameworks, this represents an excellent opportunity to build on the long-term GEF-UNDP-IMO partnership to deliver further transformational impacts towards environmental sustainability in the shipping industry. Costs, benefits and total catalysed finance are estimated below.

Public Costs - Shipping: Building on GloBallast model for grant finance needed to catalyse shipping sector transformation, cost estimated at $20 million for GEF or other financed Climate Change Mitigation project(s) to assist developing country and private sector shipping stakeholders in adopting and implementing IMO ship energy efficiency guidelines through development and promulgation of tools, methodologies, standards and guidelines for EEDI/SEEMP compliance.

Benefits/Avoided Costs - Shipping: In a balanced fossil fuel growth scenario (UNFCCC SRES A1B illustrative scenario; IPCC (2000)), by 2050 shipping grows to about 5% of global GHG emissions vs. 3.3% under energy efficiency measures, so we assume 1.7% reduction in total climate change impacts by 2050 due to implementation of ship energy efficiency measures. Recent estimates (Stern, 2007) of the net projected global economic impacts of climate change in business-as-usual (BAU) 'high climate impact' scenario are 5% of global GDP or .05 x $104 trillion = $5.2 trillion/year (2050). This delivers a benefit estimate of 0.017 x $5.2 trillion = $88 billion/year in avoided global climate change costs from ship energy efficiency by 2050. Additional benefits (avoided costs) of SEEMP/EEDI compliance realised by the shipping sector have been estimated as $90-310 billion/year in fuel savings by 2030 (Bazari, 2011).

Catalysed Finance – Shipping: New IMO EEDI requirements are expected to catalyse sizeable investments in design of more efficient new ships including expected features such as more efficient engines, efficiency optimised auxiliary machinery, waste heat recovery systems, new lightweight construction, hybrid electric power, shaft propulsion generators, solar power, decreased design speed (power), advanced hull coatings, etc.; no estimates are yet available of projected new net investment in the sector but clearly it will be 'multiple billions of dollars' stimulated by the new EEDI requirements; this is conservatively estimated at $20 billion one-time private sector finance. This is underscored by the fact that annual capital costs associated with new ships relative to annual fuel costs has changed significantly such that annual fuel costs are now much higher than capital costs. This effectively drives the economics of building new ships in the same direction as the EEDI regulation: diminishing the increased construction costs of EEDI compliant ships while emphasising the fuel savings.

Blue Carbon for Climate Change Mitigation

As noted earlier, loss of critical coastal habitats such as coral reefs, mangrove and seagrasses, continues unabated in nearly all locations around the world. Stressors causing these losses include unsustainable fishing practices, pollution and sedimentation, poorly planned coastal development, growth in coastal aquaculture, and others. While there is broad agreement in the environmental community that these ecosystems provide a wide range of valuable ecosystem services, ranging from nurseries for fisheries of commercial interest, to protection from storm surges, to nutrient sinks, unfortunately few of these ecosystem amenities have been converted into services that can be bought and sold in functioning markets. Selected coastal habitats, particularly seagrasses and mangroves, while relatively small in areal extent on a global basis, have extremely high carbon sequestration values when looked at from the perspective of mass of carbon sequestered per hectare per year. On this basis, these ecosystems are believed to store carbon at rates several times higher than the more widely recognised terrestrial carbon sinks such as tropical rain forests and temperate forests. In the aggregate, protection and restoration of these coastal carbon sinks could represent as much as 0.4-3.0% of present day global anthropogenic CO_2 emissions (Pendleton, 2012). Maintenance of these habitats also delivers climate change adaptation benefits by helping to protect coastal communities from the impacts of sea level rise and storm surge. In the same context as the UN-REDD (Reducing Emissions from Degradation and Deforestation) programme, communities interested in reversing the loss of these coastal ecosystems and the services they provide are increasingly looking at them from the perspective of their value as carbon sinks – so-called "blue carbon". Blue Carbon provides an opportunity to build upon each of our three *Catalysing Ocean Finance* instruments – Integrated Coastal Management, TDA/SAP and building on existing regional or global legal frameworks.

Efforts are underway by a number of international and non-governmental organisations (UNEP, IOC/UNESCO, Conservation International, IUCN, etc.) to develop robust methodologies to quantify the carbon sequestration values of seagrass and mangrove ecosystems. Local and national ICM policies and plans, and regionally adopted SAPs, could incorporate blue carbon in the mix of policy instruments municipalities and countries adopt through these frameworks. If such methodologies can be advanced, verified and formally adopted by appropriate international bodies (UN Framework Convention on Climate Change, Clean Development Mechanism, UN-REDD), this could present a transformative opportunity to bring the very high carbon sequestration value of these critical coastal ecosystems into global carbon markets and lead to rapid upscaling of 'blue carbon' as a key vehicle to both help mitigate and adapt to climate change, and to protect and restore these key coastal habitats in the context of ICM.

What kind of costs might be required to bring blue carbon fully into carbon finance markets? The principal barriers at play are technical and informational; what's primarily needed is broad agreement and formal adoption of a robust methodology to quantify the net annual carbon sequestration value of mangroves and seagrasses, and building of necessary national, local and community capacities to establish baselines and annual carbon storage values for specific blue carbon sites, along the same lines as REDD's Measurement, Reporting and Verification (MRV) system. Efforts to scale up blue carbon would build upon each of our three *Catalysing Ocean Finance* instruments – Integrated Coastal Management, TDA/SAP and building on existing regional or global legal frameworks. Estimates of the costs, benefits and catalysed finance deriving from a major scaling up of blue carbon follow.

Public Costs – Blue Carbon: We use the experience of REDD as a proxy of about $10-20 million per country to establish robust blue carbon inventories, build national capacities for applying blue carbon, and for ongoing monitoring, reporting and verification, targeting high carbon sequestration mangrove and seagrass habitats. According to FAO data (FAO), 40 countries contain 96% of the world's mangrove habitat by area. Unfortunately similar data on the areal extent of seagrasses do not appear to be available; however, visual inspection of WCMC global seagrass maps (http://data.unep-wcmc.org/datasets) indicates important seagrass areas in about three-fourths of the world's 153 coastal nations; the WCMC data also indicate a very high degree of overlap between countries with both mangrove and seagrass habitat so the 40 country figure is used as an overall proxy for the number of countries that could benefit most from participation in a blue carbon approach. Combining these figures produces an estimate for the enabling public finance required of about: 40 countries x ($10-20 million/country) = $400-800 million (one time cost).

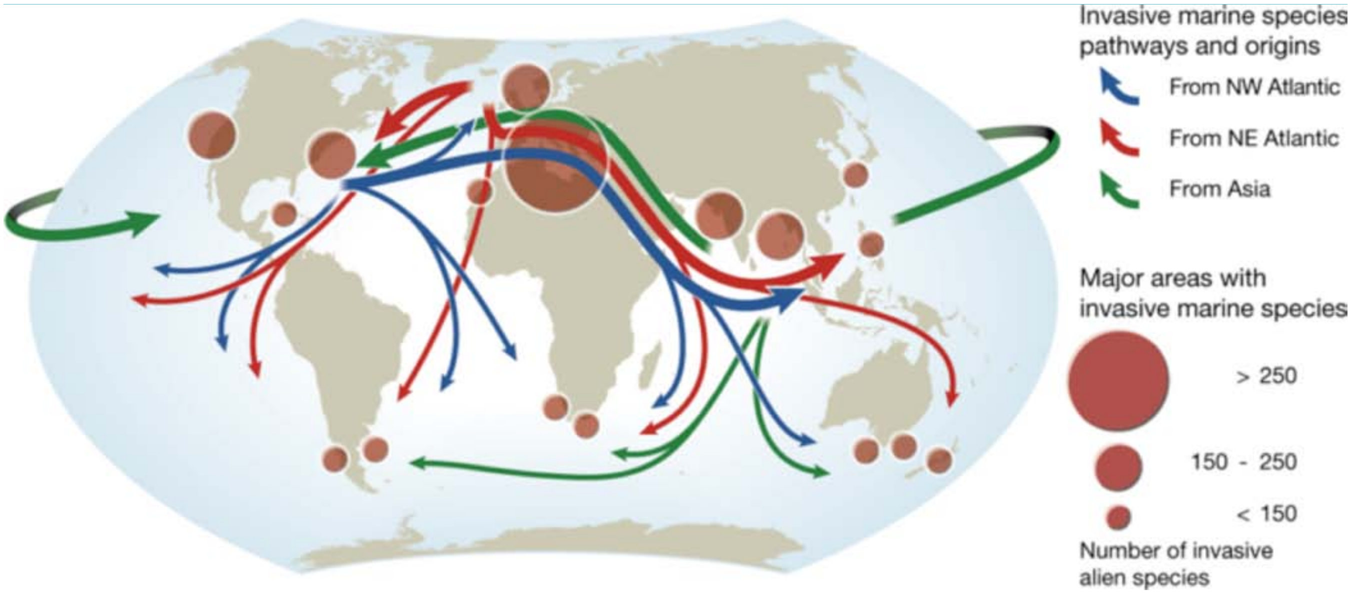
Benefits/Avoided Costs – Blue Carbon: A global scaling up of blue carbon could reduce GHG emissions from loss of coastal habitats by around 0.15-1.02 $GtCO_2$/year (Pendleton, 2012); with global GHG emissions presently at about 33.5 $GtCO_2$/year, and using same A1B scenarios as for the shipping calculation (58.7 $GtCO_2$/year by 2050),this would reduce the economic impacts of climate change by about 0.3-1.8% or (0.003-0.018) x $5.2 trillion/year (Stern, 2007) = $16 - 94 billion/year by 2050. Substantial additional economic benefits would add to this in terms of adaptation benefits (protecting coasts from storm surges, etc.) and maintaining other ecosystem services of these habitats (fish spawning areas and nurseries, recreation, etc.).

Catalysed Finance - Blue Carbon: Blue Carbon catalysed finance again assumes 0.15-1.02 $GtCO_2$/year x $2-5/mt carbon price for blue carbon credits = $0.3 - 5.1 billion/year; given that blue carbon sinks would need to remain largely undisturbed to maintain their carbon sequestration values, these sizeable financial flows could be directed in part towards the establishment and sustainable management of coastal MPAs in mangrove and seagrass habitat (see also 4.4 Overfishing).

4.3 Invasive Species through Ship Hull Fouling

The introduction of aquatic species to new marine and freshwater environments, through ships' ballast water and sediments, is considered to be one of the greatest threats to the world's freshwater, coastal and marine environments (Figure 14). When discharged into new environments these organisms may become invasive, severely disrupt the local ecosystem, seriously impact the economy and local livelihoods, and cause human disease outbreaks and even death. Estimates of the annual global economic damage from aquatic invasive species run as high as $100 billion per year. Through the recently adopted Global Convention on Ships' Ballast Water and Sediments, and through broad-based technical, policy, legal and capacity building support under the GEF-UNDP-IMO GloBallast programme (see *Catalysing Ocean Finance* Volume II, Case Study #6), the international community has taken significant steps towards reducing the threat from ballast water invasives.

Figure 14: Invasive Marine Species Pathways and Origins



Source: UNEP/GRID-Arendal Maps

In addition to the threat of invasive species from ship ballast water, ships provide a second mechanism as a vector for transferring invasive species – hull fouling by organisms that attach to the exterior of the ship. Hull fouling is arguably a more complex vector in that it also results from the movement of other vessels that are outside what is normally considered the shipping industry, e.g., fishing vessels, oil rigs, dredging equipment, etc. While it is difficult to quantify the specific difference in risk and impact between ballast water and hull fouling, there is wide agreement in the scientific community that risks of invasive species transfer via hull fouling are of a comparable scale to those from ballast water and therefore quite sizeable both environmentally and economically. The close linkage between the two vectors in turn allows us to identify an opportunity for replication of our third instrument, building on regional and global legal frameworks.

The International Maritime Organization (IMO), working with its member states and the shipping industry, has already begun to take steps to address the hull fouling issue. As was taken as the first step in addressing the ballast water issue, voluntary guidelines for hull fouling have been prepared and issued, and plans to monitor their implementation are currently being negotiated. The strong parallels between hull fouling and ballast water suggest the opportunity to replicate the strategic approach pioneered by the GEF-UNDP-IMO GloBallast programme including national capacity building, global awareness raising, development of tools, methodologies, standards and guidelines, and constructive engagement with the shipping industry as well as the nascent industry that would develop technological and management tools to minimise the risks of species transfer via hull fouling. As was the case with the GloBallast programme, such an initiative could both accelerate progress on addressing the issue of hull fouling, and permit rapid start-up of its implementation by well prepared governments and the concerned private sector entities. Combined with the ballast water convention, this two-pronged strategy could significantly mitigate the long-term risk of invasive species transported by ships and minimise future impacts on marine ecosystems and dependent livelihoods.

As with ship ballast water, the main catalysis of private sector R&D and ultimately investment would occur as the certainty of a global legal mechanism regulating hull fouling became apparent, leading the shipping and related industries to rapidly mobilise development of the necessary technologies and management practices towards compliance with the anticipated regime. At this early stage, it is of course impossible to project the possible size of new private sector activity in this area but clearly it would be sizeable given the scale of the global fleet of over 57,000 large vessels and the technical challenges inherent in preventing hull fouling. Already, there are a growing number of companies that specialize in the evaluation of vessels for hull transported invasives and the development and application of technologies to treat hulls to prevent or remedially remove invasive species.

What kinds of financing might be required to put in place a global programme designed to catalyse action on the ship hull fouling issue? The public costs, benefits and resulting catalysed finance are estimated as follows:

Public Costs: Public cost estimates represent $20 million for GEF or other donor-financed project(s) to scale up global activity to prevent ship hull fouling through capacity building support to governments, regional ocean institutions and the private sector, building on an anticipated international instrument following the GloBallast paradigm.

Benefits/Avoided Costs: Benefits based on assumption that aquatic invasive species cause about $100 billion/year (GloBallast Programme, 2004) in economic damage but the specific share from ballast water vs. hull fouling invasives is unknown consequentially the wide range (10%-90%) or $10-90 billion/year.

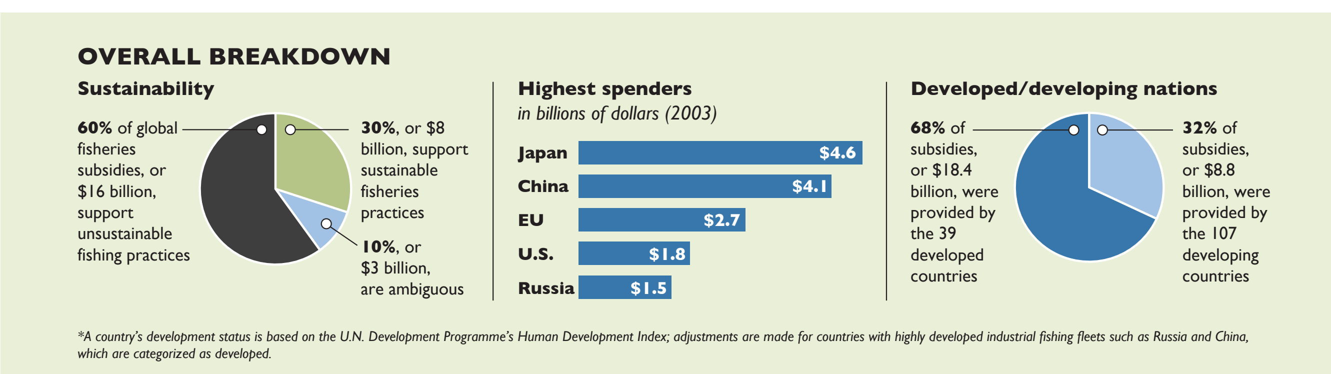
Catalysed Finance: Catalysed finance figure assumes similar range in costs to shipping industry to internalise hull fouling externality as for ship ballast water, $10-30 billion in total private sector investment.

4.4 Overfishing

The world's wild caught fisheries have reached a crisis situation. About 40% of global fish stocks are considered overexploited or collapsed, about 40% fully exploited (SeaAroundUs Project), and global wild fisheries catch has been effectively flat for the last 25 years at about 80 million mt/year. The significant overcapitalisation of the wild caught fisheries industry has clearly been a major driver of fisheries depletion worldwide. Other key drivers include destructive fishing methods, poor regulation of the fisheries sector, loss of key fish stock spawning and nursery habitat, weak fisheries management institutions and insufficient application of ecosystem approaches and innovative economic instruments to fisheries management. Over this period, the deficit in wild catch coupled with increasing global population and per capita fish consumption has driven a surge in aquaculture production, growing at an average rate of about 9% between 1980 and 2010 (FAO, 2012). Aquaculture now represents just over half of all the aquatic animals and plants consumed annually by humans on earth; global per capita consumption of farmed fish increased seven fold between 1980 and 2010. 56% of aquaculture production is freshwater fish; marine fish represent only 3% of total global production. As a result, few if any marine stocks have demonstrated corresponding recovery despite the dramatic growth in aquaculture's global share of aquatic protein. Although farmed salmon production for example increased dramatically in the 1990's, driving down prices 30-50%, wild catch continued to increase by 27% between 1988 and 1997 (Naylor et al., 2000).

One of the most significant policy failures that has driven the global fisheries crisis are subsidies to the fisheries industry which contribute significantly to overfishing by promoting fleet overcapitalisation. They total about $25-29 billion/year (Sumaila, 2010) about 60% ($16 billion), of which are estimated to support unsustainable fisheries practices (Figure 15). A sizeable fraction (about 25%) of these subsidies go to ship fuels but also support boat construction and renovation, tax breaks, access rights, and other transfers.

Figure 15: Global fisheries subsidies – breakdown by impact, source and developed/developing nations



Source: Sumaila, R. et al., 2010; Pew Charitable Trusts, 2010.

The principal barriers to reducing unsustainable fisheries subsidies are political and informational. As with most subsidies, long-term beneficiaries begin to accept the subsidies as status quo 'entitlements' and don't hesitate to take political action to prevent any threat to their continuation. The scale of 'bad' subsidies to unsustainable fishing, at about $16 billion per year, underscores the numerous vested interests and the challenge of overcoming these barriers. Even though many fishers may accept that subsidies promote overcapitalisation leading to depleted fisheries and reduced revenue and profit, it can still be difficult to convince fishermen, often just trying to make ends meet, to take the 'long view' that will permit stocks to recover and fisheries yields to return to pre-overexploitation levels. As noted in Chapter 3, Lesson 1, there is also little doubt (and experience shows, including the Yellow Sea example cited in Volume II, Case Study #2 of this publication) that reducing fisheries overcapacity inevitably leads to near-term income and job losses for affected fishermen which must be addressed through re-training and other job creation initiatives.

Destructive fisheries subsidies, as a global problem benefiting a global industry, require a global solution. Since about 2000, some progress has been made to address the issue through the World Trade Organization's (WTO) Negotiation Group on Rules where, notably, there appears to be agreement that it is no longer a question of *whether*, but of *how* international WTO negotiations to reform fishing subsidies should move forward (Benitah, 2004). Therefore the transaction costs of achieving a partial or complete phase-out of 'bad' fisheries subsidies are probably not high on a financial basis but require very convincing advocacy, lobbying and ultimately, political will, to overcome these significant barriers.

As noted in Lesson #1, strengthened regulation of ocean sectors that penalises one group (fishers in this case) can bring economic benefits to different or even new groups by driving capital in new directions. Thus, the effective 'flattening' in the global wild fish catch since the late-80's has been largely made up for by the tremendous growth in aquaculture to feed growing populations and shifting consumer preferences. Global aquaculture production will need to grow by at least 4% per year to meet projected demand by 2030 at which point aquaculture would account for about 60% of global seafood consumption (Larkin, 2012). However, at present, much of the world's aquaculture is considered unsustainable and often contributes to coastal (and inland waters) degradation such as hypoxia, disease and species introductions. Aquaculture also depends to a sizeable extent on wild fish catch as a source of food for cultured fish; about one third of capture fish production is directed to non-food use such as fish meal (World Bank, 2007). Naylor et al. (2000) suggest the following actions will be required to shift the aquaculture sector towards sustainability:

- Farming lower on the food web
- Reducing fish meal and fish oil in fish feed
- Integrating production systems (such as IMTA)
- Increase research and development on sustainable aquaculture systems
- Provide policy and economic incentives for sustainable aquaculture practices

Key to any effective wild fisheries subsidy reduction or removal scheme will be redirection (not their complete cessation which could lead to sizeable employment dislocation) of a sizeable portion of negative subsidies to scaling up sustainable marine protein production activities. This would need to include retraining of impacted fishers and processors and policy and economic incentives to the private sector to promote growth of sustainable aquaculture. A number of sustainable aquaculture certification schemes have emerged in recent years; the volume of aquaculture production certified as 'Best Aquaculture Practice' (BAP) has grown from none in 2004 to nearly 1 million mt in 2012 and well over 60 seafood producing and processing companies have endorsed BAP principles in recent years (Larkin, 2012). Sustainable forms of aquaculture are increasingly emerging (such as Integrated Multi-Trophic Aquaculture; see Yellow Sea Case Study #3 in Volume II) which produce a diversified range of marine protein products and recycle waste between cultured plant and animal species. Initial studies (Whitmarsh et al., 2006; Ridler et al., 2007) suggest that IMTA can often be more profitable (in context of Net Present Value (NPV) estimates) than monoculture systems. If some of the other ecosystem services provided by IMTA systems, such as nutrient waste recycling and carbon sequestration, can be 'marketized', this would further enhance the profitability and prospects for continued growth of IMTA systems. YSFRI (2009) estimated significant (Yuan/ha/year) additional value added from IMTA vs. monoculture in Sanggou bay, China due to provision of nutrient waste, air quality and climate regulation services. Lastly, IMTA sites may serve as fairly sizeable carbon sinks and be potentially eligible for 'blue carbon' financial flows (Tang, 2011).

To help reverse fisheries depletion, gaps and weaknesses in the regional and national institutions responsible for managing the world's fisheries must also be addressed, particularly in the areas of monitoring and enforcement to reduce illegal, unregulated and unreported (IUU) fishing. There are presently 38 regional fisheries bodies (FAO) that, in principle, cover most of the world ocean and major fish stocks therein. While 18 of these are fully established Regional Fisheries Management Organisations (RFMO), the remaining 20 are simple advisory groups. Most of the RFMOs have already taken steps to incorporate ecosystem-based approaches and precautionary approach (PA) in their management practices and several have adopted PA measures for their managed species (Lodge, 2007). The advisory bodies on the other hand do not have the power to establish conservation and management measures, weakening their overall capacity to affect sustainable fisheries; a number of them are barely functioning. As this publication demonstrates in Volume II, Case Study #5, sufficiently capacitated RFMOs such as the W/C Pacific Fisheries Commission and Secretariat, by advancing implementation of 'state of the art' regional and national fisheries policy and legislation, can lead to transformative sustainability impacts on sizeable portions of the global fishing industry.

There are also now about 16 GEF and other partner supported Large Marine Ecosystem (LME) programmes at various stages of applying the TDA/SAP approach to promoting integration of ecosystem-based approaches into multi-sectoral integrated ocean governance including fisheries management; this represents about one-quarter of the world's 64 characterised LMEs. These GEF LME programmes presently target fisheries issues in 16 LMEs representing 29.6 million mt/year in fish landings (UBC and Pew Charitable Trusts Sea Around Us Project, 2006); this corresponds to 49% of all LME landings or about 37% of global fish catch. Case Study #3, the Yellow Sea Large Marine Ecosystem, demonstrates how application of TDA/SAP methodology can help transform fisheries management and catalyse sizeable investment in reducing fisheries overcapacity and scaling up sustainable aquaculture at the scale of an LME.

Various studies have shown that effectively designed and managed marine protected areas can support the recovery of fish stocks, often delivering double or tripling of spawning stocks and ten-fold increases in egg production in 5-10 year time frames (Pauly et al., 2002; Roberts and Gell, 2002). Studies suggest that as much as 20-40% of the ocean needs to be protected at some level to maximise fishery benefits; in 2004, 33% of the Great Barrier Reef Marine Park was protected from all fishing. The international community, through the Convention on Biological Diversity (CBD), has set a target (Aichi Target 11) of achieving 10% of ocean area under Marine Protected Area (MPA) by 2020 from its present (mid-2012) levels of about 1.42%. To move from this level to the Aichi target by 2020 would require an average annual increase in global MPA area of about 28% between 2012 and 2020 whereas recent (1985-2005) annual increases (Wood et al., 2008) have averaged less than 5%. However, the most recent trend (2006-2012), during which MPAs increased from 0.65% to 1.42%, represents an annual rate of increase in MPAs of 14% so if this rate can continue to increase (basically double), the Aichi target may be within reach. Because of the broad ocean use and management implications of MPAs, the involvement and support of the fishing industry and other ocean industries will be critical to advancing the development of MPAs.

Rights-based approaches to fisheries management, such as Individual Transferable Quotas (ITQs), have been shown to be very effective in reducing overfishing in a range of cases where they have been properly designed and applied. ITQs allocate to owners the right to harvest a specific quantity of fish each year and establish that right as divisible, leasable, and transferable across users (Costello, 2010). While only about 2% of global fish stocks are under catch share systems, this represents about 25% of global fish catch by volume. In an analysis of 11,000 fisheries worldwide, Costello (2010) found that ITQ fisheries are significantly less likely to collapse than non-ITQ fisheries and the magnitude of the effect increases the longer a fishery is under ITQ. These analyses suggest that broad scaling up of ITQ systems could not only halt the trend in global collapse of fish stocks, but actually reverse it.

Reversing fisheries depletion will therefore require a concerted series of actions across a wide range of actors, including:

- Reducing and ultimately eliminating negative subsidies to the wild catch industry;
- Scaling up marine protected areas to protect and expand key habitat required for fish stock life cycles;

- Strengthening RFMOs and LME institutions with responsibility for management of fish stocks, including:
  - Ecosystem-based approaches;
  - Monitoring and enforcement;
  - Eliminating destructive fishing practices;
  - Etc.
- Scaling up sustainable aquaculture;
- Scaling up application of innovative economic instruments for wild fisheries management such as rights-based approaches.

As demonstrated in the Volume II Case Studies, application of the three planning instruments described in *Catalysing Ocean Finance* – TDA/SAP, ICM and building on regional/global legal frameworks - can contribute to achieving these fisheries objectives. To estimate public costs, benefits and catalysed finance associated with implementing these actions for sustainable fisheries, *Catalysing Ocean Finance* draws once again from actual costs recorded in UNDP-GEF projects and complements this analysis with estimates provided in the specialised literature.

Public Costs for Priority Sustainable Fisheries Activities:

Public Costs – Strengthened RFMOs and LMEs/Scaled up sustainable aquaculture: Both W/C Pacific (building on the W/C Pacific Fisheries Convention) and Yellow Sea LME (through a TDA/SAP process) programmes required (GEF) grants of about $15 million to remove barriers and move these regional fisheries bodies or LME programmes towards sustainability; the fisheries involved in each of these programmes represent about 2 million mt/year in annual landings or 2.5% (2/80) of global wild fish catch of 80 million mt/year. In addition, commitments to scale up Integrated Multi-Trophic Aquaculture (IMTA) were made by China and Republic of Korea through the Yellow Sea SAP. China alone is responsible for 70% of global mariculture production and the Yellow Sea, at 6 million mt/yr, represents 47% of China's mariculture production (2006) or 29% of global mariculture, underscoring the catalytic impact of the YSLME programme on sustainable aquaculture at a global level. Depleted fisheries issues appear in virtually every one of the world's 64 LMEs (www.SeaAroundUs.org) and in all 19 FAO major fishing areas (FAO, 2005). Using this data, a rough cost estimate for a concerted global programme to scale up sustainable fisheries management and sustainable mariculture through strengthened LME programmes and/or regional fisheries management organisations would be (80/2) x $15 million = $600 million. Another approach is using the total GEF International Waters grant amount of $149 m. to 15 LME projects addressing fisheries depletion issues, multiplied by the number of additional LMEs facing 25% or more of stocks overexploited or depleted (50, basically all of them) that could benefit from application of TDA/SAP approach to promoting ecosystem-based LME management. This results in an estimate of (50/15) x $149 m. = $496 m. in additional public resources, quite close to the previous estimate.

Public Costs – Achieving the Aichi Target for MPAs: Costs of scaling up current ~1.42% of world ocean under MPAs (as of May, 2012) to CBD Aichi Target 11 of 10% of ocean area draws on recent MPA establishment and operating cost data (McCrea-Strub et al., 2011) and assumes continuation of recent (2006) distribution of MPA sizes (Wood et al. 2008) across 6 orders of magnitude of MPA areas (1-10^6 km^2); data analysis below builds on most recent data available (for Dec 2006, when 0.65% of world ocean was under MPAs = 2,346,500 km^2, scaled up to 10% of world ocean.)

Table 4: Estimated costs to achieve 10% of global ocean under Marine Protected Areas (MPA)

Number MPAs (2006)	Average Area per MPA	Area (km^2)	% MPAs of this area	Establishment Cost ($/km^2)	Total Establishment Cost for MPAs 10% ocean	Management Cost ($/km^2/yr)	Total Operational Cost for MPAs 10% ocean
1,220	0.5	610	28%	$ 63,752	$ 598,288,000	$ 293,639	$ 2,755,689,077
1,530	5	7,650	35%	$ 21,110	$ 2,484,484,615	$ 47,623	$ 5,604,860,769
900	50	45,000	21%	$ 6,990	$ 4,839,230,769	$ 7,723	$ 5,346,692,308
500	500	250,000	12%	$ 2,315	$ 8,903,846,154	$ 1,253	$ 4,819,230,769
150	5,000	750,000	3%	$ 766	$ 8,838,461,538	$ 203	$ 2,342,307,692
10	50,000	500,000	0.2%	$ 254	$ 1,953,846,154	$ 33	$ 253,846,154
3	300,000	900,000	0.1%	$ 60	$ 830,769,231	$ 5	$ 69,230,769
4,310		**2,453,260**	**100%**		**$ 28,448,926,462**		**$ 21,191,857,538**

The operational cost estimate of $21 billion/year compares relatively favorably with the estimates of Balmford et al., 2003 who estimated running cost of $5-19 billion/year to create a global MPA network representing 20-30% of the world's seas. Similarly, Ervin and Gidda (2012) estimated costs of $4.85 - 19.4 billion for protecting 10% of each of the earth's 223 marine ecoregions within 200 nautical miles. The estimates above are very sensitive to choice of MPA size distribution so this could be one reason behind the minor differences between the figures.

Benefits/Avoided Costs: The benefit represents the recovery of present day annual $50 billion/year economic loss due to overfishing as estimated by World Bank and FAO in "The Sunken Billions" (Arnason R, 2008). Quite sizeable additional benefits vis a vis enhanced ecosystem services from scaled up sustainable aquaculture/IMTA (nutrient and carbon sinks, etc.) would be realised but aren't quantifiable at present.

Catalysed Public Finance – Redirecting Subsidies: Assumes all $16 billion/year in negative fisheries subsidies are redirected to positive investments such as scaling up sustainable aquaculture, strengthened RFMOs/LMEs, and expanding MPAs (Aichi Target) to support restoration of depleted stocks. This represents application of 'substitutional' finance as per the definition provided in Chapter 1.4.

Catalysed Private Finance – Scaling up ITQs: As of 2008, globally about 148 fisheries were managed under variations of ITQs; catch shares only represent about 2% of fisheries by stocks but up to 25% by catch volume. One study (Sanchirico and Wilen, 2002) estimated that rents in ITQs often rise to 60-70% of gross revenues. Recent (2008) global first sale fisheries revenue (FAO) was about $83 billion, x 65% (assumed ITQ rent %) x 75% (remaining stock volume to shift to ITQs) = $40 billion in potential total proceeds from significant scaling up of ITQs to most of the world's fisheries. Ideally, these proceeds ('additional' (private) finance as per our definition in Chapter 1) could be combined with redirected 'bad' subsidies (above) in support of strengthened RFMO/LME fisheries management, expanding MPAs and scaling up sustainable aquaculture.

Catalysed Public Finance – Strengthened RFMO and LME fisheries management: Using Yellow Sea catalysed public finance (YSLME Strategic Action Programme) of $3.62 billion to reduce fisheries fleet overcapitalisation and continue scaling up of IMTA (vessel buy-back, retraining, stock assessment, etc.) as proxy, drawing from Public Costs RFMO/LMEs estimate above, global catalysed public finance estimated as LMEs facing fisheries depletion (all 64) x YSLME catalysed fisheries finance ($3.62 billion) = $232 billion. This is likely an upper limit given the severity of the fisheries overexploitation in the Yellow Sea necessitating quite a large scale intervention to reduce fisheries overcapacity, expand sustainable aquaculture, etc.

For fisheries, 98% of the 'one time' public costs required to transform fisheries towards sustainability (see Table 5 in Conclusion) would be the establishment and operation of a global system of MPAs that met the CBD's Aichi target of 10% of ocean area by 2020 and supported recovery of depleted fish stocks. Most notable in the estimates above is the scale of the potential catalysed public (redirection of subsidies) plus private (ITQ revenue) finance of $56 billion/year towards sustainable fisheries. If properly channeled and managed, these massive public and private financial flows would likely be more than sufficient to cover both the up front and recurrent costs for MPA establishment and operation (towards Aichi 10% target), scaling up sustainable aquaculture, and strengthening RFMOs/LMEs. RFMOs and LME programmes for example could be charged with administering ITQ systems including investing ITQ proceeds in strict quota monitoring and enforcement, stock assessment, and application of ecosystem-based approaches. Similarly, redirection of 'bad' fisheries subsidies could provide financial resources to dramatically accelerate progress towards the Aichi MPA target and associated recovery of depleted fish stocks through effectively established and managed MPAs including necessary level of 'no take' zones. Lastly, ITQ proceeds and/or redirected subsidies could support increased R&D on sustainable aquaculture, training of fishermen forced to move into the aquaculture sector, economic and other incentives to promote growth of sustainable aquaculture (guaranteed prices, consumer awareness, etc.) and scaling up of proven integrated production systems such as IMTA as demonstrated in the Yellow Sea LME Case Study #2.

5. CONCLUSION

Despite a wide range of commitments at global, regional, national and local levels, the overall health of the ocean continues to worsen. Even more concerning, most of the threats faced by the ocean, including hypoxia, habitat loss, fisheries depletion and ocean acidification, continue to increase at a geometric rate whereas human planning processes generally follow a linear trend. Several planetary boundaries related to ocean health are being approached and in some cases have already been exceeded. Even under best case scenarios, the time frames for securing commitments to required ocean policy reforms and leveraging needed investments can be 15-20 years. The time to act is now if we wish to sustain the ocean commons and the trillions of dollars in goods and services that they provide to the global economy.

As discussed in the Introduction, virtually all the major ocean challenges ultimately stem from one or more market (and linked policy) failures. Smart mixes of policy instruments, agreed upon through multi-stakeholder strategic planning processes such as those described in this publication, are needed to correct ocean market failures at local, national, regional and global scales. By focusing project interventions on activities that seek to correct such market failures through policies and instruments that 'internalise' the externalities of pollution, invasive species, habitat loss, overfishing, etc., public grant financing can be highly catalytic. The Danube/Black Sea, FrePlata, Yellow Sea and PEMSEA pollution case studies were to a large extent about internalizing the costs of pollution into the capital and operating costs of enhanced wastewater treatment and agricultural production. For wastewater, these investment costs can be further internalised by being passed on to water and sanitation system users in their monthly bills (e.g., 'polluter pays' principle) and/or into their municipal taxes to help municipalities pay back investment principal and interest. In the GloBallast example, the additional costs for ships to install ballast water treatment systems (estimated to average around $600,000 per ship) will be passed on to the many thousands of companies that buy, sell, import and export internationally traded bulk goods, and eventually to consumers. Similar arguments pertain to each of the priority ocean issues and recommended actions in Chapter 4 of Volume I; each of the four issues highlighted represents a significant market or policy failure(s) which presents an opportunity, utilising one or more of the planning methodologies described in this publication, to put in place new policy instruments at global, regional and/or national level to internalise the respective marine environmental externalities.

Over the last twenty years, UNDP-GEF has successfully developed and applied a series of ocean strategic planning methodologies and approaches – TDA/SAP, ICM, and building on regional/global legal frameworks - that have proven very effective at removing barriers and putting in place an enabling policy environment that can catalyse sizeable quantities of public and private sector financial flows for ocean restoration and protection. Notably, ratios of catalysed finance to GEF grant finance range from 50 to 1 to as high as 2,500 to 1. In several documented cases, application of these planning and policy instruments has transformed entire ocean industries, such as shipping, and fisheries in the W/C Pacific and the Yellow Sea, towards sustainability. In another example, the world's first reversal of a large scale hypoxic area ('dead zone') was achieved over a 15 year period through catalysed investments and policy implementation.

These planning methodologies have proven effective at global, regional, national and local scales at addressing most of the key environmental challenges facing our ocean, including sustaining fisheries, reversing ocean hypoxia, and preventing marine invasive species. Opportunities exist to scale up and in some cases combine these methodologies, existing and emerging policy instruments, and the catalysed finance they deliver, to address each of these issues at a global scale. Furthermore, these tools can be applied and scaled up to help address other global ocean issues including habitat loss as well as emerging issues such as ocean acidification.

Excluding the public investments required for achieving the MPA component (Aichi Target) of reversing depleted fisheries (which could be financed through a fiscally neutral redirection of subsidies and recycling of ITQ rents), the 'up front' public costs of scaling up these approaches to slow down and ultimately reverse ocean degradation is surprisingly low. As summarised in Table 5, as little as five billion dollars of new public grant finance could catalyse many hundreds of billions in public and private sector financial flows in transforming ocean markets towards sustainability. For ocean hypoxia, overfishing, ocean-related climate change mitigation (shipping, blue carbon) and marine invasive species, catalysed ocean finance ratios range from 8 to 1,000, comparable to the ranges observed in the case studies. Table 5 also demonstrates that the benefit/cost calculus of the avoided costs of reversing hypoxia, slowing ocean acidification, sustaining fisheries and preventing invasive species, are even more favorable.

If the five billion dollars of public grant finance required were programmed over 10-20 years, this would represent an average annual allocation of about $250 - $500 million per year, well within the reach of existing financial mechanisms such as the Global Environment Facility (and possible additional support from new mechanisms such as the World Bank's Global Partnership for Oceans or the Green Climate Fund), underscoring that a concerted programme of highly catalytic public investments to sustain the world ocean lies well within the reach of available financial flows.

Table 5: Public Costs, Catalysed Finance and Ratios for Scaled Up Actions to Sustain the Global Ocean

Issue	(1) One-time public cost ($ m.)	(2) Recurring Public Costs ($ m./yr)	(3) One-time Catalysed Finance ($ m.)	(4) Recurring Catalysed finance ($ m./yr)	(5) Catalysed Finance Ratio (1-time costs)=(3)/(1)	(6) Avoided Costs ($ m./yr)
Hypoxia	2,500	-	76,000	-	30:1	200,000-790,000
Ocean Acidification	820	-	20,000	300-5,100	24:1	104,000-182,000
Overfishing	29,048	21,000	232,000	56,000	8:1	50,000
Marine Invasive Species	20	-	~20,000	-	1000:1	10,000-90,000

Source: Data from Chapter 4 and also summarised in Figures 2 & 16.

Clearly all the estimates of up front public costs, catalysed finance and realised benefits described in this section are rough and probably accurate to no more than a factor of about 2-3. Even with this acknowledged uncertainty, this doesn't alter the overall conclusion: the volumes of catalysed public and private finance that could be realised through the scaling up of the strategic planning and existing and emerging policy instruments described in *Catalysing Ocean Finance* would be many times the initial publicly funded investments, and the realised benefits/avoided costs would exceed the initial public costs by even higher ratios.

Catalysing Ocean Finance also demonstrates that taking concerted action to address ocean issues through 'smart' mixes of policy instruments can not only catalyse large amounts of public and private investment but also help to strengthen and even transform local, national and global ocean-related industries. As always, when the 'playing field' in which the private sector operates is changed through regulation, elimination of subsidies, etc., there are winners and losers, but *Catalysing Ocean Finance* shows that the kinds of 'creative destruction' that innovative ocean policy instruments can promote can be financially neutral overall and, in some cases, likely serve as net job creators.

In sum, *Catalysing Ocean Finance* provides a road map for transforming management of global ocean resources towards truly sustainable practices through a proven mix of planning methodologies, policy instruments and catalysed public and private finance. By making the relatively modest but increasingly urgent public investments needed to catalytically reverse ocean degradation, the trillions of dollars in market and non-market economic benefits and ecosystem services the ocean provides to humanity can be sustained into perpetuity. Figure 16 concludes *Catalysing Ocean Finance* by summarising this road map to restore and protect the global ocean.

Figure 16: Scaling up Actions to Restore Ocean Ecosystems

	Ocean Hypoxia	Ocean Acidification	Overfishing	Marine Invasive Species
	Reduce nutrient over-enrichment of coastal areas	Energy efficient shipping Protect & restore coastal carbon sinks	Reduce unsustainable fishing practices	Reduce aquatic species transfer via ship hull fouling
Strategic Planning Methodologies	• Scale up TDA/SAP in 20 remaining LMEs (& linked river basins) facing hypoxia • Scale up ICM in same LMEs as tool to leverage nutrient pollution reduction investments and protect nutrient sinks	• Build on UNFCC – Ocean pH target (minimum) – Adoption of Blue Carbon • Build on new IMO ship energy efficiency guidelines • ICM, TDA/SAP to help promote scaling up local and national Blue Carbon initiatives	• Build on Global & Regional Legal & Institutional Frameworks – Complete WTO negotiations to phase out negative fisheries subsidies – Strengthen RFMOs & LME institutions • TDA/SAP: Scale up in ~50 LMEs/fisheries areas facing depletion/overexploitation • ICM as cross sectoral tool to promote sustainable fishing & aquaculture	• Build on anticipated international instrument on Ship Hull Fouling • Incorporate hull fouling issue into LME TDA/SAPs where invasives are priority issue
Policy Instruments	• Nutrient management regulations • Nutrient emissions cap and trade in river basins (national, regional) • Fertiliser subsidy reform • Subsidies to agricultural nutrient reduction practices & technology • Subsidies to wastewater and industrial nutrient recovery & re-use • Global nutrient reduction fund capitalised by innovative financial mechanism(s)	• Amend UNFCCC to incorporate safe ocean acidity limit & catalyse action on low carbon economy • Blue carbon inventory methodologies • Tools, methodologies, standards & guidelines to promote uptake of IMO energy efficiency guidelines – Ship management plans (SEEMP) – Ship design standards (EEDI) – Facilitate private sector R&D	• Shift negative fisheries subsidies $16 billion/yr to sustainable aquaculture & MPAs • Scale up Individual Transfer-able Quotas (ITQ), $ to MPA, aquaculture, management • CBD Aichi Biodiversity Target 11-10% oceans under MPAs • Ensure sound science, EBA, data sharing, precautionary principle in RFMO & LME commission mandates • UN Fish Stocks Agreement, FAO Code of Conduct, Port State Measures, etc.	• Tools, methodologies, standards & guidelines on hull fouling management • Support to negotiations and enhanced capacity for implementation of possible new international agreement • Facilitate private sector technology R&D
Costs, Benefits & Catalysis	• Public costs: – TDA/SAP LMEs: $1.0 billion (1 time) – ICM global: <$1.5 billion (1 time) • Benefits (avoided costs): $200-790 billion/year • Catalysed Finance: – TDA/SAP LMEs: $60 billion – ICM global: <$16 billion	• Public costs: $420-820 million (1 time) • Benefits (avoided costs) – Shipping on CC: $88 billion/yr (2050) – Blue Carbon on CC: $16-94 billion/yr (2050) – Shipping $90-310 billion/yr (fuel savings) by 2030 • Catalysed Finance: – Blue Carbon $0.3 - 5.1 billion/yr – Shipping ~$20 billion (1 time)	• Public costs: – RFMOs/LMEs: $496-600 million (1 time) – MPAs @ 10% ocean: – Establish $28 billion (1 time) – Operation $21 billion/yr • Benefits (avoided costs): $50 billion/yr • Catalysed Finance: – Shifted subsidies: $16 billion/yr – ITQ sales: $40 billion/yr – RFMOs/LMEs: $232 billion (1 time)	• Public costs: $20 million (1 time) • Benefits (avoided costs): $10-90 billion/yr • Catalysed Finance: $10-30 billion

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