出國報告（出國類別：其他）

參加「經濟合作發展組織（OECD）第 112 屆漁業委員會（COFI）」報告

服務機關：行政院農業委員會漁業署
姓名職稱：黃鴻燕 主任秘書
派赴國家：法國（巴黎）
出國期間：102 年 10 月 21 日至 10 月 27 日
報告日期：102 年 11 月 29 日

參加「經濟合作發展組織（OECD）第 112 屆漁業委員會（COFI）」報告

摘要

一、OECD 第 112 屆漁業委員會（COFI）會議於本（2013）年 10 月 23 日至 25 日假法國巴黎 OECD 總部會議中心召開，我方由本署黃鴻燕主任秘書及遠洋漁業組陳宗霆助理代表出席，駐法國台北代表處經濟組徐炳勳副參事陪同出席。會議計有 OECD 各會員國代表、聯合國糧農組織（FAO）、世界貿易組織（WTO）與我國等參與方（Participants）及秘書處等共約 50 人與會。

二、本（112）屆會議主要討論漁業委員會秘書處針對綠色成長與漁業研究報告(Green Growth and Fisheries)、政府財政轉移專家研討會成果檢討、OECD 漁業委員會／OECD 發展協助委員會／聯合國糧食及農業組織／世界銀行之漁業政策聯合研討會議程以及 2015/16 年工作計畫與預算等議題。其中綠色成長與漁業研究報告主要將以「捕撈漁業及養殖漁業之綠色成長概念說明」、「養殖漁業與綠色成長」、「捕撈漁業與綠色成長」以及「綜合報告」四篇文件組成。

三、漁業委員會〈Committee Of Fisheries; COFI〉匯集跨領域、跨地域專家學者意見，研議當前國際全方位漁業政策改革，其會員多為歐美先進國家，尤其以歐盟國家作為主體，各國參加人員亦參與聯合國糧農組織（FAO）及世界貿易組織（WTO）、區域性漁業組織等國際組織進行漁業管理相關議題溝通協商，建立各方聯繫管道，並蒐集當前國際全方位漁業政策，給與政策執行者制定之參考依據，爰我國宜持續參與 OECD COFI 相關會議，俟機經驗分享與交換國際漁業知識，有助於強化我國國際競爭力，更能為全球永續漁業發展之願景貢獻心力。

參加「經濟合作發展組織（OECD）第112屆漁業委員會（COFI）」報告

目　次

壹、 目的

一、經濟合作暨發展組織（Organization for Economic Co-operation and Development, 簡稱 OECD）成立於 1961 年，總部設於法國巴黎，目前有 34 個會員國，主要是以工業先進國家為主，由各會員國及歐洲執委會（European commission）各推派一位代表組成理事會（Council）是最高權力機構，另設立各種不同之專門委員會（Committee）、工作小組（Working Party）及專家小組（Expert Group），針對實質經濟與社會問題進行討論與研究，相關成果則做成報告或建議案提報理事會裁決，OECD 之秘書處則負責協調及行政後勤工作，討論與研究成果則做成報告或建議提報理事會裁決。

二、「漁業」、「鋼鐵」及「競爭」等三個 OECD 委員會為我國得以「一般觀察員」身分參與 OECD 之活動，原須每 2 年更新觀察員身分(按：我國自 2005 年起加入漁業委員會，上一次身份更新年度為 2010 年)。2012 年 10 月 9 日起 OECD 更改非會員國參與規則，改由各委員會研擬「全球關係策略」並制定「參與計畫」逕行邀請非會員國以「參與方（Participant）」身分參與，再透過對外關係委員會將各參與計畫送交理事會核准，因此我方參與資格因新規定更動而自動延長至今(2013)年底，而漁業委員會之參與計畫業於今年 7 月正式為理事會核准通過，本(112)次會議為我方於新制通過後，首次以「參與方」身分出席。

三、漁業委員會〈Committee For Fisheries; COFI〉以責任制、永續性、全球化及生態和諧等思維為基礎，匯集跨領域、跨地域專家學者意見，研議當前國際全方位漁業政策改革，進而影響聯合國糧農組織（FAO）及世界貿易組織（WTO）、區域性漁業組織等國際相關組織的政策方針，受到許多國家之關注與討論。漁業委員會代表團多為各國參與國際組織之代表性人物，建立各方聯繫管道，有利於未來國際漁業合作及交流，爰我國宜持續與 OECD 漁業小組保持密切聯繫，我國倘有機會在專案計畫合作進行研究，或合辦相關研討會，以共同關切議題活絡關係，促進與相關國家的互動，營造有利於參與國際社會的條件，以增加參與程度。

三、我國歷年積極參與 OECD COFI 年會各項議題，並針對秘書處所需填報統計數據、問卷與國家報告，與會中可能分享經驗及表達看法，以促進國際漁業交流。秘書處所蒐集之相關統計資訊為研究漁業發展之依據，其內容涵蓋全球漁業現況暨發展趨勢，該結果可作為我國漁業政策研擬及產業輔導之參考方向。

貳、 會議過程

一、經濟合作及發展組織（OECD）漁業委員會（COFI）於本（2013）年 10 月 23 日至 25 日在法國巴黎 OECD 總部召開第 112 屆會議，我方在我國駐巴黎辦事處經濟組徐炳勳副參事陪同下，由本署黃鴻燕主任秘書及遠洋漁業組陳宗霆助理以「參與方（Participant）」身份出席。

二、本次會議時程安排原則自上午 9 時 30 分起至下午 6 時止，包含中午休息 2 小時，出席者計有德國、澳洲、奧地利、加拿大、智利、韓國、丹麥、西班牙、愛沙尼亞、美國、芬蘭、法國、希臘、愛爾蘭、冰島、義大利、日本、墨西哥、挪威、紐西蘭、荷蘭、波蘭、葡萄牙、捷克、土耳其、瑞典、英國、歐盟代表及哥倫比亞、俄羅斯、拉脫維亞、泰國、聯合國糧農組織（FAO）、世界貿易組織（WTO）與我國等參與方（Participants）及秘書處等共約 50 人與會，會議主席由法籍 Mr. Philippe Ferlin 擔任。

三、黃鴻燕主任秘書並於會議開始前，與 OECD 貿易與農業處處長 Mr. Ken Ash、漁業政策組組長 Mr. Carl-Christian Schmidt、COFI 主席 Mr. Philippe Ferlin、美國代表 Mr. David Hogan(國務院保育處副處長)及 Mr. Greg Schneider（大氣海洋局資深國際貿易專家兼現任 APEC OFWG 主席）、歐盟代表 Ms. Angela Martini(歐盟海洋與漁業總署國際關係官員，承辦 WCPFC 及 IATTC 相關業務)、日本代表傅永溫夫(水產廳漁政部加工流通課課長補佐)、韓國代表崔國日(海洋漁業部國際合作處副處長)、泰國代表 Mr. Pongpat Boonchuwong(漁業部漁業經濟專家)寒暄並短暫交換意見。

三、會議係以專家論壇的模式進行，原則上先由委員會研擬報告之大綱及方針，委請專家學者草擬報告草案，於一定時間提供各會員國審查研究後，召開會議供各會員國據實務經驗及施政觀點闡述修正意見，最後由秘書處整合各方意見統一修正後，公佈各國施政及研究參考。

四、本次會議主要係討論 OECD 之綠色成長與漁業研究報告(Green Growth and Fisheries)、政府財政轉移專家研討會成果檢討、OECD 漁業委員會／OECD 發展協助委員會／聯合國糧食及農業組織／世界銀行之漁業政策聯合研討會議程以及 2015/16 年工作計畫與預算等議題。

伍、本次我方出國開會行程如次：

10 月 21、22 日（星期一、二）搭機經奧地利維也納轉機赴法國巴黎

10 月 23 日（星期三）參加 OECD 的 COFI 第一日會議

10 月 24 日（星期四）參加 OECD 的 COFI 第二日會議

10 月 25 日（星期五）參加 OECD 的 COFI 第三日會議

10 月 26 日（星期六）返程，由法國巴黎經德國法蘭克福

10 月 27 日（星期日）返回國門

參、 會議紀要

本（112）屆會議主要討論漁業委員會秘書處針對綠色成長與漁業研究報告(Green Growth and Fisheries)、政府財政轉移專家研討會成果檢討、OECD 漁業委員會／OECD 發展協助委員會／聯合國糧食及農業組織／世界銀行之漁業政策聯合研討會議程以及 2015/16 年工作計畫與預算等議題。其中綠色成長與漁業研究報告主要將以「捕撈漁業及養殖漁業之綠色成長概念說明」、「養殖漁業與綠色成長」、「捕撈漁業與綠色成長」以及「綜合報告」四篇文件組成。會議主要議題及會議文件內容，茲按日分述如下：

10 月 23 日：第一日除工作報告及業務檢討外，並探討綠色成長與漁業研究報告中之「捕撈漁業及養殖漁業之綠色成長概念說明（Green Growth In Fisheries and Aquaculture: An Introduction and Clarification of Concepts）」、綠色成長與養殖漁業（Green Growth and Aquaculture）、漁業之能源使用政策建議(Energy Use in Fisheries: Policy Response)和政府管理與綠色成長（Green Growth: Governance Issues For Marine Capture Fisheries）等四份文件進行討論審查，以及討論上（111）次會議中之政府財政轉移（Government Financial Transfer; GFT）專家研討會成果。

一、議程草案（議程一）：FERLIN 主席宣布會議開始，並說明由於貿易與農業部處長 Mr. Ken ASH 因行程問題無法參與明日上午之會議，因此將提前把第二日上午的議題 4，即有關前（111）次會議中所舉辦之政府財政轉移研討會成果檢視提前至今日下午進行。另外並歡迎秘書處新任韓籍研究員 Dr. Lae Hyung HONG。

二、貿易及農業處處長 Mr. Ken ASH 聲明（議程二）：ASH 處長首先感謝各會員國對於前次政府財政轉移研討會的踴躍參與，並說明目前 OECD 對於漁業和綠色成長，以及政府財政轉移的議題，主要目的皆是希望能夠建立相關的政策衡量指標，以便於評估政策實施後的影響程度。而 2014 年度開始該處在資金運用上將擁有更多的彈性，因此在多方考量挹注目標的情況下，期許漁業委員會能夠更積極的爭取更多的資金挹注。

三、漁業與綠色成長進度報告（議程三）：

（一）捕撈漁業及養殖漁業之綠色成長概念說明：

1.首先由漁業政策組組長 Mr. Carl-Charistian SCHMIDT 簡報綠色成長與漁業的基本概念分析，蓋因 OECD 希望將此「綠色成長與漁業」主題製作成一套完整的研究報告，包含綠色成長的概念說明、綠色成長與養殖漁業、漁業之能源運用以及漁業之政府管理四大篇章。因此本概念文件說明綠色成長的核心宗旨，即在追求經濟發展的同時，也兼顧環境資源的永續性。此文件中並分析捕撈漁業與養殖漁業在綠色成長之相關重點、各議題研究領域如：生態系統管理、能源利用、混獲與丟棄、廢棄物、海洋空間規劃、娛樂漁業、治理與利害關係者之參與、漁業綠色成長之價值鏈分析，以及捕撈漁業和養殖漁業的競合問題，包括飼料來源、空間競合、消費市場的競爭、魚苗補充以及育肥（Fattening）等，另外由於養殖漁業將是未來水產品供應的主要來源，因此捕撈漁業若不提高管理和作業效率，將越來越難與養殖漁業競爭。此概念說明目的即為提供各國對於綠色成長與漁業的相關概念與基本方向。

2.日本代表表示該文件中，第 17 段提及“應去除對環境有傷害的補貼，包括對於燃料補貼”，敘述不甚正確，認為燃料補貼不必然對環境有傷害，端視如何補貼，因此日本建議將此部分文字刪除，因補貼問題應回歸至 WTO 討論；另外有關指標設定的效果可能不甚理想；此外亦呼應文中對於養殖逃逸對於環境衝擊的嚴重性。

3.智利代表表示由於該國小型及家計型漁業數量龐大，因此相當重視相關的發展議題，惟本概念說明中對此方面無甚著墨，因此建議是否可在此份報告中對此方面多加一段說明，另外也建議可增加災難補貼對於經濟重建與成長的重要性。紐西蘭代表針對智利代表對於增加小型及家計型漁業的相關說明，並表示紐西蘭擁有許多成功的小型及家計型漁業案例，可與智利進行交換意見。

4.美國代表表示 APEC 目前也有許多綠色成長相關的工作正在進行，包括其綠色成長策略等皆可成為 OECD 相關工作的參考。另外針對智利和紐西蘭發言，表示目前 WTO 多哈回合談判的停滯原因之一，即是各國對於小型及家計型漁業之相關補貼問題僵持不下，即使是現在進行中之 TPP 談判，也是一個困難的議題，因此建議 OECD 能夠對此多所著墨，惟此份報告係著重捕撈和養殖漁業的綠色成長概念，若加入小型及家計型漁業的相關內容，可能會混淆甚至扭曲本概念說明文件的內涵，因此不贊同智利要求增加文字說明的建議。

5.主席為此要求在中段休息時間內，請紐西蘭、日本、智利、美國私下討論有關燃料補貼和小型及家計型漁業的文字刪修。經討論過後，對於日本關切部分之文字“包括對於燃料補貼”刪除，餘保留；另智利關切部

分，將不刪修目前內容。最後經主席在詢問現場意見後，正式宣布此概念說明文件獲得通過

（二）養殖漁業與綠色成長：

1.由 OECD 漁業委員會秘書處人員簡介內容重點與增修部分，並說明新技術的研發對於養殖漁業的綠色成長具有重大貢獻，惟現階段對於新技術的散播較慢，因此也阻礙了養殖漁業進行綠色成長的進程。在場多位代表對此報告之內容表示贊同，並就養殖漁業在綠色成長之指標內容發表看法。

2.美國代表建議在本養殖漁業的文件中，可多著重於水產認證制度的說明，因為此議題對於市場進入、消費者行為與認知的調整皆有重要影響。

3.紐西蘭代表表示，對政府而言，新技術的散播是種兩難，因為無法確保新技術的投資報酬是否會因散播而遭到損害，對於國內投資的廠商無法交代，牽涉到智慧財產權的問題。

4.智利和韓國提出對於本文件中的指標設定和案例說明來源的適用性，懷疑此文件中的設定可能無法普遍適用。

5. F 主席總結：主席回應目前使用市場機制方法進行綠色成長仍是一個剛起頭的概念，因此尚未有明確的方法論或進程形成，但挪威的配額轉讓制度是一個相對成功的案例，因此雖然理解有些代表對於本篇文件中，挪威案例說明的適用性有些疑慮，但此案例仍具有參考性。在接受歐盟和紐西蘭對於報告文件中的部分文字修改建議後，主席宣布綠色成長與養殖漁業文件正式通過。

（三）漁業之能源使用政策建議：

1.由秘書處人員 Mr. Roger Martini 報告，此文件主要目的為替能源的使用效率提出有效建議，雖然理解執行面將會面臨許多困難，但這無妨此文件的參考性。文中建議包括：盡可能確保燃料價格忠實反映社會成本，以及盡可能替漁民提供政策彈性令其改變作業習慣。盡可能避免補貼，並委任民間處理能源使用的效率問題，此方式可能比使用能源稅的成本還低。另外，替新型研發的設備訂立能源使用標準（例如油耗標準）。

2.OECD 了解修改既有政策具有困難度，但仍必須致力尋找實際的替代策略，尤其是當既有策略將鼓勵能源耗用時。為了減少爭議，建議使用較為軟性的策略，例如以訓練、宣導和規劃等相關的服務來使能源使用效

率進步。下次會議將有整套綠色成長與漁業的報告草案和統整報告，希望在下次會議討論，也希望此套報告能被收入ＯＥＣＤ的農漁業與食品報告出版物中。

3.加拿大表示，是否應多為燃料稅優惠的相關政策對能源使用效率的影響作出說明，促使各方了解相關的影響並加速研究可行的替代方案。

4.日本表示文中（第 27 段）對於燃料稅優惠將導致更多非法漁業相關說法是有問題的，因為此二議題並不必然有關連性。

5.我方發言呼應日本對於燃料稅優惠並不必然導致更多非法漁業的說法，建議秘書處修改此段落的說明。另外對於文中（第 82 段）提及之挪威案例，表示挪威在國內可能缺乏燃料稅優惠的情形下，其漁船隊在國外可買到較便宜的燃料，導致漁業能量過多的問題，我方提出質疑，對於其他國家而言可能難以理解，因大多數國家，例如我國遠洋漁船長期在國外作業補給，在國外購油的成本基本上皆大於國內成本，無法享燃料稅優惠，因此本文中的挪威案例的適用性可能有問題，必需再思考。此外，我方贊同秘書處對於新技術應多加散播的建議，並表示創新研發分享，有助綠色成長，由於現階段的技術傳播較慢，因此導致過多重複研發的科技項目，皆造成研究能量的浪費。最後再度建議秘書處應增加案例研究(Case study)數量的收集，俾使各國能夠從足夠的案例說明中，尋找符合自身國情的政策設計參考。

6.秘書處表示理解加拿大對於補貼必要性的說明。因對各國來說考量角度過多，因此本報告主要希望指出政策改革對於能源使用效率的影響及收益。同意我方及日本意見，對於段落中將 FTC 與 IUU 連結過近，但報告中主要是想說明因為燃料稅優惠所增加的漁業能量，非常可能會鼓勵較多的非法漁業。但秘書處將修改文字。由於目前在養殖漁業中，能源使用效率並不是主要議題，也較缺乏相關的案例研究，因此除非有會員可提供清晰的政策與養殖漁業能源使用效率的研究，此章節目前將主要討論捕撈漁業的能源使用效率，本文件將參考各方意見持續修改，將在下次會議提供更新的修正版本供各方討論。

（四）政府管理與綠色成長：

1.秘書處人員簡報此文件的內容，包括收集不同的政府管理系統對於綠色成長的發展影響，以及提供政府在政策制定上，走向綠色成長的概念說明和建議。

2.歐盟發言評論本文件內容中，許多引用的理論和相關案例皆較過時，無法忠實反映現代化的漁業管理，此外，歐盟在漁業管理方面有許多相關的新理論及案例說明，歡迎 OECD 與歐盟就此進行交流。

3.日本表示此文件目前過於概念化，雖然有助於建立概念，但是看完文件後會不清楚政府應有甚麼樣的作為。

4.韓國同意日本的說法，認為此報告似乎只有介紹各式的管理系統和措施，建議將其他綠色成長相關文件中的政策建議加到本文件中。

5.智利分享了去年 2 月該國政府修改了漁業管理政策，將漁業資源保護分離出來，並用科學研究團隊之建議作為背書，再將相關建議引進政策制定過程中，提高漁業資源保育政策的專業性與效率，提供給與會各方參考。

6.秘書處表示，有關公海漁業管理的分析和建議將在下屆會議中用另一份文件來發表。此外，由於與會各方對此管理章節內容尚有許多評論與修改意見，因此秘書處將重新思考如何呈現此管理章節，下屆會議中的文件將致力符合本次各方的建議。另外感謝智利提供的政策修改範例，鼓勵各會員多提供自身國家的相關政策改革案例。

四、政府財政轉移研討會（GFT Meeting）之成果（議程四）：

（一）秘書處人員說明由於原先的漁業統計報告中，對於 GFT 章節的表格設計過於簡化，無法反映政府財政轉移政策對於漁業能量或是產量的影響，也令 OECD 難以彙整研究各國 GF 政策的影響。因此 GFT 統計格式的修改，主要是希望能夠得知更多對於市場價格支持的效果資訊，以及 GFT 政策對於漁業能量、產量等相關的成果之影響。

（二）智利表示，現階段的統計模式對小型漁業的統計只有一個項目，因此希望未來在 GFT 統計模式的修改中可以改善對小型家計型漁業的統計模式。

（三）美國表示，有許多國家在共同漁場中作業，其中每個國家各有不同的 GFT 政策，因此 GFT 統計是否有辦法分辨出擁有不同 GFT 政策的國家在同一個區域作業下所造成的不同影響。

（四）挪威建議秘書處可就此議題召集相關專家進行更深入的研究。

（五） 就此議題，在下午會議中返回的 Ken Ash 處長回應，統計模式的修改是希望能夠更加強政策影響層面的研究，並能夠加強 GFT data 的可用性，和與其他 data 的連結性以便於其他研究的綜合取用。

10 月 24 日： 本(24)日主要討論本次會議之摘要報告、2014 年 4 月與 OECD 發展協助理事會（DAC）、世界銀行、聯合國糧農組織之漁業研討會議程、OECD/FAO 農業展望報告介紹、2015/16 年之工作計畫與預算等，與會者未變。謹將本日會議重點扼陳如次：

一、本次會議摘要報告（議程十四）：

（一）主席說明由於前一日會議進度超前，且今日 OECD 將進行報告的相關人員時程變更，因此提前將前一天會議摘要報告提交與會各方進行檢視，且本日其他議題順序將視 OECD 人員時程而予以變動，請各方諒解。

（二）日本首先表示，前一日討論概念文件時，討論到“應去除對環境有傷害的補貼，包括對於燃料補貼”字句時，日本提出燃料補貼不必然造成環境傷害，建議刪除“包括對於燃料補貼”字句，昨日且獲得我方呼應，要求相關的關切應記錄在摘要報告中。

（三）美國表示此次會議只是讓各方提出看法，讓秘書處作為修正之參考，摘要報告的寫法，應審慎考慮，由於未作討論，不宜以決議方式記錄。

（四） 歐盟表示在綠色成長與政府管理的文件討論中，歐盟對此做出許多評論，但摘要中並沒有相關紀錄，另外建議摘要中之各議題後續(Follow Up)可再詳細一些，使本摘要更有參考性。

（五）秘書處表示，由於各方評論過多，而摘要主要為重點式的紀錄，若要將特定評論加入摘要中則容易出現取捨爭議。昨日會議如何紀錄較妥適，秘書處另斟酌修正討論

二、OECD COFI- DAC（發展支助委員會）-WB（世界銀行）-FAO 聯合舉辦漁業及養殖漁業研討會之議程（議程五）：

（一）秘書處說明聯席研討會預定有四大主題：(一)IUU 漁業、(二) 區域漁業管理組織、(三) 漁業資源再生、(四)養殖漁業。研討會預計於 2014 年 4 月 10 至 11 日召開，為期二天，所有 OECD 會員國及觀察員（包括我國）均將被邀請參與，另因各項議題涉及開發中國家，非會員亦將納入邀請；議程設計，每一議題由秘書處作背景報告，點出問題點，再搭配案例研究引發討論，秘書處目前已洽得部分會議承諾作案例研究報告，惟亦希望有意願於此研討會發表案例說明的會員，可在本(102)年 11 月底前將資料傳送至秘書處彙整。

（二）世界銀行代表表示，由於世界銀行過去十年來持續的投資漁業部門，其中近三億美元為政府管理之相關項目，因此相當期待本研討會的舉辦可有豐碩的成果。

（三）FAO 代表說明目前本研討會的籌備尚算順利，惟在邀請開發中國家參與的部分還需要多加追蹤。

（四）紐西蘭表示漁業議題需要全球合作，爰感謝這次的共同研討會，此外，由於能力建構是促成永續漁業的重要因素，希望在此次研討會中，發掘其中困難之處並研商解決之道。另外建議納入討論太平洋島國權益問題。

（五）加拿大表示糧食安全為一跨界議題，且對於開發中國家而言極為重要，建議在此研討會中多加著墨。

（六）韓國代表發言說明 IUU 現已由各 RFMO 全面監視並處理，因此在議題討論中應多回歸 RFMO 的相關作為。

（七）歐盟表示本研討會主要為一原則性的政策討論，因此不同意紐西蘭的建議將特定的地區國家（指太平洋島國）納入討論議題，以免討論偏頗。此外，挪威的 IUU 犯罪議題當作案例討論可能太過偏頗，且 IUU 包含許多議題，其中許多金融與犯罪防治的問題可能不適合在 COFI 討論，因為此等議題已超出 COFI 的能力範圍。此發言得到墨西哥代表呼應，並表示若研討會討論過多犯罪相關議題，因與會各方大多為漁業部門代表，議題基本上不在其管轄或專業範圍內，可能會影響研討會進程。

（八）秘書處表示感謝各方對於本研討會的意見，此次研討會期望能產出一份結論報告甚至是行動計畫，可供各 OECD 會員及開發中國家參考，因此歡迎所有案例呈交，即使是太平洋島嶼的案例報告，自然會引發討論，不必刻意迴避。

三、漁業委員會委任延長之進度報告（議程八）：秘書處說明，OECD 理事會授予漁業委員會之權限至 2015 年 7 月底止，秘書處計畫將在 2014 年 10 月的第 114 次會議將更新的職權範圍(Terms of Reference)提交予各會員參考，並於 2015 年 4 月底提交理事會核定，期儘快更新漁業委員會的委任期。出席會員無發言表異議。

四、漁業統計報告說明（議程六）：

（一）秘書處說明，目前有關 OECD 漁業統計資料的提報，有很多需要改進，

其中魚種捕獲量的表格中，因各國對魚種的分類不同，且可能隨著時間變更分類定義，所以請盡可能提供分類方式的詳細說明及數據來源，以免與先前資料不符。此外，請各國提供數據資料時以完整數字統計，避免概括數字呈現，秘書處並表示了解各國在蒐集各種統計資料時，所需的時間不同，但要求必需在期限前，提交已有的資料，避免只為因等待資料齊全而遲交，造成困擾。

四、2015/16 年之工作計畫與預算（議程十）：

（一）主席說明 2015/16 的重點工作，將著重在於政府財政轉移(GFT)的架構改良、技術革新的討論、改善 OECD、與包括東南亞等其他國家的關係等。

（二）挪威代表表示，建議工作計畫，包括養殖漁業權和漁業犯罪兩大議題，希望各會員和秘書處能贊成將此二議題列為 2015/16 的工作計畫。智利發言支持。

（三）韓國要求加強統計改良及養殖漁業權列入計畫。另表示挪威要求漁業犯罪議題在定義上甚為困難，由於漁業部門的犯罪問題，包括非法漁業在內，皆涵蓋許多層面，非 COFI 單一委員會可以應付（此一發言獲歐盟支持）。歐盟另支持養殖漁業權、沿岸水域與公海的競爭納入計畫。

（四）對此挪威回應理解各方對於討論 IUU 犯罪可能造成 COFI 負擔過重的問題，但挪威期望藉由提供大部分的討論資料，且鼓勵各方踴躍提供相關資料以減輕秘書處的負擔。但由於國家資源的使用上經常會引起許多相關的金融犯罪，導致稅收減少或其他相關的產出影響。挪威理解許多會員對於非法漁業議題過於複雜的立場，但此提議主要是希望提升一國內部不同政府部門的共同合作，以打擊漁業犯罪的能力建構和建議。因此挪威期望秘書處仍能夠就此議題納入工作計畫。

（五）紐西蘭代表發言說明，建議 COFI 的工作重心仍應放在漁業資料的蒐集分析與政策建議，並表示現階段紐西蘭在漁業管理上，所碰到的主要困難是對於娛樂漁業的資源分配問題，由於紐西蘭的娛樂漁業產值與商業漁業之產值相當，因此在資源分配上遇到許多問題，相信許多國家會面臨似問題，建議秘書處在下一階段的工作中，可就此議題進行相關研究。

（六）其他國家亦分別提出建議，荷蘭提出工作計畫建議：捕撈漁業的綠色創新、海洋保護區議題。

（七）冰島提出工作計畫建議：GFT 改善、海洋空間規劃、沿岸水域與公海的競爭等議題。前兩項獲加拿大呼應支持。

（八）美國提出工作計畫建議：捕撈漁業的綠色創新、娛樂漁業利用分配（但強調需擴大非只漁業的競爭）、海洋空間規劃等。

（九）主席總結時表示，由於各方對於下一階段的工作計畫意見踴躍，惟本次會議基本上是希望先確定一到兩項最核心的工作項目，由於現階段各會員對於政府財政轉移的統計改良，和技術革新兩項議題皆無反對意見，因此本次會後將優先納入；其次是綠色創新、養殖漁業權；至於海洋空間規劃（因缺乏資料）、漁業犯罪（具爭議）、娛樂漁業利用分配（具複雜度）等，有待進一步意見整合。

五、其他議題（議程七與十四）：

（一）OECD 農業與貿易理事會人員簡報與 FAO 合作的農業展望報告出版品，鼓勵大家帶回去給漁業部門參考。去年所進行的報告以中國為一重點研究的對象，明年預計將以印度為主要對象。COFI 秘書處研究員和 FAO 代表皆表示歡迎COFI與會各方協助檢視本報告中之漁業章節並提出評論或增修意見。

（二）OECD 環境委員會人員簡報其 2015/16 計畫中，也包含海域空間規劃和海洋保護區相關的問題，及相關的財政規劃等。下周開始該理事會將召開相關會議討論，期待會議成果能夠促成與 COFI 之間的相關合作。

六、2014 年之 COFI 主席及幹部選舉（議程十一）：

（一）經秘書處人員報告本次幹部候選名單後，由漁業政策組長 Carl-Christian Schmidt 詢問與會各方對於名單是否有反對意見，在場各方一致無異議通過由原主席 Mr. Filippe Ferlin 續任主席。

（二）主席在感謝各方支持其續任後，宣布接下來將由會員國討論 COFI 與非會員之間的關係，為秘密會議，因此我方偕同泰國、拉脫維亞、俄羅斯、哥倫比亞等參與方暫時離開會場。

（三）在秘密會議結束後，主席宣布本日會議結束。

六、會外事項：

（一）本日下午洽出席會議之 FAO 之代表 Ms. Stefania Vannuccini （農漁業資訊統計處 Statistics and Information Service of the Fisheries and Aquaculture

Department），渠為 FAO 資深漁業統計員，職提及我國每年應聯合國 FAO 要求提供漁業統計資料，每次都會附加信件要求應不要以中國台灣省名稱列，但 FAO 每次都還是這樣作，也没正式信函回復我們，有否改善空間？渠回復稱，她首先謝謝台灣的合作，讓她們能順利完成工作，她說這是政治問題，並非故意刁難，希台灣諒解，至少台灣資料單獨列，雖有名稱問題；她說除台灣問題外，FAO 碰到另一同樣類似問題是福克蘭群島漁業統計資料應放在何處的問題，英國及阿根廷均要求納入其國內資料，每次都讓她們很為難。基於諒解，希台灣持續合作，職回以表理解。另詢及 FAO 與 OECD 關係，渠表示統計資料是一切研究之根本，為求正確，雙方在統計資料會作比對，並作必要調整，如有差異過大，會再詢問提報國了解原因，此即大會要求各國提報資料務必在截止前提供的原因。

（二）續昨日洽美國保育處副處長 David Hogan 就國際漁業交換意見，職過去與渠在 IATTC 場合，有多次會談，算是舊識，渠看到職名片就先表祝賀，並表示在鮪類組織部分，渠主要還是負責 IATTC 部分，其他與保育有關的，他也要出國開會。提及下月初 Borten 大使將率美國團訪台進行台美雙邊會談，職表示本署正安排大使訪台期間面見總統事，渠表示非常高興樂見台灣如此重視台美漁業關係，有助於未來在漁業領域之合作。渠未曾到訪過台灣，職表示未來有機會希能邀請他訪台，渠欣然應允。

10 月 25 日：本（25）日之會議因前兩日進度超前，因此會議提前至中午全部結束。本日會議重點在於 OECD 財務委員會研究員簡報其主辦之第三屆金融稅務犯罪論壇相關資訊，世界銀行及 FAO 的近況報告，以及討論修改本屆會議摘要報告的最終版本。謹將本日之重點扼陳如次：

一、OECD 第三屆金融稅務犯罪論壇(議程十三)：

（一）由主辦之 OECD 財務委員會研究員就此論壇之議程及宗旨進行簡報，該論壇預定於本(102)年 11 月 7 至 8 日在土耳其伊斯坦堡召開。由於金融犯罪牽涉層面廣泛，因此在管理及防治上同樣牽涉到政府間不同部門的跨界溝通和合作。因此本論壇宗旨即在於協助與會各方進行金融犯罪防治的能力建構和跨部門間橫向溝通的相關策略。而會選擇在 COFI 會議中進行此簡報，則是因為主辦方意識到漁業部門的相關金融犯罪防治亦隨著漁業之跨國特性而益發重要，因此本次論壇之第二日將有專門討論漁業部門相關犯罪的議程。希望屆時 COFI 成員能夠踴躍參與本論壇。

（二）主席表示，在 OECD 內部，跨委員會的相關合作很常見，因此這次有關金融財務犯罪的研討會，是一個使 COFI 成員和其他委員會交流諸如犯罪問題等跨領域議題的良好機會。

（三）冰島首先發言表示贊同此論壇的宗旨，因冰島漁業部門也面臨相同的犯罪問題，因此期待論壇能有豐碩成果。

（四）挪威表示該國政府已在此領域努力近十五年，且本次 COFI 會議中也提案希望將犯罪防治的相關議題列為下一階段的工作，因此挪威樂見此論壇的舉辦。

（五）紐西蘭發言表示贊同，因此議題為全球問題，不只在漁業部門。且由於公海和沿近海的管轄權劃分問題，使得處理相關的犯罪問題相當困難。

二、世界銀行及 FAO 的近況報告（議程七）：

（一）世界銀行簡介目前進行中的漁業部門相關投資，並表示由於世銀已投資許多開發中國家的漁業相關部門，因此亟需借重 FAO 和 OECD 的專業並加強合作與交流。

（二）FAO 表示 2014 年 1 月起將修改組織的優先策略，以減少貧窮、降低與穩定糧價、加強與其他國際組織的合作等為優先。此外，與世銀合作的相關報告已出版，其中包括漁業貿易和政策等內容，歡迎與會各方參考指教。

三、第 112 次會議摘要報告(議程十四)：

（一）主席將摘要報告呈現後，與會各方依序檢視每一段的摘要報告文字，並提出許多增修意見，諸如日本要求修改能源效率與資源存量的相關文字，歐盟將許多過於武斷或偏頗的敘述修改為較中性的說法，並加入一些未被摘要收錄的相關結論，以及紐西蘭和挪威修正了摘要中一些涉及該國發言的相關立場說明等。

（二）摘要報告的增修完畢後，秘書處表示更新版的摘要報告將上傳至 OECD 網站系統上供各方下載。主席隨後感謝各方在本次會議中的踴躍討論，使本次會議收穫良多，隨後宣布本 112 次會議至此結束。

肆、 心得與建議

一、本次會議之主要成果係討論漁業與綠色成長之發展策略，透過秘書處將 OECD 曾製作有關漁業管理文獻重新編彙，並配合現今資料加以修訂，以期提供漁業及水產養殖決策管理人員參考及後續制定政策之依據。本會議顯示 OECD 會員國對綠色成長之永續概念之重視，並預計於 2014 年底前完成包含「「捕撈漁業及養殖漁業之綠色成長概念說明」、「養殖漁業與綠色成長」、「捕撈漁業與綠色成長」以及「綜合報告」共 4 篇文件所組成之「漁業與綠色成長」研究報告，作為 COFI 綠色成長之產出。

二、我方應積極參與明年 4 月舉辦之聯合研討會，因本研討會涉及主要國際組織之間的政策統合，對於全球未來漁業政策走向具有重大影響，爰我國可在本研討會中與各國交流國際最新漁業政策走向，並作為未來我國漁業政策制定之參考。

三、有關政府財政轉移改良部份，會員國多對此議題表示支持。雖然現階段 OECD 專家們欲將農業統計指標引入漁業部門尚有技術上之障礙，惟我方仍應密切注意本統計模式的修改，因其未來可能涉及我方敏感資料，如燃油補貼等數據資料的提交，故未來就此議題應審慎處理。

四、針對 OECD 之相關研究報告，我方應於會議前多加熟悉草案內容，並預擬相關增修意見，藉由積極參與文件討論，可使研究報告成果之於我國而言更具有參考性，並連帶使其他國家因此得益。

伍、 附件：

1.會議議程：TAD/FI/A(2013)2。

2.漁業與綠色成長研究報告：

2-1. 捕撈漁業及養殖漁業之綠色成長概念說明：TAD/FI(2013)2/REV。

2-2. 養殖漁業與綠色成長：TAD/FI(2012)11/REV2。

2-3. 漁業之能源使用政策建議：TAD/FI/RD(2013)10。

2-4. 政府管理與綠色成長：TAD/FI(2013)11。

3. 政府財政轉移研討會之成果：TAD/FI(2013)12

4. OECD COFI- DAC（發展支助委員會）-WB（世界銀行）-FAO 聯合舉辦漁業及養殖漁業研討會之議程：TAD/FI/RD(2013)5。

5. 2015 至 2016 之工作計畫與預算：TAD_FI(2013)9、 TAD-FI(2013)9-ADD1。

6.會議紀錄暨與會者名單：TAD_FI_M(2013)2。

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Organisation de Coopération et de Développement Économiques
Organisation for Economic Co-operation and Development **31-Jul-2013**

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TRADE AND AGRICULTURE DIRECTORATE
FISHERIES COMMITTEE

TAD/FI/A(2013)2
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DRAFT AGENDA OF THE 112TH SESSION OF THE COMMITTEE FOR FISHERIES

Paris, 23-25 October 2013

The meeting will start at 09:30 on Wednesday, 23 October 2013 and will be held at:

Organisation for Economic Co-operation and Development (OECD)
Conference Centre, Room 10
2, rue André-Pascal
75016 Paris

For further information, please contact:
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COMMITTEE FOR FISHERIES

DRAFT AGENDA of the 112th SESSION

OECD Conference Centre, Room 10
2, rue André Pascal, Paris 75016

23-25 October 2013
9:30 – 18:00

Wednesday, 23 October *(morning)*		
1.	**Adoption of the Draft Agenda for the 112th Session**	TAD/FI/A(2013)2 ***Action required***: Approval
2.	**Statement by Mr. Ken Ash, Director of Trade and Agriculture Directorate**	Information
3.	**Fisheries and Green Growth: Progress reports** ***i) Green Growth in Fisheries and Aquaculture: An Introduction and Clarification of Concepts*** The COFI is asked to approve the second version of the document which has been revised substantially to take into account the various points raised at the 111th Session. The document will be integrated with the other green growth elements once they are finalised.	TAD/FI(2013)2/REV ***Action required***: Discussion and approval
Wednesday, 23 October *(afternoon)*		
	ii) Green Growth and Aquaculture: Progress Report A revised and updated version of the COFI's work on Green Growth and Aquaculture has been prepared. The COFI is asked to approve this part of the work on green growth. The document will be integrated with the other elements once they are finalised. ***iii) Energy Use in Fisheries*** This document follows the report *A Green-Growth Perspective on Energy Use in Fisheries and Aquaculture* [TAD/FI(2012)1/FINAL]. This document considers policy options to improve energy efficiency in fish production and suggests recommendations for reform. This document will also form part of the "Green Growth in Fisheries" synthesis.	TAD/FI(2012)11/REV2 ***Action required***: Discussion and approval TAD/FI/RD(2013)10 ***Action required***: Discussion

	iv) Governance and Green Growth This item provides a progress report on the work titled, "Green Growth and Governance in Fisheries and Aquaculture". A consultant's report by Professor David Symes which will be a significant input into the final report is also presented under this item. Once completed, the document will also be integrated with other elements to form a synthesis report.	TAD/FI(2013)11 ***Action required:*** Discussion
Thursday, 24 October *(morning)*		
4.	**Outcome and follow-up to the GFT Experts Workshop, 25 April 2013** A document on the key discussion points and suggestions for further work on GFT has been prepared. Additional work is proposed to take place in the 2015/16 Programme of Work period. In particular, the paper discusses possibilities for enlarging the scope of the GFT exercise and proposes a "way forward" to be undertaken in 2015/16.	TAD/FI(2013)12 ***Action required:*** Discussion and approval of scope and content of additional work on GFTs.
5.	**Preparations for the joint session with DAC-WB-FAO on Policy Coherence for Development; progress report on discussion notes; VC and country submissions** The COFI will be informed about the progress made on the preparations for the joint session. Delegates are requested to look into the possibility of submitting case studies for the joint session and/or provide voluntary contributions.	***Action required:*** Discussion and guidance
6.	**Review of Fisheries Statistics**	Information
Thursday, 24 October *(afternoon)*		
7.	**Other activities** ***i) Report on other OECD activities related to Fisheries*** As has been established practice, the Secretariat will inform delegates about projects in other parts of the OECD that have relevance to the work of the Fisheries Committee. ***ii) Reports on activities of the Fisheries Secretariat*** The Secretariat will report on past and planned activities of the Secretariat, including attendance at meetings.	Information Information Information

	iii) Reports from member countries on activities of relevance to the COFI Oral reports from Delegations are welcome. ***iv) Reports from Observers*** Oral reports are expected from observers of the FAO, Council of Europe, World Bank and UNEP.	Information Information
8.	**In-depth Evaluation Phase 2** The COFI will be informed of any new developments with respect to the second phase of the in-depth evaluation.	Information
Friday, 25 October *(morning)*		
9.	**Results of the PIR 2011/2012** The COFI will review the results of the PIR exercise, if available; alternatively, an update will be presented by the Secretariat. Delegates are reminded that the PIR results are important for future programme of work and budget discussions.	TAD/FI(2013)13 ***Action required:*** Discussion
10.	**Programme of Work and Budget 2015/16** To start the reflections on the 2015/16 Programme of Work, a document has been prepared. Delegates are asked to identify the policy priorities they wish to address over the coming PWB, in light of available resources. Based on the discussion at the 112th Session, the Secretariat will prepare a document for decision/approval at the 113th Session to be able to submit this to the Organisation's PoW cycle.	TAD/FI(2013)9
11.	**Election of Officers to serve in 2014**	***Action required:*** The COFI is asked to elect its Bureau and Chair to serve in 2014.
12.	**COFI relations with non-members** The COFI will be informed of the process of accession reviews of new candidate member countries and well as the status of its Participation Plan.	**CONFIDENTIAL Item**
13.	**Other business**	***Action required:*** Discussion
Friday, 25 October *(afternoon)*		
14.	**Adoption of the Summary Record of the 112th Session of the Fisheries Committee**	TAD/FI/M(2013)2 ***Action required:*** Approval

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Organisation de Coopération et de Développement Économiques
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05-Sep-2013

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TRADE AND AGRICULTURE DIRECTORATE
FISHERIES COMMITTEE

TAD/FI(2013)2/REV1
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GREEN GROWTH IN FISHERIES AND AQUACULTURE: AN INTRODUCTION AND CLARIFICATION OF CONCEPTS

23-25 October 2013

This document is presented to the 112th Session of the Committee for Fisheries under item 3 i) of the draft agenda and is distribution for DISCUSSION and APPROVAL.

Contact:
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JT03343990

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NOTE BY THE SECRETARIAT

At its 109th Session in April 2012 the Fisheries Committee (COFI) decided to work on applications of the OECD green growth agenda to fisheries and aquaculture. At its 110th Session in October 2012 the COFI further refined that decision[1] by identifying an end product that would consist of a document divided into three parts containing an overview and discussion of specific topics in fisheries and aquaculture.

This paper represents the first part of that document, being an overarching clarification of the concept of green growth for the development and management of fisheries and aquaculture specifically addressing interactions between aquaculture and fisheries.

A first draft of this paper was discussed at the COFI's 111th Session in April 2013; this draft has benefitted from comments received at that session and comments submitted by Delegates since then. This draft is submitted for DISCUSSION and APPROVAL at the 112th Session of the COFI, 23-25 October 2013.

1. See Summary Record of the 110th Session [TAD/FI/M(2012)2].

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GREEN GROWTH IN FISHERIES AND AQUACULTURE: AN INTRODUCTION AND CLARIFICATION OF CONCEPTS[2]

1. Fisheries, Aquaculture and Green Growth

1. Fisheries and aquaculture depend directly on the natural environment for their productive capacity. The challenges of delivering on economic and social goals under environmental constraints are a familiar one for fisheries and aquaculture policy makers. In this light, it is no surprise that much of the past work of the COFI can be considered to be relevant to the Green Growth concept.

2. But understanding the links between economic, social and environmental objectives is not enough to guarantee success for policy makers in achieving them, and this is where the OECD Green Growth Strategy (GGS) comes into play. The OECD GGS is an attempt to define concrete and practical approaches to achieving sustainable economic growth in the long term, i.e. ensuring both "green" and "growth".

3. The OECD Green Growth Strategy provides a set of principles for policy reform and a roadmap to follow to achieve reform in practice. This Strategy offers useful advice to fisheries and aquaculture policy makers who seek to ensure long-term growth for the sector while mitigating environmental impacts and resolving resource use conflicts.

4. The objective of this report and the synthesis document that will follow it is to combine the practical knowledge and experience of the COFI with the structure of the OECD GGS in order to provide a more complete set of policy principles and advice of use to policy makers as they pursue green growth policies and objectives in fisheries.

5. Policy advice will necessarily be different for capture fisheries and aquaculture. The two sectors have different modes of production, face different environmental constraints and challenges, and serve different social policy objectives.[3] For this reason some countries place the fisheries and aquaculture portfolios in different ministries. Regardless, due to the physical and economic interactions between capture fisheries and aquaculture there remains a need to ensure coherence across these policy domains. This issue is addressed in section 5 of this paper.

6. The capture fisheries sector is uniquely reliant on a renewable natural resource. For fisheries, there is an ultimate limit to the amount that can be produced from a fish stock. That means economic growth for fisheries must come through the use of more efficient fisheries management models, better use of raw material once harvested, less waste, lower energy intensity, which may come through innovations and market creation. The costs of fishing can in some cases be significantly reduced through a better organisation of fishing activities. And on the income side, quality enhancement may produce higher prices for the fishers. The central tenet of the green growth strategy is to produce long-term economic growth while respecting environmental limits.

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2. This paper draws on "Towards Green Growth" (OECD, 2011) and "Conceptual framework for achieving green growth through improved regulation of fisheries and aquaculture" (Copenhagen, 2012) by Max Nielsen, Lars Ravensbeck and Rasmus Nielsen.

3. On the other hand, they share (some) products, common space, and some aquaculture production systems depend on capture fishing for some inputs.

7. In most cases capture fisheries draw on a resource (the fish stocks) that has elements of both common property and property rights characteristics, depending on the particular management objectives for the fishery. Fisheries policy makers and managers play a crucial role in determining both economic (growth) and biological and broader environmental (green) outcomes. Within this context fish stocks are public assets and the role of the regulator is to produce the highest return to society possible from this asset.

8. Aquaculture or the farming of aquatic organisms involves a degree of human intervention that varies according to the species being farmed, the intensity of farming and the specific production system. Aquaculture mostly takes place as a private activity controlled by individuals, even though it may take place in water bodies which are held as common property. The aquaculture policymaker's key role is to ensure that the externalities - in particular environmental - from aquaculture are addressed and that policy frameworks are in place to deliver sustainable growth.

9. Over the past decades many countries have made great strides in rebuilding their fish stocks and establishing robust management regimes. At the international level the past decades have witnessed a range of activities, spanning from the setting-up of a number of regional fisheries management organisations (RFMOs) to the adoption of new hard and soft law. Examples include the 1995 Fish Stocks Agreements, the FAO Code of Conduct and the WSSD Johannesburg 2002 Plan of Action. In addition a number of private initiatives – including labelling initiatives - have contributed significantly to heighten awareness that action is needed to arrest overfishing and to preserve and share the environmental assets that underlie the fishery.

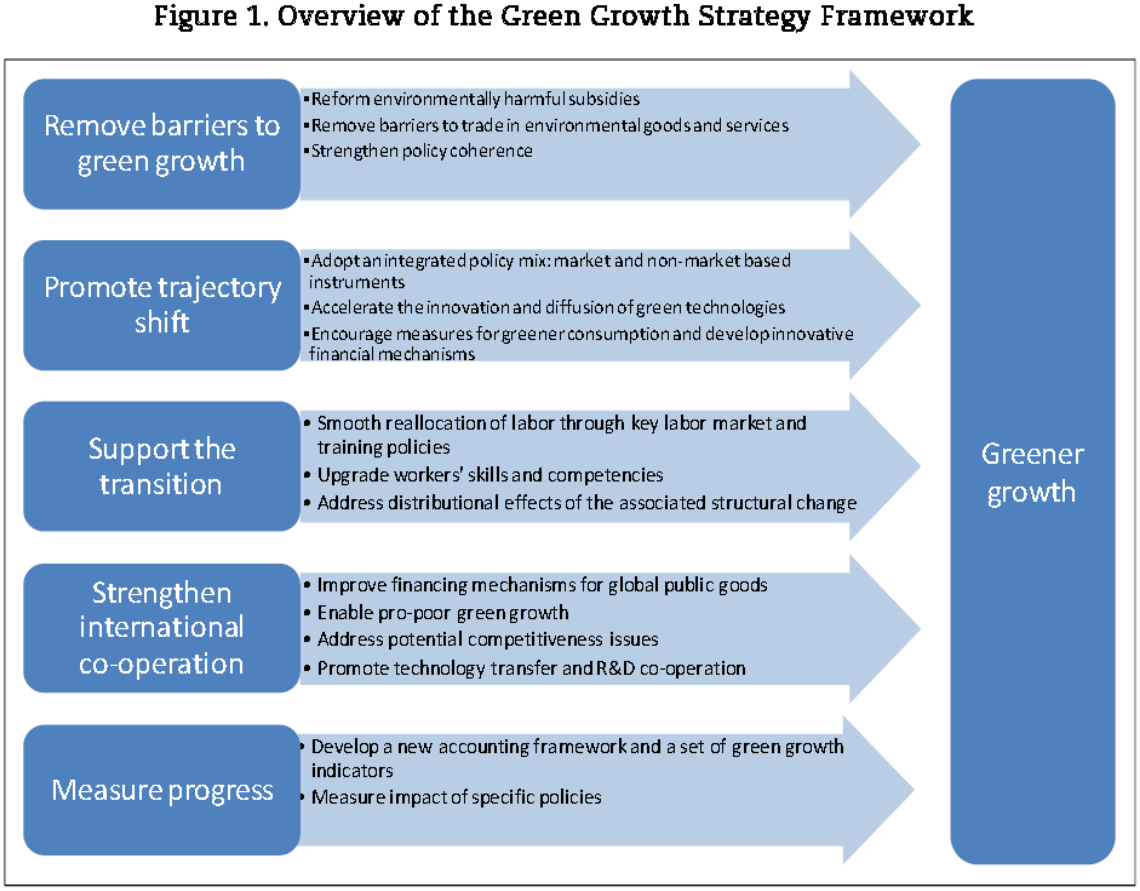
2. The OECD's Green Growth Concept

10. Green growth means fostering economic growth and development while ensuring that the natural assets continue to provide the resources and environmental services on which our well-being relies. The OECD Green Growth Strategy (GGS) establishes a set of principles for policy makers along with a roadmap for how to achieve green growth in practice.

11. One of the main ideas of the GGS is to bring together policy making in the economic and environmental domains, demonstrating the need for a bridge between these two policy areas that are often kept separate. Fisheries policy makers have been grappling with this problem for at least the last several decades, when it became obvious that the seas were not a limitless resource and that fishing would need to be controlled if it was to be sustainable.

12. So if fisheries policy makers have long been aware of the need to balance economic growth with environmental constraint, what does the OECD GGS have to offer them? The OECD GGS is a practical tool that helps policy makers establish the conditions for success in designing their own strategies for growth. The OECD green growth strategy identifies a number of specific steps that must be taken to improve growth and welfare while enhancing sustainability (Figure 1).

Figure 1. The OECD Green Growth Strategy



Source: OECD 2010, Interim Report of the GG strategy MCM, 2010

13. The green growth concept has its roots in the ideas of sustainable development (Box 1). However, the green growth concept emphasises *policy action* and *deliverables* and so is a more tangible way of concurrently addressing economic growth and environmental concerns. With its focus on policy action and the need for long-term growth, the green growth concept is more operational for policy makers and provides more compelling arguments for policy reform.

14. The green growth elements of the COFI's work consist of elements (waste, energy, governance, recreational fisheries, etc.) which will lead to a Synthesis Report tying together the key policy messages for green growth in fisheries and aquaculture. Ideally, it will translate the OECD GGS concepts and principles into more specific options for policy action relevant for fisheries (and aquaculture) policy makers.

Box 1. Green Growth and sustainable development

Green growth has not been conceived as a replacement for sustainable development, but rather should be considered a subset of it. It is narrower in scope, entailing an operational policy agenda that can help achieve concrete, measurable progress at the interface between the economy and the environment. It provides a strong focus on fostering the necessary conditions for innovation, investment and competition that can give rise to new sources of economic growth – consistent with resilient ecosystems.

Green growth strategies need to pay specific attention to many of the social issues and equity concerns that can arise as a direct result of greening the economy – both at the national and international level. This is essential for successful implementation of green growth policies. Strategies should be implemented in parallel with initiatives centering on the broader social pillar of sustainable development.

Source : Towards Green Growth (OECD 2011)

2.1 Elements of the OECD Green Growth Strategy

2.1.1 Remove Barriers to Green Growth

15. A number of policy barriers can hamper the move to green growth, including environmentally harmful subsidies, tariff and non-tariff barriers to trade in environmental goods and services, inefficient regulatory interventions and conflicting policy instruments.[4] Such barriers are distorting the efficient allocation of resources in the economy that affects the transition towards green growth. One example is the absence of, or an inadequate pricing of, natural resource use including in fisheries.

16. In the case of capture fisheries, reform towards a green growth path has been timid owing to a number of governance and institutional barriers to policy action. The COFI's work on "Fisheries Policy Reform: National Experiences" and the recent work on Rebuilding Fisheries underscored that, while reform is necessary, resistance to change in fisheries is endemic. Particular factors inhibiting reform include i) the distributions of benefits and losses from change; ii) the timing of benefits and losses; iii) uncertainties regarding the distribution of benefits and losses; and iv) the ability to sustain reform processes over time. Reform strategies, including compensating those who lose out from reform, are therefore needed. In this process the role and involvement of stakeholder groups (fisher organisations, NGOs etc.) is central to success and is a prerequisite for the alignment of incentive structures.

17. Potential areas of policy action include: i) the removal of environmental harmful subsidies including in particular fossil fuel subsidies; ii) regulatory reform, iii) tenure reform for natural resource ownership; and iv) green tax reform. Importantly it also includes that countries improve policy coherence across institutions that design and deliver policy.

2.1.2 Promote Trajectory Shift

18. Promoting successful transition towards green growth mean: i) developing strategies for reform; ii) facilitating adjustment in the labour market; iii) addressing concerns about distributional impacts on firms and households, especially those on low incomes; and iv) promote international cooperation[5].

19. A green growth strategy must consider many specific details in designing policies for growth:

4. OECD 2010, Interim Report of the GG strategy MCM, 2010

5. Towards Green growth (OECD, 2011)

"One of the objectives of a green growth strategy is to find the policy mix that minimises the economic cost of a transition towards a growth path that better internalises environmental externalities. Therefore, one of the primary criteria for policy assessment is the cost-effectiveness of specific economic instruments. However, given the existence of monitoring and enforcement costs as well as information problems and market incompleteness, the appropriateness of policy instruments also needs to be assessed on the basis of their adoption and compliance incentives, of their ability to cope with uncertainty, as well as of their effectiveness in stimulating innovation and the diffusion of green technologies. Finally, given that environmental externalities often spill across national borders, the extent to which instruments can be designed and implemented in a way that facilitates international co-ordination is also considered." (OECD 2010).

20. This description of green growth is especially relevant to the fisheries case as it observes the need to assess cost-effectiveness, underscores monitoring and enforcement costs as part of the equation, recognises market incompleteness, the role of incentives in adoption and compliance and the international dimension of the sector. These are longstanding and recognised issues in fisheries policy.

21. The OECD Green Growth strategy proposes a flexible policy framework that can be tailored to the different circumstances of each country.[6] A range of options are available to promote positive change and establish a new policy set. The OECD suggests that policy makers build a new policy set that contains the following elements:

- Use market based instruments and pricing mechanisms when feasible. This entails the integration of natural assets (like fisheries) into day to day decisions by market operators.
- Ensure coherence across policy areas and instruments in use vis-a-vis the economic sector.
- Existing and new programs that entail subsidies should be carefully scrutinised for their side effects; environmentally harmful subsidies should be removed.
- Concurrently develop an innovation strategy which can help underpin a move to green technologies that addresses environmental externalities of production, distribution and consumption.
- Co-opt consumers to change behaviour and demand towards green products.
- Leverage private and public finance into green growth.
- Facilitate transition to green growth through labour market policies, improving skills and flexibility and adjustment to new economic sectors.
- In the face of adjustment income distribution may be a cause of concern for stakeholders and flanking policies may be needed to ensure buy-in. Measures to provide adjustment assistance or compensation can help enable reform.

22. Against this background it would seem that fisheries and aquaculture policy makers have a number of angles from which to lay the foundations for a green growth strategy. What is important to keep in mind in building these policy packages is to achieve *growth* (needed to create jobs and economic activity) while ensuring *green* (sustainability and containing environmental externalities of production).

6. See *Tools for Delivering on Green Growth,* Paper prepared for the OECD MCM 2011.

2.1.3 Support the transition

23. Governments can do a lot to support a transition towards green growth. Involvement of stakeholders, skills upgrading, flanking measures for the transition of workers, educational initiatives, early retirement programmes and innovation initiatives may all be used to sustain a green growth transition. In the case of capture fisheries focus should be on removing excess capacity whether in capital or labour. Economies are not at the same stage of development and traditions may play a role and hence the specific policy that may be used differs across countries and possibly economic sectors as well.

24. In the case of capture fisheries, the COFI's work on Using Market Mechanism to Manage Fisheries: Smoothing the Path (OECD 2006) outline a list of ten tracks for policy makers in embarking on reform. Using Market Mechanism was intended to demystify the concept of market based economic instruments. The ten tracks, which are useful to consider within a green growth strategy, are:

1. Making all stakeholders comfortable with the concept of market-like instruments
2. Preferring an incremental or gradual implementation of market-like instruments
3. Not necessarily adopting a "one-size-fits-all" strategy
4. Carefully designing the process to allocate rights
5. Pragmatically using market forces
6. Overcoming the "excessive consolidation" question
7. Using the "demonstration effect" (drawing on experience)
8. Involving stakeholders in the reform process
9. Integrating fisheries characteristics
10. Dealing pragmatically with trade-offs

2.1.4 Strengthen international cooperation

25. The world is increasingly globalised and interconnected. This is particularly the case in fisheries and aquaculture where more than 50% of all fish is traded across the globe and a substantial amount of the fish consumed in OECD countries originates in developing countries. Many fish stocks are also global in the sense that they are crossing national boundaries because they are migratory (e.g. tuna) or the stocks may seasonally move in and out or between national fishing zones. It follows that there is a strong need for international co-operation if we are to achieve green growth in fisheries.

26. The COFI's work on Policy Coherence for Development and Strengthening Regional Fisheries Management Organisations are examples of the growing interest and concerns about the need for international co-operation to address impacts across the world of domestic fisheries policies and the challenges of dealing with the global commons.

2.1.5 Measuring progress towards green growth

27. Government progress on implementing policies that promote green growth in the fisheries and aquaculture sectors can be evaluated using well designed operational sets of indicators, which the OECD is

currently developing in consultation with a broad group of stakeholders, including other international organisations.

28. The OECD has developed a conceptual framework for monitoring progress towards green growth, including a set of indicators ("Towards Green Growth – Monitoring Progress", OECD 2011). This work observes that "green growth indicators should therefore strive and identify the most important environmental services, and if possible quantify their role in economic growth". (see page 18 of "Towards Green Growth: Measuring Progress"). While the set of indicators is still being refined, the headline indicator pertinent to the fisheries and aquaculture sectors measures "the proportion of fish stocks within safe biological limits (global), expressed as the percentage of fish stocks exploited within their level of maximum biological productivity, i.e. stocks that are underexploited, moderately exploited, and fully exploited. Safe biological limits are the precautionary thresholds advocated by the International Council for the Exploration of the Sea. This indicator is also included in the Millennium Development Goal monitoring framework. Trends in fish production from aquaculture along with trends in fish production from capture fisheries presented worldwide and for major species groups are given as complements" ("Towards Green growth – Monitoring Progress" page 84).

29. The indicator reported in "Towards Green Growth: Measuring Progress" is not sufficient for the fisheries and aquaculture case as its main focus is on "green" progress. Hence additional indicators incorporating the "growth" aspect and their role will be discussed in the section 3.6. and 4.2. Future work will look at possible ways to monitor progress towards green growth related to fisheries and aquaculture based on existing OECD studies . While fisheries and aquaculture statistics are generally well established in countries and at international level, measuring efficiency and innovation is difficult, and coherent industry level information is scarce. Additional work will be needed to improve data quality, methodologies and definitions, and to link the data to economic information.

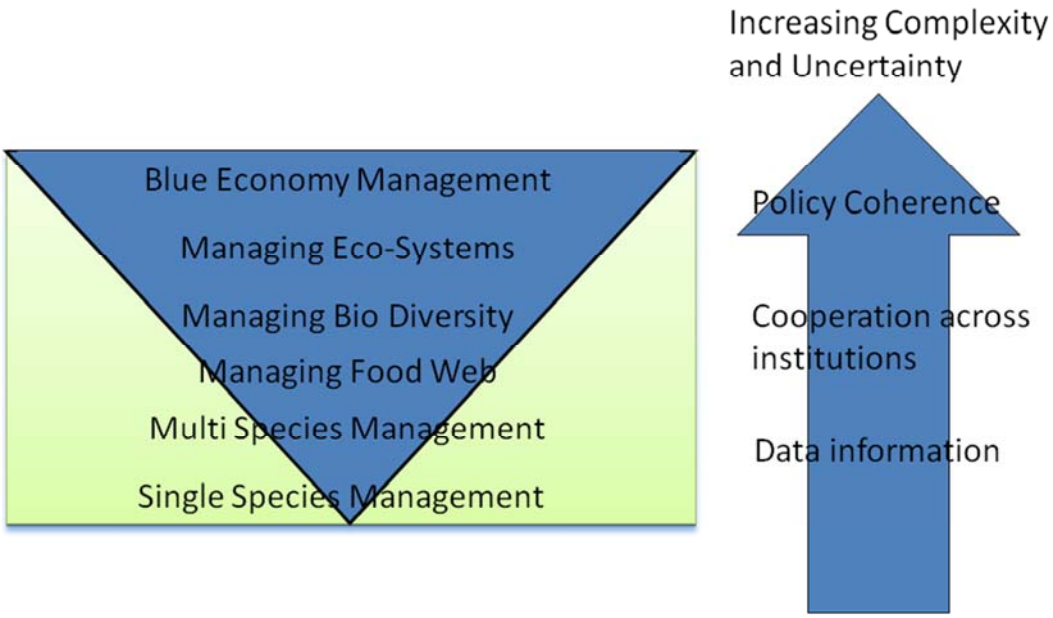
2.2. Towards a Green Growth perspective

30. The activities of the fisheries and aquaculture sectors do not take place in a vacuum. COFI has highlighted the linkages between these two activities. Feed and competition for space are particular important, but also fisheries and aquaculture activities compete with tourism, shipping, exploration for hydrocarbons, agriculture (for land-based aquaculture and for run-off in the coastal zone) electricity generation and other activities.

31. Fisheries and aquaculture are also more broadly connected with the ecosystem and its different users (Figure 1). Expanding the perspective of the management to include broader objectives brings greater potential societal benefits. This coherence between policy domains is a key element of the GGS. Taking a broader view and operating at a higher level also comes at a higher cost. Additional efforts are required to ensure policy coherence and co-operation across policy domains that affect the ocean activities, including for data and information, surveillance, enforcement and administration.

32. Taking a broader perspective entails an evolving governance model for fisheries. Management of a single species can, as has traditionally been the case, be handled by a ministry assisted by a directorate that feeds data and management information. Stakeholder involvement will be limited to user groups with a direct interest in the fishing sector. When managing at higher levels, i.e. ecosystems or integrated ocean management, interest groups are spread more widely and pursue a variety of economic activities and more ministries and agencies have competence. For example, managing coastal eco-systems might require agriculture, rural development, fisheries, aquaculture, tourist, zoning interests etc. to be taken into account in decision making. This complexity increases costs, adds uncertainty and time to the process, and as well introduces information asymmetries. This needs to be weighed against the additional benefits accruing to society of improved management.

Figure 2. Moving from single species management to a 'blue economy' approach



33. Most ocean policies aspire to take a broader approach to management and recognise that this is key to maximising benefits. In practice however most countries find it prudent to stick to a simpler and more practical single-species approach to managing fisheries and aquaculture. The OECD's Green Growth Strategy calls for establishing more effective institutional arrangements that can help countries to eventually take a more holistic approach. However, an important observation is the constraints on aspirations imposed by limits in science and knowledge. As highlighted above one objective of the green growth strategy is to minimise the cost of transition which include an assessment of the cost-effectiveness of policy instruments. Moving to more complex management models will not be done overnight.

3. Green Growth in Fisheries

34. Applying the principles of the OECD green growth strategy in the capture fisheries sector can result in a number of benefits:

- Improved efficiency in management that can increase welfare through higher value of production (increasing quantity, price or both while respecting the environmental carrying capacity) or by lower fishing costs (public and/or private).

- Net welfare gains from reduced externalities, such as those generated by pollution or environmental degradation (e.g. reduction in energy use).

- Enabling the production of valuable non-market goods and services (e.g. recreational fishery)

- Reaping the benefits of improved technologies (e.g. innovative gear technology leading to better fuel economy).

Each of these benefits are further elaborated on in the following

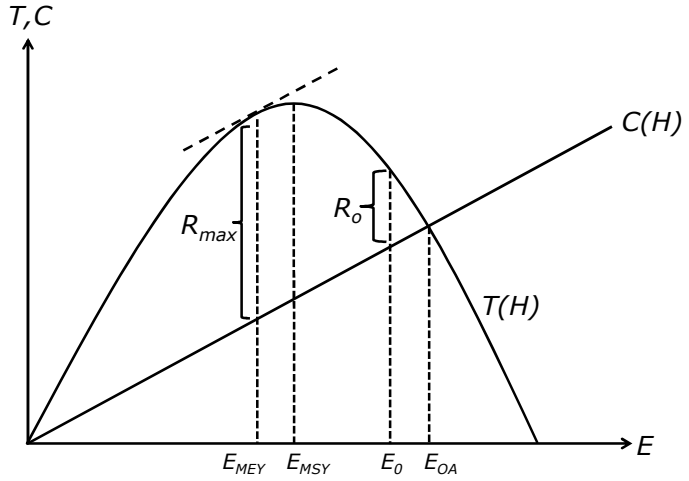
3.1 The benefits of fisheries management reform

35. Fish stocks are a public resource that should be used to provide the greatest possible social benefit. In principle public and private actors both have a role to play, but the well-understood problem of over-use of common resources means that there will always be a role for management.

36. The right management target for a stock depends on a number of factors. Targeting anything beyond maximum sustainable yield (MSY) should be ruled out as MSY is the environmental carrying capacity limit and from a biological perspective it is not possible to exceed the MSY systematically over time. In mixed fisheries there may however be an issue of trading off between predator-prey relations. Targeting MSY of a fish stock results in the largest possible harvest level, and so maximises consumer benefits.

37. Maximum economic yield (MEY) – an economic concept -- on the other hand maximises the rents from fishing (Box 2). MEY however does not represent a biological objective; at zero discount rates it represents a point at which the fish stock and the required harvesting capacity is optimised and where cost of production is minimised. To achieve the full benefits of MEY in practice requires market mechanisms that align the interests of fishers with public objective. Furthermore, MEY is preferred by some on conservation grounds as it is more precautionary, with higher stocks and lower harvest than at MSY. MEY can therefore mitigate some risks associated with uncertain estimates of stock growth and harvest.[7]

Box 2. Managing harvest to maximise benefits to fishers



The relationship between fishing effort (*E*) and, respectively, total social cost (C) and total revenue (T) is shown in the figure. Total revenue is the product of the sustainable yield and price. Total revenue increase with fishing effort until the maximum sustainable yield (MSY), after which it decreased in the long run owing to overexploitation and reduced fish stocks. MSY identifies the maximum sustainable catch. Total costs represent production costs of fishing with

7. But the ideal stock size from a risk mitigation perspective will only coincidentally be equal to MEY.

capital and labour in alternative use and increase with effort.

Under open access, the bio-economic equilibrium is reached where total cost equal total revenue, i.e. where the T and C curves intersect. In that situation, the resource rent (total revenue minus total cost) is zero and profit is at exactly the same level than what can be obtained from using labour and capital in alternative sectors.

Under optimal regulation, which ensures maximisation of the vertical distance between total revenue and total costs, represented by R_{max} in the figure and also known as the maximum economic yield (MEY), the resource rent is maximised. Effort in open access is larger than effort in MSY, which again is larger than effort in MEY. Conversely, resource rent earned by fishers is largest in MEY, lower in MSY and zero under open access.

Source : Nielsen (2012)

38. Achieving general green growth in fisheries means using the resource as efficiently as possible to obtain the greatest possible benefits. This suggests a key role for the management system in ensuring that stocks can deliver maximum value for the long term. Rebuilding and maintaining fish stocks at more productive levels of biomass and ensuring that management systems are efficient and cost effective are central to this.

39. Market based approaches to fisheries management – through its incentive creation – have the potential to help maximise the benefits flowing from fish stocks while making management more cost effective. *Using Market Based Mechanisms to Manage Fisheries: Smoothing the Path* (OECD, 2006) outlined a typology of management instruments (see Annex 2) of which the market-based instruments such as transferable licenses (LTL), individual transferable effort quotas (ITE) and individual transferable quotas (ITQ) are of particular interest in a green growth context.

40. The operation of economic instruments such as LTL, ITE and ITQs depend on the mix of property right characteristics that they contain. These characteristics are exclusivity, duration of right, quality of title, transferability, divisibility and flexibility. Governments ideally define these rights to balance the economic, biological and social sustainability objectives particular to a fishery. Market-based economic instruments encompass a continuum of situations from little content of the six property/use rights characteristics to a situation where the property/use rights characteristics are fully present (typically not achievable in practice). The various combinations will suit various situations depending on the scale and capitalisation of the fleet, the fish species involved, the role (e.g. economic, cultural) of fishing in coastal communities and the fisheries management objectives agreed upon by fisheries policy makers, managers and stakeholders. Evidence shows that stronger property/use rights characteristics lead to higher levels of economic efficiency and rent generation and thus moving closer to MEY.

41. Aligning incentive structures in the fishing industry can also improve compliance, increase trust in government and its policies and can streamline surveillance and enforcement operations at lower costs. If reducing government expenditure is a policy objective, a green growth strategy in fisheries may be a helpful path to reduce overall costs of running the sector.

42. A number of studies have shown the potential of better management. The World Bank (and FAO) estimated in 2008 that USD 50 billion is lost annually to poor management (*The Sunken Billions*) on a global scale. A more recent study by the New Economic Foundation (NEF) suggests that in the United Kingdom "*To land the same quantity of fish as they did in 1889, UK trawlers must now exert 17 times more effort – equivalent to a 94% fall in productivity*" ("*Value Slipping Through the Net*"). The NEF has also produced a report "*No Catch Investment*" suggesting that restoring 39 North East Atlantic stocks could deliver up to GBP 14.62 billion per year in gross revenues. Improved management of stocks has been shown to increase profits through higher CPUE while improving the energy-efficiency of the sector ["Green Growth and Energy Use in Fisheries" document TAD/FI(2012)2].

43. Over the past decades several countries have undertaken fisheries policy reform and introduced market like instruments in their fisheries management (see Annex Table 3). In *Fisheries Policy Reform: National Experiences* (OECD, 2011), it was noted that "*poor environmental performance is generally not sufficient to prompt governments to undertake significant reform efforts. In each of the case studies, it was economic crisis rather than environmental crisis that provided the key trigger for reforms to be contemplated and acted upon*". A consequence of this is that the overall costs induced by poor environmental performance – for private operators and for public coffers as forgone revenue – will be higher the longer one waits to undertake reform. This is in line with the observations that delaying reform will result in continued rent dissipation, higher risk for fish stocks, and generally lower fish stocks than otherwise would have been the case with reform and rebuilding.

44. Fisheries management reform can bring considerable economic and social benefits. The Danish experience has been that better green growth strategies in fisheries increase stock sizes, reduce the amount of inputs used (vessels, fishers, energy, etc.), improve catch per unit of effort (CPUE) and could also increase quality of harvest (Box 3). This makes efforts to overcome resistance to reform worthwhile. As noted in *Towards Green Growth "Consulting on how distributional impacts will be dealt with is a crucial part of policy communication. This includes taking careful account of how affected groups want to be compensated"*.

Box 3. Market-based instruments in Denmark

In Denmark, a system of individual transferable quotas was introduced in 2003 in the pelagic fishery. In 2007 the scheme (also somewhat modified) was introduced in the remaining fisheries. The consequence has been that the number of active vessels declined from 1,528 in 2000 to 688 by 2010. Simultaneously, the total operating profits increased from DKr 620 million in 2006 to DKr 1453 million in 2010, corresponding to a 130% increase. The Danish example shows that green growth can be achieved through better fisheries regulation and fisheries policy reform. Other green growth improvements have included a considerable reduction in energy use.

	2006	2007	2008	2009	2010
Number of registered vessels[1]	3 134	2 957	2 890	2 834	2 826
Number of commercially active vessels[1]	1 093	846	777	703	688
Number of employed	2 341	1 751	1 577	1 446	1 392
Total landing value (DKK Million)	3 183	2 719	2 560	2 218	3 004
Average per commercially active vessel					
Landing value (DKK 1 000)	2 785	3 053	3 076	2 955	4 176
Earning (DKK 1 000)	1 726	1 857	1 691	1 636	2 658
Operating profit (DKK 1 000)	620	829	609	623	1 453
Net profit (% of insurance value)	15%	20%	20%	13%	30%

Source : Danish country note to the Review of Fisheries 2013.

3.2 Managing the costs of pursuing green growth in fisheries

45. Fisheries policy reform and fisheries management more generally carry costs to implement and run. Fisheries reform will induce costs for those negatively affected by economic changes in coastal communities as economic activity can shift away from fishing, reducing jobs and the value of investments in capital.

46. A successful transition as part of a green growth strategy requires managing and sharing these costs in a way that ensures that:

- They do not exceed the potential benefits of reform

- They do not become a barrier to necessary changes or progress
- They are as low as possible.

47. One way to ensure that reforms bring net benefits – to both private operators and public coffers -- is to rely more strongly on cost recovery to fund fisheries management (Box 4). A cost recovery approach ensures that the management system is delivering net benefits to fishers and so acts as a benchmark for efficient management. For example in New Zealand the government, through a series of levies on quota holders, catch limits conservation service levies recoup around one-third of the total costs of "general services" to the fishing industry. Cost-recovery approaches will always be country- and fisheries management- specific, (Table 1). In some cases (Iceland, New Zealand) the right institutional frameworks have led the industry to demand additional expenditures on management services suggesting that well-designed reforms can demonstrate the benefits of sound management.

Box 4. Cost Recovery in Fisheries

The question of how to improve and make the delivery of management services more cost effective is an important one for policy makers. Fisheries management costs are an important factor in delivering effective and sustainable fisheries management outcomes. Budgetary pressures mean that obtaining the best value for money and resource efficiencies are always a priority for policy makers.

Using cost recovery to fund fisheries management shifts the burden from the taxpayer to the beneficiary of the management services. If the benefits of fisheries management are less than their costs, cost recovery will make this apparent and serve as a prod to reform that either reduces costs or changes the economics of the fishery.

Institution structure determines how users are co-ordinated, how information is generated, how decision are made and how monitoring and enforcement take place and will influence the magnitude of the costs of arranging, monitoring and enforcing agreements. The extent of user participation in the process of design, implementation and enforcement of fisheries management regimes will also influence services costs.

Source : The Costs of Managing Fisheries (OECD 2003)

48. Management systems incur costs related to administration, research, enforcement, surveillance and control. Such costs can be a significant part of the overall costs of running the fisheries sector. Fisheries management can take place at several levels of complexity depending on its ambition and scope. In particular, moving from a focus on a single species to multi species or eco-system approaches brings additional costs and benefits.

49. There are a number of ways to manage costs. Some reforms can bring lower costs, and policy reforms are a good moment to consider ways to reduce management costs. There is some evidence to suggest that *"Those OECD countries employing predominantly output controls have significantly lower total costs per tonne of production than the rest of the OECD countries. They also mostly have lower management and enforcement costs per tonne of production.*" (*The Cost of Managing Fisheries* OECD 2003).

50. As management becomes more holistic, data and information requirements become increasingly complex and costly. Achieving higher levels of coherence across policy domains affecting the broader use

of oceans and requires high levels of institutional co-operation.[8] This co-operation can be time consuming, so finding ways to streamline cooperation will bring additional benefits.

Table 1. Typology of fishery service delivery and payment models

Table I.1. Typology of fishery service delivery and payment models

Model	What type and level of services to provide	Who provides the services	Who pays for the services	Incentives for improved fishery performance	Incentives for increased cost-effectiveness
1	Government	Government	Government	Poor	Poor
2	Government	Government	Industry	Poor	Poor
3	Government	Government contracts services providers	Industry	Poor	Good
4	Government and industry	Government contracts services providers	Industry	Good	Good
5	Government sets standards and industry undertakes decisions	Devolved to industry	Industry	High	High

Source: OECD Secretariat.

Source: The Costs of Managing Fisheries (OECD, 2003)

3.3. Finding new Green Market Opportunities

51. The OECD GGS emphasises that new green market opportunities can be a source of growth as economies transition to a greener growth path. In particular, investing in innovation and taking the "first mover" advantage are two ways to ensure that governments can take advantage of new sources of economic growth.

52. Recreational fishing can in some cases deliver more economic value per quantity harvested than commercial fishing. In 2009, commercial fisheries in the United States induced a turnover of USD 116 billion compared to USD 50 billion for the recreational sector (Box 5). In the same year jobs created or sustained were 1 million full/part time in commercial fishing compared to 327 000 jobs supporting recreational fishing excluding the 11 million recreational anglers taking part in this activity.

8. See for example discussion by Anthony Charles: Integrated Ocean Management and the Fisheries Sector, TAD/FI(2011)4

Box 5. Recreational vs. commercial fishing in the United States

The US seafood industry includes the commercial harvest sector, seafood processors and dealers, seafood wholesalers and distributors, importers, and seafood retailers. In 2009, this industry supported approximately 1 million full- and part-time jobs and generated USD 116 billion in sales impacts, USD 32 billion in income impacts, and $48 billion in value added impacts.

Seafood retailers generated the highest job and income impacts, contributing 484 000 jobs and USD 10 billion in 2009. In contrast, the largest sales (USD 49 billion) and value added impacts (USD 15 billion) came from the importer sector. The seafood wholesalers and distributors sector contributed the least to the national seafood industry impacts with 47 000 employees, USD 6.5 billion in sales impacts, USD 2.1 billion in income impacts, and USD 3.1 billion in value added impacts.

In 2009, there were approximately 11 million recreational anglers across the United States who took 74 million saltwater fishing trips around the country. These anglers spent USD 4.5 billion on fishing trips and USD 15 billion on durable fishing-related equipment. These expenditures contributed USD 50 billion in sales impacts to the US economy, generated USD 23 billion in value added impacts, and supported over 327 000 job impacts.

Durable equipment impacts contributed the most to these totals, accounting for 74% of employment impacts, 79% of total sales impacts, and 77% of value added impacts. Of the three fishing trip modes, shore-based fishing trips contributed the most to the number of jobs supported by recreational angling with 11% of employment impacts. For-hire sales (USD 1.9 billion) and value added impacts (USD 1 billion) were approximately half the magnitude of impacts generated by either private boat (USD 4.2 billion, USD 2.2 billion) or shore-based trips (USD 4.3 billion, USD 2.2 billion).

Source: Fisheries Economics of the United States, 2009.

53. Policy tools to manage different economic activities sharing a common resource will in principle include use of auctions and other means of making use of the resource transferable between activities. In practice, most countries use command and control methods to delineate the activities of commercial vs. recreational fishers and others. This may include specific licensing arrangement for recreational fisheries, prohibition on selling the fish (thus avoiding market interaction and the potential under-pricing of commercial fish), limitations on gear and seasons. The reason for this may have to do with the transactions costs or other limitations that make exchange of use rights difficult. A green growth strategy would look for solutions to reduce or abolish these limitations in order to maximise the benefits derived from the resource.

54. Commercial and recreational fisheries often exploit the same fish stock and can be in competition with each other. Both activities generate economic value albeit in different ways. To ensure that the fish stock is exploited in the best way possible, the fishery manager must (i) set the optimal joint total allowable catch (TAC) for both fisheries and (ii) allocate this TAC optimally to both sectors. As highlighted in the paper by Arnason (2012), "*commercial fisheries are operated primarily for profits and recreational fisheries primarily for enjoyment. There are important similarities, however. Both extract from the fish stocks and thus have a comparable impact on the evolution of fish stocks. In particular, recreational fisheries will, just as commercial fisheries, reduce the size of fish stocks although the details of the impact may be different. Moreover, recreational fisheries are no less than commercial fisheries subject to the ill-effects of lacking property rights and, consequently, excessive effort and overexploitation"*. Arnason concludes that the economic importance of the recreational fisheries sector should be taken into account in allocations and that those allocations would be most efficiently achieved through a market based solution such as a tradable rights system.

3.4 Innovation and improved technologies

55. The report *Towards Green Growth* (OECD, 2011) suggests that *"The core of transforming an economy is innovation. Innovation and the resulting creative destruction mean new ideas, new entrepreneurs and new business models. It contributes to the establishment of new markets, leads to the creation of new jobs and is a key ingredient of any effort to improve people's quality of life."* Also, innovation is fundamental to addressing environmental issues (Box 6). Achieving green growth in practice means increasing economic output while maintaining or reducing demand on environmental inputs. When fisheries management and governance systems are doing their job well, the only way to obtain continued growth is through innovations that add value, create new markets, or lower costs. In fisheries, for example, trawl door design that do not rip up the sea floor is a major advance in leaving the sea floor ecosystem undisturbed and can produce wider social benefits.

56. New techniques and innovations can spur growth through improving quality and catch quantity, by reducing costs of harvesting or by creating increased private and social benefits. Some innovations will be entirely in the private domain and be spurred by the search for additional profits. Other innovations are driven by the public sector advances in technology, costs reductions (e.g. surveillance) and enforcement and through investments by the public sector.

Box 6. Innovation for Green Growth

Innovation will be an important driver of the transition towards green growth. Without innovation, it will be very difficult and very costly to achieve a transformation to a greener economy. By pushing the frontier outward, innovation can help to decouple growth from natural capital depletion. Innovation and the related process of creative destruction will also lead to new ideas, new entrepreneurs and new business models, thus contributing to the establishment of new markets and eventually to the creation of new jobs. Innovation is therefore the key in enabling green and growth to go hand-in-hand

Source : Fostering Innovation for Green Growth (OECD 2011)

57. The OECD Innovation Strategy identifies five principles that can help governments use innovation (including green innovation) as a tool to improve economic performance, address societal challenges and enhance welfare. The five principles are i) empowering people to innovate; ii) unleashing innovations; iii) creating and applying knowledge; iv) applying innovation to address global and social challenges; and v) improving the governance and measurement of policies for innovation. A green growth strategy in fisheries would find practical approaches to applying these principles to the fisheries sector.

58. While the private sector is the main driver of innovation public policies can support a move towards green innovation. OECD work suggests that in cases where market failures stymie green innovation, public intervention to address those market failures may be warranted (*Fostering Innovation for Green Growth*, OECD 2011). Boosting green innovation requires clear and stable market signals and public investment may be required for basic and long term research, possibly through international cooperation. Finally the work underlines that specific public interventions may be necessary to support private investment in innovation, R&D, support for general purpose technologies, fostering new entrepreneurial firms and through facilitating transition to green technologies in small and medium sized enterprises.

59. In fisheries and aquaculture, innovations have been driven to a large extent by evolving legislative frameworks for the sustainable use of fish and other natural resources. For example, size limits on fish, discards and by-catch rules, requirements for fishing gear will induce net-makers and fishers to

search for new solutions and improved fishing techniques. Another driver has been the search for lowering cost of energy use in fishing and includes hull and gear design and in particular motor technology and the installation of effective fuel meters.

60. Innovations to reduce waste have led to new uses for fish parts in glue, extraction of bioactive peptides (from fish bones and frames, heads), chitin (from shrimp shells), fish sauces, fish skin for leather goods and more. The basic point is that when a market exists or can be created/developed (e.g. fish oil supplements) innovation and products will follow. The introduction of a discard ban in the European Union, starting in 2014, will lead to the landing of fish without a ready consumer market. Alternative uses and markets – e.g. ensilage, fodder – will need to be developed to bring the raw material to good use.

61. An example of innovation in the public domain is the use of remote electronic monitoring through a combination of CCTV (closed circuit television) technologies and electronic log book data (Box 7). This can reduce monitoring costs by eliminating observers while at the same time increasing coverage and effectiveness. Denmark and the United Kingdom have been very active in this field making it easier to monitor and control fishing activities. A so-called "fully documented fishery" entails detailed recordings in logbooks combined with the use of electronic monitoring systems where various sensors and CCTV cameras are recording fishing events and catch handling operations. Sensor recordings and video footage make it possible to retrospectively verify the electronic logbook records.

Box 7. Danish Experiments with Monitoring and Remote Sensing

Catch Quota Management (CQM) including full documentation has been on trial in Danish fisheries in the period 2010 to 2012. By introducing full accountability through catch quotas instead of landing quotas the fisherman's incentive to optimise the value of his catch by discarding less valuable fish would be substituted by his incentive to use selective fishing methods to optimise the value of his total removals from the stocks. The trial aimed at testing whether CQM could provide a reliable accounting for all catches of cod, give better scientific data and encourage fishermen to fish more selectively and reduce accidental catches. The main feature of the trial is that all catches count against the vessel quota and that the fishing vessels are monitored from port to port using sensors and CCTV technology. The Remote Electronic Monitoring (REM) system has collected sensor data and images throughout the trial period and according to the vessel electronic-logbooks the vessels were at sea for app. 80 000 hours, carried out app. 1 114 fishing trips and conducted app. 9,800 fishing operations during the project period.

Source : Yield of Fish accessed via http://www.fvm.dk/Default.aspx?ID=24957

62. The high cost of energy faced by many fishers has driven innovation in energy efficiency. The UK's Seafish is an example of how the public and private sectors can work together to promote innovation. Seafish is funded by a levy on the first sale of seafood landed and imported in the United Kingdom. It aims to support and improve the environmental sustainability, efficiency and cost-effectiveness of the industry, as well as promoting sustainably-sourced seafood. Seafish has worked on the installation of fuel meters on fishing vessels as well as other energy saving devices notably gear and vessel design. This type of research has proven valuable for the UK fishing industry (Box 8).

Box 8. Fuel Flow Meters use in the UK

Fuel flow meters proved useful to skippers in highlighting the change in fuel consumption as a result of altering engine revs. Small reductions in revs resulted in substantial reductions in fuel usage. This information proved very useful in setting the optimum revs of the engine whilst the vessel was steaming to the fishing grounds with a minimal loss to vessel speed. Several of the skippers commented that this information alone would result in the meter paying for itself in less than 6 months.

Source : Seafish "Work currently being undertaken by Seafish to improve fuel efficiency in the fishing fleet".

63. The Nordic Marine Innovation (part of the Nordic Council) has funded a number of marine related innovation programmes and innovation conferences (e.g. http://www.nordicinnovation.org/events/nordic-marine-innovation-conference-2013/). This includes a project related to the removal of pinbones in cod and whitefish, the development of novel bioactive seaweed-based products, marketing, including retail displays of fish and fish products. A particularly interesting project is the establishment of a North Atlantic Marine Cluster which seeks to strengthen relationships, build arenas for communicating research findings and benchmarking in the marine sector.

64. Improving the efficiency of resource use has a central role in green growth planning. In fisheries, there remains significant room for improvement in the use of discards, by-catch, and trimmings, among other things. One part of the OECD green growth strategy is to reform policies that impede progress, such as requirements that fish must be landed headed and gutted, or that fish for which the fisher does not have a quota must be discarded. A sector wide industrial dialogue may be a useful tool to identify where in the value chain improvements can be made.

65. Other elements of the OECD green growth strategy are to identify opportunities for green growth and to put in place a policy set that helps realise these opportunities. For example, recent developments show that by-products can have higher value if used in functional foods (marine fatty acids and bioactive peptides, for example) and in pharmaceuticals[9]. In addition, fish skins can also be used in the leather garments industry.

66. A recent OECD STI report (DSTI/STP/BIO(2012)9/REV1) "*Marine Biotechnology: Enabling Solutions for Ocean Productivity and Sustainability*" considers *inter alia* the potential of marine biotechnologies and the challenges of developing marine bio resources as these are situated in complex marine ecosystems where our knowledge is currently limited. A key conclusion of the report is the need for international co-operation in developing these resources and the building of a monitoring framework – including economic indicators – which will help understand the potential direction of this marine green growth potential.

3.5. Fisheries and Other Marine Activities

67. Fishing is just one of many activities that take place in the marine environment. Aquaculture, coastal tourism, dredging, maritime transport, habitat for people, plants and animals, dumping and waste, agriculture run-off, oil and gas extraction all take place in the same area or in close vicinity to fisheries. The co-existence of these activities adds pressure to the marine environment and may also add competition for space in ports (e.g. berthing space, space for fish processing activities).

9. Bioactive peptides have shown to be good inputs into promoting health as they reduce blood pressure, can address cancer, obesity and diabetes

68. The co-existence of such activities pose a number of challenges related to conflicts over the use of the same inputs (e.g. fish, marine space and ports) and externalities between the activities (e.g. agriculture run-off, coastal encroachment/sewage and fish/aquaculture). To make informed decision about trade-offs between these diverse activities (who should have the right to use the marine space?) would require information about the various activities' value added contribution, job creation and environmental externalities. Alternatively, the establishment of a trading system could help allocate resources among users.

69. The increasing focus on ocean activities in recent years (World Bank, APEC, Yeosu EXPO, UN Ocean Compact) shows that the international community is increasingly concerned about the marine environment. Finding ways to address how the fisheries and aquaculture sectors interact in a broader oceans management concept and identifying accompanying institutions and governance developments are important areas for future work.

3.6. Green Growth Indicators for Fisheries

70. The OECD's green growth indicators set is currently proposing only one green growth indicator for fisheries: the proportion of fish stocks within safe biological limits (global), expressed as the percentage of fish stocks exploited within their level of maximum biological productivity. While this is an important indicator, it does not capture the full range of issues fisheries policy makers will need to monitor as they implement a green growth agenda.

71. Possible additional indicators to monitor developments towards green growth in fisheries could include:

- Quota rents or other measures of economic surplus measured as capitalised value of fishing rights (for harvest or effort).
- Energy use per unit landed or per unit value.
- Value added in the fisheries food chain.
- Biodiversity or other measures of the health of the marine ecosystem.
- Percentage of fishing operations having carried out an environmental or energy audit.
- Percentage of fishing operations having implemented an environmental plan.
- Share of waste material (discards, trimmings, other) recovered for secondary use.

72. A good indicator should be unambiguous - an increase in its numerical value should be either always good or always bad. Total landings are not a good indicator because increases are good if they are done sustainably and bad otherwise. The indicator needs more information to be understood. The same is true for other economic measures like employment, number of vessels, or profits, where understanding whether growth is "green" or not is important. On the other hand, quota rents are a good measure as these ideally represent the net present value of the fishery, and so incorporate sustainability implicitly.

73. Indirect indicators can be useful when direct ones are impractical or ambiguous. For example, measuring the availability or use of energy audits demonstrates increases in environmental awareness on the part of fishers and indirectly measures energy efficiency.

3.8. Concluding remarks regarding capture fisheries

74. The fishing sector has strong potential to deliver green growth. Pathways are available that can optimise investment in fleet capacity, reduce fishing costs and increase the productivity of the sector and the capacity of the resource to deliver benefits to society. Concurrently public expenditure in fisheries administration, surveillance and enforcement can be reduced considerably when public and private incentive structures are aligned and new innovations adopted. In essence, there may be an important untapped potential for private operators, public coffers and the environment.

75. The publication *Fisheries Policy Reform: National Experiences* (OECD, 2011) provided evidence of the high economic returns which can be unleashed through fisheries management reforms. The involvement of stakeholders was seen as particularly important; their co-operation is important for success, but also it is important to understand how policies shape their incentives and behaviour. For a green growth strategy to be successful stakeholders must share a common vision of the future of the fisheries sector and flanking measures may be part and parcel of the fisheries reform agenda.

76. Capture fisheries can involve important externalities as fishers operate in a complex human and biological ecosystem. By-catch, bio-diversity impacts, sea floor effects, congestion and space conflict must be dealt with in a way that improves the efficiency of the sector and brings benefits, even though those benefits may be broadly shared and difficult to measure. The latter may be an important area of future research as it will help inform the political economy of reform.

77. The OECD's Green Growth Strategy sets out a process that can move fisheries towards green growth. Change does not come without cost, and there may be conflict and controversy along the way. But these barriers can be overcome by improved measurement and monitoring of outcomes, putting in place a policy set that brings real improvements for stakeholders and which concurrently addresses compensation strategies for losers, and by keeping a focus on recurrent review and improvement of the management system. In this process the key to acceptance and success relies heavily on stakeholder involvement and dialogue. A shared and agreed vision for the fisheries sector and its role in the economy in exploiting a common natural asset of a country is fundamental for green growth.

78. There is broad international agreement on the need to improve fish stocks. The WSSD Johannesburg 2002 Plan of Implementation called on governments, inter alia, to "maintain or restore stocks to levels that can produce the maximum sustainable yield with the aim of achieving these goals for depleted stocks on an urgent basis and where possible not later than 2015".[10] A more recent call is the Aichi 2011 Strategic Plan for Biodiversity calling for fisheries to be sustainably managed by 2020 (Box 9). The work of the COFI and the FAO Code of Conduct for Responsible Fisheries provide important inventories of practical, evidence based "ways forward" to achieving green growth in fisheries.

Box 9. The Aichi Strategic Goal B Target 6

By 2020 all fish and invertebrate stocks and aquatic plants are managed and harvested sustainably, legally and applying ecosystem based approaches, so that overfishing is avoided, recovery plans and measures are in place for all depleted species, fisheries have no significant adverse impacts on threatened species and vulnerable ecosystems and the impacts of fisheries on stocks, species and ecosystems are within safe ecological limits.

Source : http://www.cbd.int/sp/targets/

10. Paragraph 29 of http://www.johannesburgsummit.org/html/documents/summit_docs/2309_planfinal.htm

79. The tools are known and governments have acknowledged the necessity to address the poor fisheries performance observed in many countries. What is needed is bold action. The fisheries sector has an important economic potential to help public finances directly through improved economic returns by increasing the tax base and indirectly through a more efficient delivery of publically financed fisheries services. Current OECD work on green growth in fisheries including on indicators and measurement tools is designed to help countries by identifying the policies and potential for improvement in energy, waste and governance. The COFI has a long history of work that helps inform countries how to manage and measure their green growth transitions, and will continue to contribute to this in the future.

4. Green Growth in Aquaculture

80. As mentioned above the aquaculture production system is very different from capture fisheries. Capture fisheries take place on a commonly held resource where management intervention is fundamental for the organisation of the sector. The capture sector is characterised with a relatively high degree of policy intervention that dates back for a long period and which gives rise to a policy richness not seen in many other sectors. On the other hand, public intervention in the aquaculture sector is mainly addressing externalities of production. Aquaculture is a private enterprise affair in the domain of private property although taking place in the commons (at least when in the ocean) and is thus like any other food producing industrial sector where public concern is about production externalities. Nevertheless, the aquaculture sector remains the food system with the most important future food potential and central in addressing food security concerns in many countries.

81. Aquaculture production has grown considerably over the past decades. FAO statistics suggest a production increase from 3.5 million tonnes in 1970 to close to 79 million tonnes in 2010 (Table 2). The OECD/FAO Agriculture Outlook (2013) expects world fisheries production to expand to a total of 181 million tonnes by 2022 (which includes 15,6 million tonnes of fish for reduction to meal and oil) of which 85 million tonnes will come from aquaculture - projections which seem to be rather conservative compared to the increases that have taken place over the past two decades. Of the total aquaculture production of 78,9 million tonnes in 2010, 72,2 million tonnes, corresponding to 91.5%, was produced in Asia, predominantly by developing economies in the region.

Table 2. Aquaculture volume and value, 1970-2010

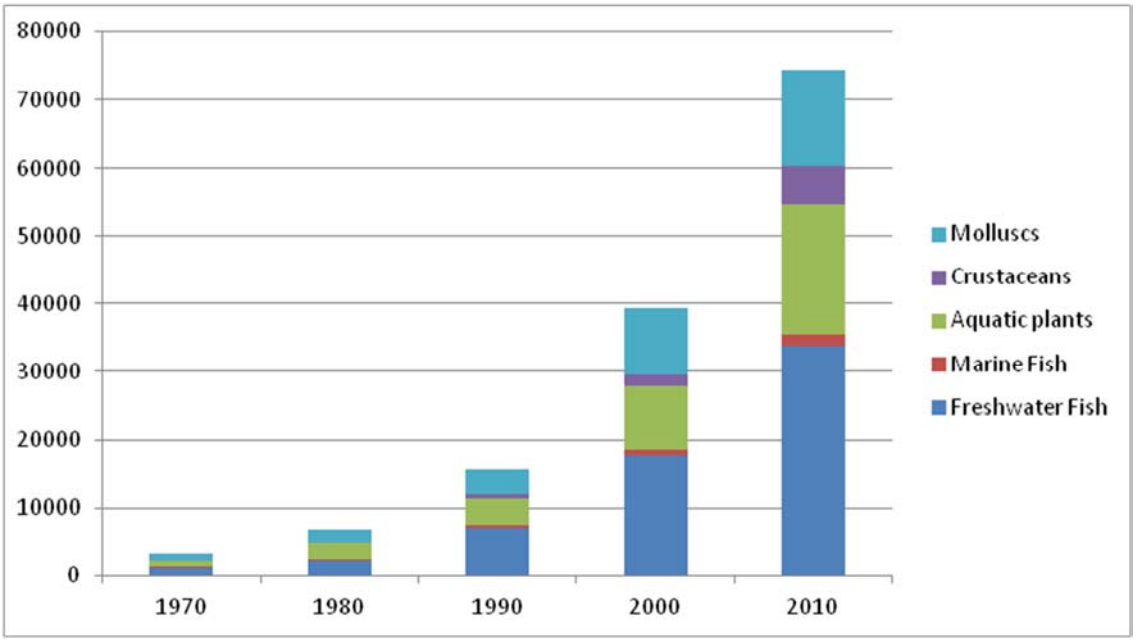
volume thousand tonnes, value USD millions

	1970	**1980**	**1990**		**2000**		**2010**	
	Volume	*Volume*	*Volume*	*Value*	*Volume*	*Value*	*Volume*	*Value*
Brackish water	185	368	1 305	5 271	2 124	9 001	5 222	15 440
Freshwater	1 270	2 343	7 631	11 951	18 477	22 111	37 017	69 409
Marine water	2 071	4 636	7 903	9 450	21 124	19 962	36 705	40 374
Total	**3 526**	**7 347**	**16 840**	**26 272**	**41 724**	**51 073**	**78 943**	**125 224**
of which…								
Freshwater Fish	1 168	2 092	7 140		17 585		33 742	
Marine Fish	51	187	318		977		1 834	
Aquatic plants	959	2 641	3 765		9 306		19 007	
Crustaceans	10	87	755		1 691		5 725	
Mollusks	1 068	1 837	3 609		9 757		14 158	

Source: FAO

82. Over the past four decades the largest production increases have come from freshwater fish, seaweeds, crustaceans and molluscs. Production of marine fish (most of which are carnivorous) has grown more slowly, and now makes up a relatively small portion of the total (Figure 3). The slower increase in the production of carnivorous species is likely due to the costs of feed and feed compounds which have increased markedly due to scare resource base (fish meal and oil). A key future challenge in this regard is innovations that allow substituting fish meal and oil with terrestrially-produced substitutes. Another factor for the relatively modest production growth for carnivorous species is the relatively high level of externalities in production and the resulting administrative limitations to growth.

Figure 3. Aquaculture production by type



Source: FAO

4.1 Green Growth Strategies for Aquaculture

83. A green growth strategy for aquaculture would seek to continue the expansion of the sector while reducing its negative impacts and demand on natural resources. Externalities from aquaculture include discharges (nitrogen and phosphorous in particular), diseases, demand for wild feed stocks, escapees and local environmental degradation. Aquaculture externalities are a function of:

- The species being grown (e.g. seaweed is mostly about competition for space; mussels have positive externalities as they consume excess marine nutrients; carnivorous species such as salmon or shrimps give rise to nitrogen discharges);
- The method used by the fish farmer (i.e. intensive vs. extensive, cage, recirculation, ponds or open marine farming) with lowest discharges coming from land based recirculation systems albeit such systems are relative energy intensive;
- The degree of human intervention for example in terms of disease fighting using medicines and the amount of feed being used.

84. Aquaculture policies should be tailored to address externalities specific to the species being produced and the production system i.e. the external impacts of carnivorous fish production in recirculated production system (see Table 3) can be more easily contained than in open marine cage culture.

85. The best response to these externalities depends on the direction of the externalities caused by aquaculture production:

- when the externality impact the farmer himself (e.g. local water pollution harming productivity) it is self-interests that drives the response;
- when impacting other fish farms (e.g. disease outbreaks) in which case an industry association combined with public regulation might be able to address the problem; and
- when impacting other sectors of the economy (e.g. aesthetic conflicts with tourism) in which case public regulation may be necessary.

86. The types of externalities most prevalent vary by cultured species (Table 3). A particular case is carnivorous species in both fresh and marine waters which are very nutrient-intensive. However, the culture method (e.g. land based tanks vs. sea based cages) will determine the nature and intensity of the externalities.

Table 3. Typology and strength of externality

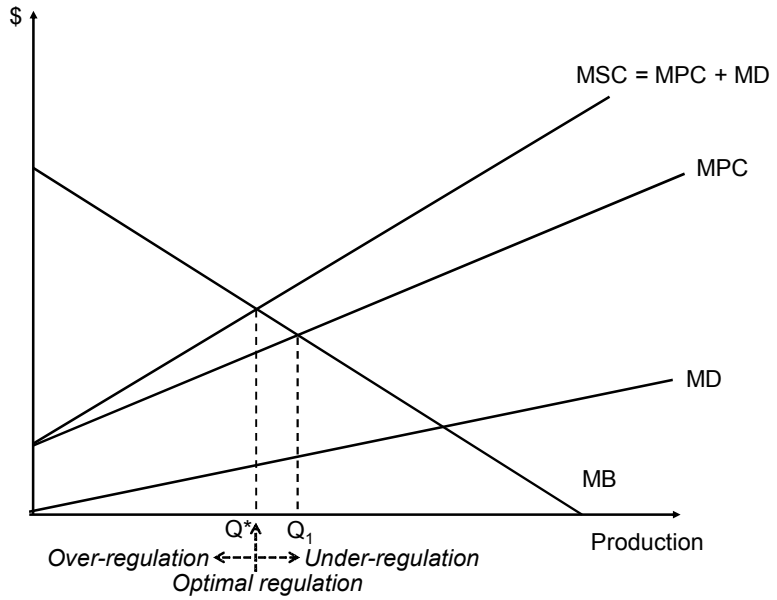
	Discharges	Feed resources	Diseases	Escapees	Collecting harvesting	Space	Aesthetics
Policy control variable	Feed, feed conversion	Feed	Density, medicines	Storm, accidents	Bottom, sediment changes	Space allocation	
Freshwater/brackish fish Carnivorous	++	+	+	O	+	+	+
Freshwater/brackish fish Herbivorous	O	+	+	O	+	+	+
Carnivorous Marine fish	++	++	+	++	++	+	+
Crustaceans	+	+	+	O		+	
Mollusks	O	O	+	O		++	
Seaweed. There are several species and ways to culture seaweed including (most common) in open sea, ponds.	O	O	O		+	++	

Source: OECD Legend: ++ strong; + medium; 0 none

87. The challenge for public regulators is to find the right level of intervention (Box 10). The industry itself has an interest in addressing externalities as the negative effects may reduce profitability and demand in the long run (Asche, 2011 *Green Growth in Fisheries and Aquaculture* [TAD/FI(2011)6]) . Certification schemes like the Global Aquaculture Alliance's "Best Aquaculture Practices Standards" or

the Aquaculture Stewardship Council's certification program can help aquaculture producers adopt best practices and market their product on the basis that they are sustainably produced. Certification schemes can influence consumer concerns about aquaculture and thus help improve the image of the sector.

Box 10. Optimal Regulation in Aquaculture



The relationship between the marginal private costs (MPC), the cost of producing an additional unit, and the level of production is shown in the figure. Marginal benefit (MB) is achieved from each additional unit produced. Marginal damage (MD) is damage done by pollution coming from production of each extra unit. The slope of the MD curve is positive indicating that each additional unit of pollution does more damage than the preceding.. The marginal social cost (MSC) is the vertical summation of MPC and MD. Hence, MSC represents the total cost to society of the existence of production, including production costs and cost of damage from production done to other parties in society.

Given an unregulated market, the optimal production level and the corresponding optimal pollution level would be at Q_1, since this is where marginal benefits equal marginal production costs. However, in a situation where pollution is regulated, damage done to the environment is taken into account in identifying the optimal production level. In this case the optimal level of production (Q^*) is where the marginal social costs equal marginal benefits.. Regulations that allow production above Q*, are too loose, allowing marginal social costs to exceed benefit. Regulations that lead to production below Q*, are tighter than necessary, implying that marginal benefit exceed social costs.

Source : Nielsen (2012)

88. The challenge for policy makers is to ensure that the economic contribution of the sector can continue to grow while minimising its negative environmental impacts. Regulations have many roles to play in meeting this challenge. They should stimulate investment, foster economic growth, reduce systemic risk, lead to environmental improvements as well as health and overall quality of life. The paper *Aquaculture and Green Growth* [TAD/FI(2012)11/REV2] discusses how to move the sector towards a green growth path and provides examples of successful cases of green growth.

4.2. Indicators for Green Growth in Aquaculture

89. A number of indicators to capture both green and growth in aquaculture are needed:

- Number and size (production capacity) of farms
- Local water quality
- Riparian habitat quality
- Species produced
- Employment
- Turnover/tax base
- Feed use as a proxy for NOx and COx
- Number of fish escaped—risks to wild species
- Medicine use

The use of aquaculture logbooks, as is the case in Norway, can help ensure that all the data and information needed is collected and recorded.

4.3. Aquaculture Innovation

90. Several new species have come into aquaculture production over recent years (e.g. *pangasius*) and scientists are working on bringing the life cycle of other species under control. The principal challenge is feeding at the early stages of larvae after hatching. In addition from one species to the other only little of the knowledge and techniques are transferable. In other words bringing a new species under human control requires major laboratory efforts and starting fresh for each species. Species such as trout and salmon are mature in production, while some species with great potential such as the Bluefin tuna and the eel have not yet seen full control of the reproduction circle.

91. The *pangasius* story is one of remarkable success. Production in Vietnam has grown from around 100 000 tonnes in 2000 to more than 1,4 million tonnes in 2008, but such rapid growth has led to environmental and social concerns. Another fast growing production has been shrimps, facilitated by the development of pathogen-free and pathogen-resistant species. A ready consumer market, logistics and processing capabilities are of course central to these developments.

92. The reduction in the use of fishmeal and in particular fish oil from feed compounds for carnivorous species remains a particular concern. Sustainable growth of aquaculture production requires sources of feed that can also grow, and many wild species currently used are unlikely to be able to support increased harvest levels. Research into using various new sources of raw material as feed for fish farming is seen as a solution. These include the use of algae and mussels (Nordic Innovation initiative) in trout and

tilapia farming and changing feed compounds for turbot aquaculture. Such substitution of novel feed sources can also provide significant costs savings (see for example the EU-financed MAXIMUS project[11]).

93. Alternative systems of aquaculture production are being developed with a view to reducing environmental load. Recirculating systems and integrated multi-trophic aquaculture productions systems are among the ways proposed to capturing the nutrients that would otherwise be discharged to the environmental (see Box 11).

Box 11. Canadian Aquaculture Innovation and Market Access Programme (2008-2013)

The overall goal of the Aquaculture Innovation and Market Access Program (AIMAP) was to catalyze aquaculture industry investment from the private sector, as well as other sectors, that would:

- Improve the competitiveness of the Canadian aquaculture industry by encouraging an aquaculture sector that continuously develops and adopts innovative technologies and management techniques to enhance its global competitiveness and environmental performance; and

- Position Canadian aquaculture products as having high value in the market place based on their environmental performance, traceability and other considerations.

These goals contributed to the DFO strategic outcomes of sustainable fisheries and aquaculture and healthy and productive aquatic ecosystems. Contribution funding under AIMAP was intended to enable recipients to plan, manage and complete projects that would achieve these strategic outcomes. The AIMAP was a nationally competitive process with calls for proposals issued on an annual basis, and based on priorities established in consultation with provinces, territories and sector stakeholders. The program focused on one year duration projects with demonstrable industry-wide benefits implemented by the end of the project.

Under this program a maximum of $4.5 million in DFO contribution funds was available annually to support innovation initiatives, and up to $0.2 million in DFO contribution funds was to support market access initiatives.

Source : http://www.dfo-mpo.gc.ca/aquaculture/sustainable-durable/index-eng.htm)

4.4. Concluding remarks about green growth in aquaculture

94. As highlighted above and as shown in the case studies presented at the December 2012 *Korean Yeosu Workshop on Aquaculture and Green Growth*, aquaculture has a strong potential to deliver green growth. Many countries are now looking at regulatory reforms to help deliver on this promise. New technologies can reduce the environmental impact of production. Market based instruments have been successfully introduced in some jurisdictions (e.g. replacing allowable feed quotas with tradable N emission permits). New innovations will continue to emerge, and the cost of alternative production methods will continue to decline as technologies mature. A change in focus from regulating inputs like feed quantities or production systems to outputs like emissions and effluents will promote innovation. A move towards aquaculture systems and species less dependent on feed and other inputs can also contribute towards green growth and in this regard integrated multi-trophic systems is a promising avenue.

95. Aquaculture can provide beneficial jobs in rural areas with better growth potential than capture fisheries. The challenge for policy is to realise the potential of the sector while addressing the concerns that are a normal part of a new and rapidly growing industry. The framework described in the OECD Green

11. See http://www.akvaplan.niva.no/en/resource_centre/news_detail/maximus_a_new_european_funded_r4smes_project

Growth Strategy can help by pointing out how to put in place innovation-friendly governance, including market-based approaches that let the private sector take the lead in addressing environmental externalities.

Box 12. Strategic Guidelines for the Sustainable Development of EU Aquaculture

In April 2013 the EU provided strategic guidelines for the sustainable development of the EU aquaculture sector. The guidelines contains proposals for:

- Simplifying administrative procedures for aquaculture
- Coordinated spatial planning of aquaculture
- Enhancing competitiveness of aquaculture producers
- Promote a level playing field for EU operators
- The development of multi-annual strategic plans for the promotion of sustainable aquaculture
- European Maritime and Fisheries Fund eligibility
- Exchange of Best Practices
- Creation of Aquaculture Advisory Councils

Source : European Commission (COM(2013)229final)

5. Fisheries and Aquaculture Interactions

96. The capture fisheries and aquaculture sectors intersect in a number of important ways. Fishmeal and oil from capture fisheries are used in feed compounds; marine space is needed by both activities and their products compete in the marketplace. The line between wild and cultured stocks is sometimes blurred by the use of restocking from hatcheries or the ranching of wild species.

97. Policy helps determine the relationship between capture fisheries and aquaculture, and policy-makers face difficult choices. Should the available space be used for capture fishing or aquaculture? Should the fish be used as food fish or in feed compounds for aquaculture? And are capture fish more or less "green" or environmentally responsible than their farmed cousins?

98. Policy makers must gauge the extent of the interaction between fisheries and aquaculture in order to ensure coherence between the two. An urgent challenge is to understand the effects on capture fisheries of increased production and competition from aquaculture. Biological and management limits on capture fisheries makes competition from aquaculture products challenging. As aquaculture production continues to grow, additional pressure will be put on the fisheries market. This will make ensuring that capture fisheries are competitive and economically sound even more crucial over time, demonstrating the importance of a green growth strategy.

5.1 Feed market interactions

99. Most carnivorous fish need some amount of fishmeal and oil rich in Omega 3 in their diets. The global production of fishmeal and fish oil has stabilised around 6 to 7 million tonnes of fishmeal and

1 million tonnes of fish oil per year. In 2010, 73% of fishmeal and 71% of fish oil was used by aquaculture.

100. The cost and availability of fishmeal and oils is a challenge to future aquaculture growth. According to the International Fishmeal and Fish Oil Organisation[12] (IFFO) replacement of fishmeal and oil is an on-going issue mainly driven by the cost of fishmeal and oil as an ingredient in the feed compounds.

101. The share of fishmeal in the overall feed mix has declined as meal from terrestrial production sources (mainly soybean meal) are introduced. Fish oil continues to be a key ingredient in aquaculture feed due to its Omega 3 content. Fish oil is also used in the high-value human supplements market. IFFO believes that aquaculture can continue to reduce its use of fish oil but only within certain technical limits. Oil produced from marine algae and genetically-modified grains will eventually come to the market, replacing some of the fish oil presently sourced from capture fisheries and trimmings. Fish with high Omega-3 content may ultimately become a premium product to those fed with feed not containing this nutrient.

102. Wild caught fish used for fish meal need to be sustainably managed. Most fish used for fish meal and oil do not have ready alternative markets (i.e. human consumption). A green growth strategy will ensure that demand for aquaculture feeds do not undermine the management of the "industrial" fish used to produce them. This includes ensuring that the ecological role of these species as prey fish is maintained and that the fishery is based on eco-system management approaches. The indirect value of these fish as prey for valuable wild carnivorous species can exceed their direct value as feed inputs.

103. Certification schemes may be a useful tool for sustainable resource use. IFFO has developed a "Global Standard for Responsible Supply" (GSRS) based on the FAO Code of Conduct for Responsible Fisheries. Certification to GSRS takes place as a third party independent certification schemes requiring among other a solid management system and procedures and the use of the precautionary approach to manage stocks.

104. Thus, within a green growth strategy the link between capture fisheries and aquaculture can be addressed in two ways. First, promoting innovations to reduce the use of fish meal and oil in feed compounds for carnivorous farmed species, and second by ensuring, through certification and other means that the fish stocks used for fish meal and oil products are sustainably managed. Promoting consumer acceptance of non-carnivorous species can weaken the link between capture and aquaculture and could be further supported through information campaigns. Species like catfish, carps and *pangasius* require little or no use of fishmeal and oil. Currently, however, in most OECD markets farmed species like salmon, turbot, sea bass and bream have higher consumer appeal.

5.2 Use of space (marine space used for both activities)

105. Competition for marine space increases with the number and extent of economic activities that depends on it. Beyond capture fisheries and aquaculture, tourism, maritime transport, extraction of minerals and hydrocarbons, production of electricity through windmills and tidal wave systems, naval activity, dumping and disposal of waste from production on land all use marine space. In addition to space conflicts these activities will also compete for scarce resources in harbours and other infrastructure.

106. Ideally, allocation of access or user rights to marine space would be based on the added value to society of the activity. How to do this effectively is the challenge for the policy maker intent on

12. Presentation given at the Yeosu, Korea "Aquaculture and Green Growth workshop", December 2012.

implementing a green growth strategy. Traditional regulation is one approach, but designing and developing institutions in such a way that different users can negotiate and compete directly will also be important (i.e. market based approaches). This reduces the burden on the regulator to measure and evaluate the relative benefits of different uses, thereby reducing costs while increasing efficiency in allocation.

107. Policy approaches such as integrated ocean management have a number of ingredients (notably multi-sectoral management and ecosystem-based management) and component tools (such as marine spatial planning), and particularly the links of integrated ocean management (IOM) to fisheries management (Charles, 2011). Charles underscores the need to deal with issues of boundaries, scope and scale, the range of instruments and institutions for IOM, including ocean zoning, rights-based approaches, and governance institutions and the role of economics in design and implementation of integrated ocean management.

5.3 Competition in markets

108. Fish from aquaculture and from capture fisheries ultimately ends up in a common market for fish and fish products. While capture fish may carry a premium (rarity, size and consumer preference for wild caught fish) farmed fish has several other advantages including standardised size, year-round availability and a known production environment.

109. From a green growth perspective one question is the extent to which the two production modes have been supported by government financial transfers (GFTs) and how this affects supplies. In the case of capture fisheries GFTs to production is unlikely to change output when the fishery is effectively controlled (vertical supply curve). In aquaculture the use of GFT can lead to a positive supply response depending on the way the GFT is provided.

110. Policy measures taken in support of aquaculture should take account of the potential impacts on the capture fisheries sector. In addition, increasing support for aquaculture products can lead to trade disputes under present tariff schedules as the schedules do not distinguish between products from aquaculture vs. capture fisheries. As mentioned above, increasing competition from aquaculture will affect the capture fisheries sector.

5.4 Fisheries Enhancement

111. Rivers, lakes and in certain cases marine waters can be repopulated with juveniles produced in hatcheries. This can help rebuild fish stocks under pressure from human activities and compensate for lost fishing possibilities for commercial or recreational fishing interests[13]. However, the effectiveness of fisheries enhancement on rebuilding fish stocks is questionable. In "*Rebuilding Fisheries: The Way Forward*" (OECD, 2012) it is reported that:

> "*Rebuilding fisheries through aquaculture-based techniques has been used with mixed results. Stocking may not be a solution for all fisheries, but could contribute to the rebuilding of coastal or sedentary species.*
>
> *According to Bell et al. (2008) there are three types of enhancement related to fisheries:*
>
> *Restocking refers to the release of cultured juvenile fish into the wild in order to restore a severely depleted spawning biomass to a level where it can once again provide regular, substantial yields.*

13. See http://www.stockenhancement.org/about/history.html for a historic account of stock enhancement.

This could also extend to the re-establishment of a species where it is locally extinct to rebuild a fishery or for conservations purposes (i.e. conservation hatcheries).

Stock enhancement refers to the release of cultured juveniles into the wild to augment the natural supply of juveniles and optimise harvests by overcoming recruitment limitations.

Sea ranching refers to the release of cultured juveniles into unenclosed marine and estuarine environments for harvest at a larger size in "put, grow, and take" operations. Note that the released animals are not expected to contribute to spawning biomass, although this can occur when harvest size exceeds size at first maturity or when not all the released animals are harvested".

112. Two case studies (rebuilding plan for Chum salmon in Hokkaido, Japan, and a Korean case study) illustrate that stock enhancement can be implemented as part of a broader suite of measures in rebuilding plans (*Rebuilding Fisheries: The way forward,* OECD 2012*)*. Several other countries are using stock enhancement through the release of juveniles of both freshwater and marine species most notably countries in the Baltic (salmon), the Netherlands (flatfish).

113. While the effectiveness of the practice is debatable it may in certain circumstances be the only means to replenish a water body with fish or other aquatic animals. The initial cause of reducing the original stock must however be addressed, whether it is overfishing, dam building, pollution etc. so that the replenished stock does not meet the same fate. Restocking can lead to weaker genetic material (a problem known in particular for salmon the genetic of which is decided by each river in which the salmon was born).

5.5 "Fattening" of wild caught fish

114. A particular aquaculture activity is the catch of juveniles for fattening in pens. Especially for Bluefin tuna this has become an important practice. In essence fish farmers appropriate a wild resource and grow them to marketable size. The practice allows the fish farmer to add value to a wild harvest by converting lower value feed fish into larger-bodied high value carnivorous fish.

115. The most serious potential problem of this practice is when the catch quota of juveniles is measured in quantity (tonnes) but at the juvenile stage a much larger number of individuals will be taken compared to the number of fish the quota (of mature fish) would otherwise indicate. A proper accounting mechanism should be in place for the fish mortality to be corrected for this effect. One way forward may be to impose specific fees or levies based on the number of fish caught and subsequently transferred for fattening

116. The fattening process will involve some level of catch of fish for feed or the use of feed compounds both of which will have effects on wild stocks. The fattening process can also concentrate the pollution (effluents) to the area of fattening leading to local environmental degradation.

5.6. Going for Green Growth

117. Aquaculture is expected to be the main source of growth in supply of fish products in the future. The growing role of aquaculture does not need to come at the expense of capture fisheries, but nevertheless it foreshadows a changing world to which capture fisheries and fisheries managers will need to respond.

118. Green growth reforms can help ensure that capture fisheries are competitive now and in the future. Markets are increasingly global and aquaculture will be a growing and effective competitor for an

increasing number of species. Other users of marine resources will also increase their productivity and scale of operations and become more competitive users of marine inputs. Meeting the competitiveness challenge requires a focus on economic efficiency. For policy makers intent on securing the future of capture fisheries alternative regulatory frameworks that allow capture fishers to operate in the best, most productive way needs to be implemented to be able to compete with aquaculture produce.

119. In both fisheries and aquaculture many innovative approaches have helped underpin growth. Innovation will continue to be a strong driver of growth and new technologies have the potential to address the conflicts and limitations arising from the interactions between capture fisheries and aquaculture. There is role for public intervention to promote innovation, both through government research and promotion of private research and development.

120. The green growth concept has underscored that a "continue as you go" policy in capture fisheries management inevitably, in many cases, will lead to low fisher incomes, excessive costs and lost revenue for national government coffers. In times with increasing focus on government expenditure the fisheries policy makers can make a major contribution by spearheading fisheries reform. Green growth reform in capture fisheries will improve the environment, contribute to a better fisheries economy and increase the tax base bringing fisheries back from a potentially marginalised position. Such a win-win-win approach may meet resistance among certain groups and bringing all concerned stakeholders along is a prerequisite for successful reform. Policy packages underpinning reform which addressees concerns by those groups that stand to lose will be necessary including effective flanking measures. But overall society stands to gain.

ANNEX 1: DIFFERENT TYPES OF MANAGEMENT SYSTEMS

Type of management	Potential contribution to green growth	Data challenges	Political/practical challenges/obstacles
Eco-system	Highest contribution as the economic contribution of all ocean based activities will be maximised.	Very few countries have sufficient data covering all economic ocean activities	Challenging to implement and requires fundamental change in existing governance structure towards an ocean based view. Requires co-ordination among many stakeholders and agencies
Bio-diversity	Ensure a diverse existence of genes, eco-systems and biota.		May be a legal requirement and hence a limitation on what management objectives can achieve. For example, under the Aichi targets, all signatories to the UN Convention on Biodiversity, are supposed to draw up national biodiversity plans. Together, their voluntary actions are supposed to halt over-fishing, control invasive species, reduce pollution minimise the pressure on coral reefs from ocean acidification, and halt the loss of genetic diversity in agricultural ecosystems
Food web	This may be considered as a sub element to bio-diversity but only focusing on commercially important species. Optimise the value of all commercial species from the sea eventually by reducing commercial non-important species with ones with higher value for humans		An active management of food clusters in the sea may prove ethically difficult, risky and unpredictable.
Multispecies	Optimise stocks and efficiencies across stocks and fleet segments	Multispecies models challenging and need further information on predator prey relationships.	Tradeoffs between different fishing fleet segments may be necessary and can highlight stakeholder group preferences
Single species	Reduce fishing pressure, rebuild stocks and eliminate over capacity (vessels, gear and people) to maximise economic efficiency	Most countries have solid stock information and many have economic data.	Have proven difficult due to political economy consideration but over the past decade many countries have taken this route.

ANNEX 2: TYPOLOGY OF MANAGEMENT INSTRUMENTS

Regulatory aim	Control method	Control variable	
		Fishing Effort (input control)	Catch (output control)
Maintaining productive and reproductive capacity of stocks	Regulatory (Administrative technical measures)	- mesh size - size/amount of gear - area/time closures	- size and sex selectivity - TAC
Regulating access (incentive-based access control)	Regulatory (Administrative access controls)	- Limited[a] non-transferable[c] permits/licences (LL) - Individual non-transferable effort quotas (IE) - Territorial Use Rights in Fisheries (TURF) - Other types of effort limits	- Individual[b] non-transferable[c] quotas (IQ) - Community-based catch quotas (CQ) - Other types of catch limits (maximum landings or vessel catch limits - VC))
	Economic market-based (economic access control or "rights-based method"	- Transferable[c] licences[a] (LTL) - Individual transferable effort quotas (ITE)	Individual[b] transferable[c] quotas (ITQ)
	Economic not market-based (monetary transfer)	- Input[d] tax - Subsidy - Charges	- Landing tax - Subsidy - Charges

[a] System restricting the number of vessels authorised to fish, their individual fishing capacity and fishing time.

[b] Individual quota = fraction of a TAC (Total Allowable Catch) allocated to a vessel or fishing firm.

[c] Transferable = tradable on a market.

[d] Components of fishing effort (intermediate consumption, fixed capital, labour).

Source: OECD Secretariat and Boncoeur and Troadec, 2003

ANNEX 3 SUMMARY OF THE USE OF MARKET LIKE INSTRUMENTS IN OECD COUNTRIES

	LL	IE	TURF	LTL	ITE	CQ	VC	IQ	ITQ
Australia	(X)	(X)			(X)				X
Belgium	(X)	(X)						(X)	
Canada	(X)	(X)				X	X	X	X
Denmark				X			X	X	X
Finland			(X)						
France	X	X			(LT)		X	(X)	
Germany							X	X	(ST)
Greece	X								
Iceland	X								X
Ireland							(X)		
Italy	(X)		X					X	
Japan	X		X			X			
Korea			X			X			
Mexico				(X)					
Netherlands	(X)	(X)		(X)					X
New Zealand									X
Norway				X			X	X	
Poland									(X)
Portugal						X		X	
Spain	X		X		X			X	
Sweden			X		(X)				
Turkey									
UK	(X)	(X)		X			X	X	(ST)
USA	(X)	(X)	(X)		(X)	(X)	(X)	(X)	(X)

NB: The table describes the use of market-like instruments in OECD Member Countries, notwithstanding the extent to which a given instrument is used in a given country. As a result, no interpretation regarding the coverage or the effectiveness of the management system in a given country can be directly derived from this table.
(X): system exists but not documented in the Study
(ST): some degrees of short term transferability exist, whether formally or informally
(LT): some degrees of long term transferability exist, whether formally or informally

Source: Page 63 Using Market Mechanisms to Manage Fisheries

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GREEN GROWTH AND AQUACULTURE

23-25 October 2013

This document is presented to the 112th Session of the Committee for Fisheries under item 3 ii) of the draft Agenda and is distributed for DISCUSSION and APPROVAL.

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NOTE BY THE SECRETARIAT

At its 111th Session in April 2013, the COFI discussed the "Green Growth and Aquaculture: Progress Report" [TAD/FI(2012)11/REV1] and asked the Secretariat to present a revised report to the 112th Session. This report has benefited from valuable comments and submissions from many delegates at the 110th and 111th COFI sessions, and intersessionally, as well as the wide body of case studies and discussions at "Green Growth and Aquaculture Workshop" (these documents has been distributed as TAD/FI/RD(2013)1 and TAD/FI(2012)11/ADD1, jointly organised by the Government of the Republic of Korea and OECD COFI, held on 12-13 December 2012, in Yeosu, Korea.

Following extensive review of the available literature and analysis of additional case studies, this document is submitted for DISCUSSION and APPROVAL at the COFI's 112th Session.

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EXECUTIVE SUMMARY

1. Two decades ago, Viet Nam had only traditional aquaculture for local consumption. Today, Viet Nam is the largest exporter of aquaculture products, reaching customers all over the globe. Growth in aquaculture has been nothing short of remarkable over the past two decades, transforming from a niche and experimental form of production to market dominance.

2. But what is the future of aquaculture? Many question whether this torrid rate of growth can be sustained. But future growth will not be limited by demand for aquaculture products, or by competition from capture fisheries (whose prospects are more limited), but rather from hitting local environmental, spatial or legal limits. Already, growth in salmon production in Norway, a leading producer, has slowed as new sites for aquaculture operations become more difficult to find.

3. Overcoming these limits to growth will require innovative policy solutions. Future aquaculture will produce more fish in smaller spaces, use less wild feedstock, emit fewer pollutants, and mix better with other coastal activities. Achieving this future is about more than just technologies, though new innovations are critical to success. This vision will come about only when policy makers work proactively to address problems and put together the networks, both public and private, that are required to identify new solutions that satisfy everyone.

4. In OECD countries, growth in aquaculture has slowed considerably from initial levels, and now most growth comes from developing countries. Current slow growth in OECD countries is not simply a question of competitiveness – the regulatory landscape is arguably a more important factor. Governments can spur new growth in the sector by addressing the limitations of current approaches to unleash the potential of the sector. National development plans, institutional innovation, certification, and spatial planning have all been identified as ways to improve the prospects of aquaculture.

5. This diverse industry uses a wide range of production systems, raising many different kinds of species in different environments. Such varied experiences defy "one fits all" policy solutions. However, there are several policy principles to follow to maximise the benefits of aquaculture for everyone.

6. Evidence suggests that countries that have promoted and introduced green growth policy measures are also the countries that are best positioned to succeed in the marketplace. Greening the sector leads to lower production costs as energy costs (tied up in feed compounds in particular) tends to be better managed, costs associated with disease outbreaks, waste and escapees are reduced, and innovations lead to better management of production costs. In essence, when risks associated with aquaculture are addressed early on and when innovation is embraced, costs of production tend to be lower. For example, aquaculture in Norway is both highly regulated and tremendously successful. Norwegian production is the lowest cost in the world, and Norwegian producers have the largest share of the market for farmed salmon.

7. Multi-sectoral green growth policies present an opportunity for externalities from other sectors with potential cost implications on aquaculture to be addressed. This can help make the aquaculture sector more competitive.

8. In this regard the overall use of space (whether marine or on land) and the potential for conflicts between different user groups (for example between shipping lanes and aquaculture installations) is an important issue to be addressed. Increasing pressure on natural resources and competition for space will require a major effort over the coming decade to devise governance mechanisms that can take into account the contribution of different sectors to the economy. New governance models that ensure that a range of stakeholders can cooperate with multiple government agencies across a wide area of interests need to be

devised. This will include a wide range of interests and agencies covering a wide area of government portfolios.

9. In many countries the consumer image of aquaculture production is not positive. Embarking on a green growth track can be a useful way to allay public concerns and inform the public and consumers about the benefits of aquaculture. Public-private partnerships are the best way to do this as both public and private benefits will accrue from such action.

10. Policy makers must ensure that they have sufficient statistical coverage of the green growth elements to allow for effective monitoring of developments. At present, statistics on aquaculture are generally not up to this task, and countries and international agencies involved in aquaculture statistics will need to do more to help collect the needed data. Similarly, monitoring and evaluation frameworks must be equipped to gauge advances towards green growth and to better understand why certain policies are successful while others are not. Such feedback is at the core of developing best practices. To be successful this requires willingness form both private and public stakeholders to engage in a positive dialogue and work together to achieve common goals.

A GREEN GROWTH PERSPECTIVE ON AQUACULTURE

1. Introduction

11. This report identifies the challenges for green growth in aquaculture, the policies that can be brought to bear to underpin further sustainable growth in aquaculture, and the factors necessary for successful aquaculture development[1]. The objective is to develop advice and best practices that can inform a roadmap for national aquaculture planning. This report also discusses the effects on competitiveness of incorporating green growth principles into aquaculture policy.

12. The report is organised as follows. The first chapter provides an overview of aquaculture developments over recent decades and some scenarios for the likely future development in production. Chapter 2 addresses the green growth issues which are part and parcel of the aquaculture production with an emphasis on the externalities caused by the farming of fish, molluscs, crustaceans and seaweed. Productions systems vary across species and regions; there is no "one size fits all" solution to the many challenges that aquaculture is facing. Chapter 3 looks at the policy frameworks required for optimal regulation of aquaculture and discusses the role of innovation and R&D to support green growth in aquaculture. The effects of pursuing a green growth path in aquaculture are taken up in Chapter 4. Measurement issues, i.e. are we on a green growth path, are discussed in Chapter 5 which also suggests a number of key indicators that may be useful to develop to be able to assess the status. Finally, Chapter 6 proposes some key conclusions.

1.1 Overview and context

13. Global demand for fish products has increased over the last decades and this trend is expected to continue due to population growth and increasing wealth, as well as a growing preference for healthy foods (Garcia and Rosenberg, 2010). When taking into account stagnating capture fisheries production, it is clear that aquaculture will have to meet most of the future increase in demand for fish[2] (Bostock *et al*., 2010) (Figure 1). In 2021, world fisheries and aquaculture production is projected to be about 172 million tonnes, which is a 15% increase from the average level for 2009-11. The OECD-FAO Agriculture Outlook projects that by 2021 (compared to a baseline of 2011) aquaculture will grow by 33% compared to 3% growth of capture fisheries (OECD/FAO, 2012).

14. Aquaculture grew at an average annual rate of 8.4% between 1970 and 2009. It has been one of the fastest growing food producing sectors in the world, and its potential to contribute to the global food supply is significant. In 2009, aquaculture contributed 38% to the world's fisheries production (excluding aquatic plants) (Figure 1) and contributed to about half of all seafood consumed by humans (FAO, 2011).

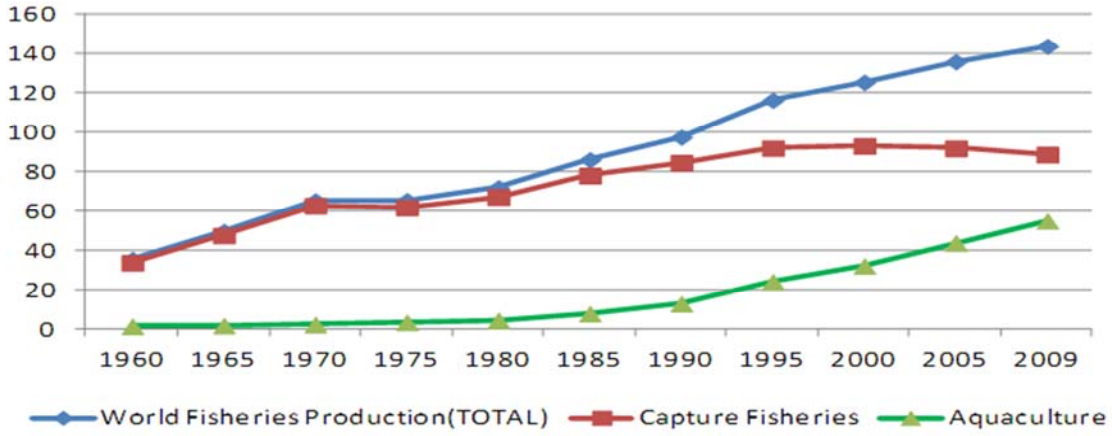
15. Aquaculture has potentially a major role in helping to reduce poverty and increase foreign currency earnings, especially for countries in development (TAD/FI(2012)11/ADD1). Increased

1 Aquaculture is the farming of aquatic organisms in inland and marine waters, involving intervention in the rearing process to enhance production and the individual or corporate ownership of the stock being cultivated (FAO, 2008). A wide range of species are farmed including fish, crustaceans and molluscs, bivalves and aquatic plants (seaweed).

2. Other sources of additional fish for food can come from an improved management and governance, a reduction in discards and a better utilisation of already caught fish. These are subjects of other studies on the COFIs green growth agenda.

production, together with innovation[3] in aquaculture, has lowered production costs significantly and has provided benefits to consumers and producers. For example, shrimp production increased 43 times (from 72 000 tonnes to 3.1 million tonnes) between 1984 and 2007. Concurrently, the price decreased to less than half of what it was originally (from USD 16.40 per kilo to USD 7 per kilo) (Asche, 2008).

Figure 1. World fisheries production



1. Aquatic plants are excluded.

Source: FAO Fisheries and Aquaculture Information and Statistics Service.

16. Aquaculture takes on many different forms in different parts of the world: inland water vs. marine; cage culture vs. ponds; species which are carnivorous, herbivorous, molluscs, crustaceans; extensive vs. intensive; etc. FAO recorded 310 species in 2008 as being cultured, excluding aquatic plants. In 2011, OECD countries produced about 6.85 million tonnes including aquatic plants of which diadromous fish (e.g. salmon) contributed 36.6% followed by molluscs (27.8%), aquatic plants (19.8%), marine fishes (8.8%), freshwater fishes (4.2%), and crustaceans (2.5%) (Source: Fisheries and Aquaculture Information and Statistics Service, FAO) (Table 1).

17. Some emerging economies such as Viet Nam are important export-oriented producers of fish from aquaculture, while others, like China, mainly supply the domestic market. This diversity, together with poor reporting from many aquaculture-producing economies, makes it challenging to identify common features of green aquaculture. Ultimately, incorporating green growth principles in aquaculture will mean more efficient regulation of externalities and a better understanding of local impacts, but what this means in specific cases will depend on individual production systems as well as local and regional factors and practices. Meanwhile a number of framework conditions for sound aquaculture development will be outlined in this Study.

18. While aquaculture production has increased substantially, there are concerns about the sustainability of aquaculture production due to environmental externalities, supply of feed resources, and competition for space. For example, many shrimp aquaculture farms in Southeast Asia were set up at the cost of mangrove destruction, and later many of them were abandoned because of contamination (Allison, 2011). Escaped fish or disease transfer from aquaculture to wild population is also a concern (Bostock *et al.* 2010).

3. The characteristic of "production controllability" coupled with a sustained demand from global markets has provided incentives for innovation in aquaculture.

Table 1. Major species cultured in OECD countries in 2011

Species		AUS	BEL	CAN	CHL	CZE	DNK	EST	FIN	FRA	DEU	GRC	HUN	ISL	IRL	ISR	ITA	JPN	KOR	MEX	NLD	NZL	NOR	POL	PRT	SVK	ESP	SWE	TUR	GBR	USA
Aquatic plants	Japanese kelp																	x	x												
	Green seaweeds				x														x												
	Red seaweeds				x										x			x	x												
Crustaceans	Red swamp crawfish																x														x
	White leg shrimp																		x	x											x
Diadromous fishes	River eels	x					x	x			x	x					x	x	x		x				x		x	x			
	Atlantic salmon	x		x	x		x			x		x		x	x								x				x			x	x
	Rainbow trout	x	x		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x	x	x	x	x	x	x	x
	Sturgeons, paddlefishes						x	x		x	x		x			x	x							x			x				x
Freshwater fishes	Grass carp					x							x			x								x		x					
	Silver carp		x			x							x			x	x									x					
	Channel catfish																			x												x
	Miscellaneous freshwater fishes	x	x	x		x	x	x	x	x	x	x	x		x	x	x	x			x			x		x	x	x		x		
	Tilapias and other cichlids															x	x		x	x	x									x	x
Marine fishes	Atlantic cod													x									x							x	
	Flounders, halibuts, soles																	x	x	x			x		x						
	Turbot				x		x			x				x							x				x		x			x	
	European seabass									x		x				x	x								x		x		x	x	
	Gilthead seabream									x		x				x	x								x		x		x		
	Miscellaneous pelagic fishes																	x	x	x							x				x
	Atlantic bluefin tuna											x					x										x		x		
Molluscs	Abalones, winkles, conchs	x			x					x					x				x			x					x				x
	Japanese carpet shell			x						x					x		x		x								x			x	x
	Mussels			x	x		x			x	x	x		x	x		x		x	x	x	x	x		x		x	x	x	x	x
	Pacific cupped oyster	x		x	x					x	x				x		x	x	x	x		x			x		x			x	x

Source: Fisheries and Aquaculture Information and Statistics Service, FAO

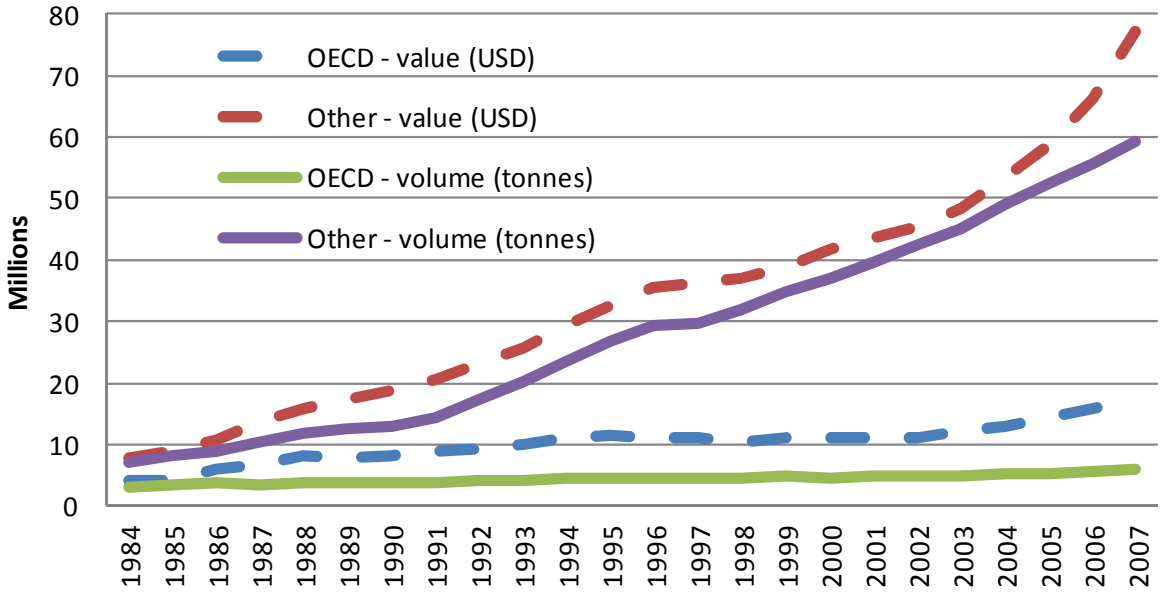
19. Concerns regarding the negative externalities of aquaculture have made it difficult for many developed countries to establish fish farming as a growth sector. After the rapid growth of the 1980s-1990s, aquaculture production stagnated in Europe and North America in particular mainly due to regulatory restrictions on site and inputs (Bostock *et al.* 2010). With a few exceptions, there has been no meaningful growth in aquaculture production in OECD economies, which accounted for 35% of the value and 30% of the volume of world aquaculture production in 1984, but only 18% and 9%, respectively, in 2007 (Figure 2).

20. On the other hand the same concerns have also encouraged the development of better practices and technologies which has resulted in more sustainable aquaculture practices in many OECD countries. For example, technology developments have improved monitoring and site selection tools, and led to new feeds that use less fish-based inputs, leave less emissions, and the use of vaccines instead of antibiotics. Seen in this light the restrictions or regulatory requirements on aquaculture growth have spurred innovations to address the concerns caused by production externalities. In this regard, an additional challenge is to change consumer's perception on aquaculture, i.e. the image of the aquaculture sector.

21. Increasing concerns regarding food security have led to a rethink of aquaculture policies, national development plans and governance of the aquaculture industry with a view to promoting growth and production. To maintain its growth, the aquaculture sector will have to adopt a Green Growth strategy. Green growth means "*fostering economic growth and development while ensuring that natural assets continue to provide the resources and environmental services on which our well-being relies*"

(OECD, 2011a). That is, the aquaculture industry must find a way to provide more seafood to meet increasing demand while mitigating the potentially environmentally negative effects of production.

Figure 2. Total aquaculture production: Volume and value



Source: OECD (2010).

22. The COFI workshop on *Advancing the Aquaculture Agenda – Policies to Ensure a Sustainable Aquaculture Sector*, held in April 2010 in Paris, France concluded that aquaculture has a high potential to contribute to economic growth and food security because good management practices make it possible to limit environmental harmful effects while increasing food production. Indeed, compared to the rearing of terrestrial animals, aquaculture offers significant advantages (OECD, 2010 - Table 5).

23. Growth in aquaculture production in OECD member economies has been slow over the past decades (*Advancing the Aquaculture Agenda*, OECD, 2010) (Figure 2). Among countries that have similar conditions for aquaculture development, some have developed aquaculture while others have not. There may be, however, common features at play which may have created differences between the OECD member economies and non-member economies, as well as among certain OECD member economies. These features may be related to governance, technologies, environmental regulations or resource availability, e.g. space and natural endowment more generally. At the same time, there has been a significant increase in aquaculture production in Southeast Asian countries, including Viet Nam, Cambodia, Thailand, Myanmar, Indonesia, Malaysia and Philippines, since the mid-1970s. Government interventions, such as a stable licence scheme, the provision of seed, and financial incentives, are factors that have contributed to this growth, in addition to growing global market demand (FAO, 2011).

24. Major points raised by the presentations at the Green Growth and Aquaculture Workshop held in Yeosu, Korea (December 2012) included ensuring biosecurity,[4] the use and potential of aquatic genetic resources; improving governance; consistency with international standards and interaction with other economic activities. The discussions summarised and highlighted three central themes: research,

[4] Biosecurity is defined as precautions taken to minimise the risk of introducing an infectious disease agent into an animal population.

international co-operation and involvement of all stakeholders. Other important points highlighted included spatial planning, certification, and a need for institutional innovation. The participants agreed that green growth in aquaculture is feasible and desirable and an on-going process to be applied in aquaculture development frameworks and strategies, most notably in national development plans [TAD/FI(2012)11/ADD1].

2. Green Growth issues in aquaculture

25. Progress on green growth in aquaculture has already been made and sustainable aquaculture is part of the landscape in many places. Aquaculture continues to have significant growth potential and can make an important contribution to food security and poverty reduction. To succeed, however, the sector needs to address environmental externalities and requires an accommodating governance framework that supports innovation in production and environmental prevention and mitigation.

26. For aquaculture to grow sustainably it must continue to address the wide range of externalities it causes. As aquaculture competes for space with other users, both recreational and commercial, the path towards green growth in aquaculture must include spatial planning (including user conflicts), sanitary issues, licence systems, site allocation and importantly cooperation among the various stakeholders in aquaculture, e.g. farmers, consumers, authorities, etc. (Box 1).

Box 1. Green growth challenges and aquaculture

Green Growth challenges	Variables to control	Policy framework	Measures (examples)
Feed resources	Feed	Innovation, Fisheries management	Use grains and vegetables, Use of wastes
Discharges	Feed, feed conversion ratio, feed components, water quality, siting of operations	Regulations, innovation, good management practices	Feed quotas, fallowing, cleaning, transferable discharging permits, taxes, IMTA, reuse, zoning, environmental monitoring, monitoring feeding
Diseases	Density, temperature	Regulations, innovation, good management practices	Distance, vaccine, limiting use of antibiotics, fallowing, zoning, environmental monitoring, screening protocol, crop calendar
Escapees	Storms, accidents, genetics, predators	Regulations, good management practices, Innovation	Stronger cages, sterilisation, paying local fishermen to catch escapees, use of native strains, genetics impact models
Space	User conflicts / conflicting uses	Coastal zone/ocean management, regulations	Reserved areas(zoning), Spatial planning
Food safety	Toxic, drugs or environmental waste in product	Regulations, good management practices, enforcement capacity	Establishment of pre-approved zones for aquaculture development, enforcement, sampling and certification system
Regional development	Development planning	Permits and zoning, environmental approvals, Investment aids, coastal zone/ ocean management	Establishment of pre-approved zones for aquaculture development
GDP contribution	Growth of sector, marketing of product	Marketing and promotion, research and development, infrastructure investments	Support private certification schemes, streamlining permit process
Development	Capital, skills	Education and training, labour standards	Continuing education for local populations
Energy use	Feed, electricity	Regulations, innovation, good management practices	Use grains and vegetables, Use of wastes, taxes, combine with wind mill, technology transfer to industry
Public perceptions and acceptance	Informed messaging of science-based information	Outreach and education	Working with press and NGOs, sharing information on websites, certification, labelling.

Source: OECD (2010).

2.1. Feed resources

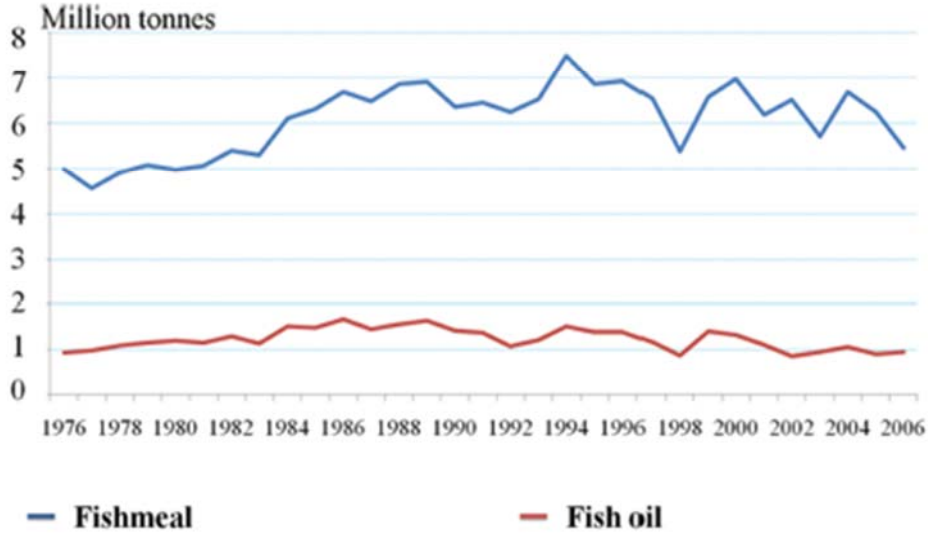
27. Aquaculture is the biggest fishmeal and fish oil consumer and it is estimated to consume more than 50% and 80% respectively of the world fishmeal and fish oil production (Hasan and Halwart, 2011). In 2006, about 37% of global aquaculture production (19.3 Mt) relied on small pelagic fisheries for its feed (Tacon and Metian, 2009). Continued growth will put additional pressure on forage fisheries from which

fishmeal and oil is produced. The potential existence of a fishmeal trap[5] is a major concern, especially when carnivorous species such as salmon are concerned. Sustainable management and conservation of forage fish stocks is central and vigilance against overharvesting is required. Concurrently alternative feed ingredients need to be developed. Innovation policies are of key importance to achieve this.

28. For some, using wild fish to produce farmed fish raises food security and ethical issues. In addition, as other resources such as grains have been increasingly used as substitutes for fish meal and fish oil, similar question arise for other ingredients of fish feeds, i.e. alternative uses of soy, colza, etc. The objective is to find additional sources of feed (whether terrestrial or marine) that are managed sustainably.

29. However, there is room for optimism. The total amount of wild capture fish used for reduction[6] to fish meal and oil has remained stable over the last three decades while aquaculture production has substantially increased over the same period (Tacon and Metian, 2009) (Figure 3). The use of fish meal in compound aquaculture feeds has been lower than predicted between 1997 and 2007 (Welch *et al*., 2010) (Figure 4).

Figure 3. World fish meal and fish oil production from 1976 to 2006

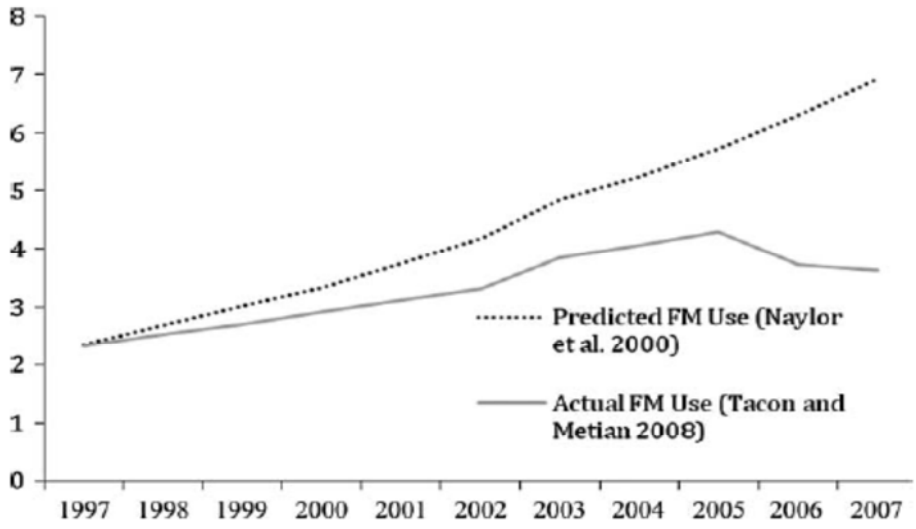


Source: Tacon and Metian (2009).

5 The fish meal trap occurs when aquaculture growth will be limited because of the lack of fish used for fishmeal and oil production a central element of fish feed for carnivorous species.

6 Reduction means that wild fish caught are transformed to fishmeal and fish oil. Most of the fish for reduction are from pelagic species, and trimmings.

Figure 4. Fishmeal use: past projections and current trends



Source: Welch *et al.* (adapted from Kristofersson and Anderson, 2006)

30. As the aquaculture industry grows, new substitutes for fish meal and oil will be needed, and for more species. This means a need for more research and innovation in ingredient substitution and improved feeding systems. (Bostock *et al*., 2010). The "fish-in fish-out ratios" for nearly all species fell between 1995 and 2006 (Table 2). While biomass transfer efficiency between trophic levels of fish is generally around 10% in natural environments, all farmed species cited in the table have greater transfer efficiency than their counterparts in the wild. In case of salmon, improvements after 2006 are particularly notable (Figure 5).

Table 2. Calculation of pelagic forage fish equivalent per unit of cultured species groups

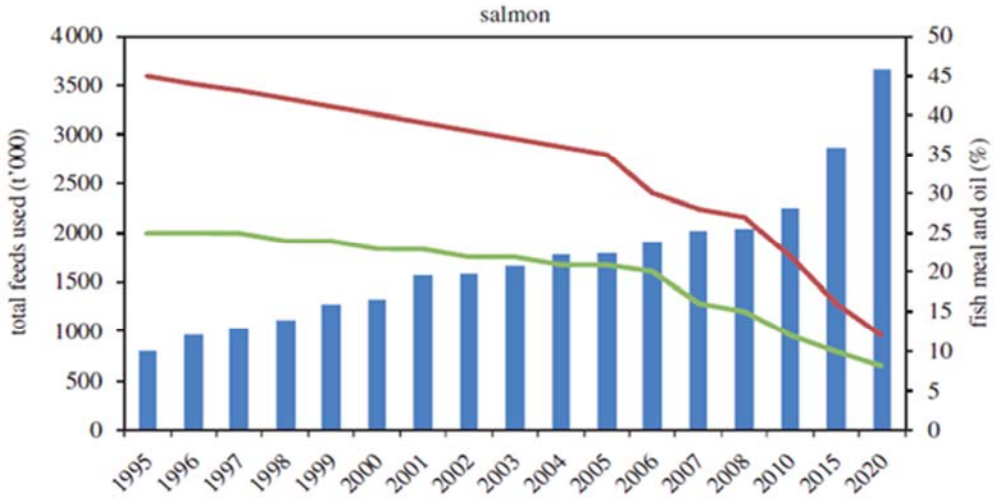
	1995	2005	2006
Salmon	7.5	5.4	4.9
Trout	6	4.2	3.4
Eel	5.2	4	3.5
Marine fish	3	2.1	2.2
Shrimp	1.9	1.7	1.4
Freshwater crustaceans	1	0.9	0.6
Tilapia	0.9	0.6	0.4
Catfish	0.4	0.6	0.5
Milkfish	0.4	0.2	0.2
Non-filter feeding carp	0.2	0.3	0.2
Total major fed species	1	0.9	0.7

Source: Tacon & Metian, 2008.

31. In the near term, supply of fish-based feedstocks will probably not be the limiting factor for aquaculture growth. The use of fish meal and fish oil per unit of output has decreased, mainly because of industry's keen interest and investment to find substitutes in response to rising prices and social pressure for improved sustainability (Bostock *et al.* 2010). The industry is expected to continue to find ways to drive down fishmeal and oil levels in the future (Welch *et al*., 2010). In particular, there have been major achievements in reducing the fishmeal and oil component in the salmon industry (Figure 5). In addition,

about 25% of fish meal and oil sources are now provided by processing waste, i.e. trimmings and waste water from fish processing (Jackson, 2010). As it is now technically feasible to produce carnivores such as salmon using low levels of fishmeal and oil, the quantity of Omega 3 oils available in the fish is becoming an issue. Ultimately, two market segments for carnivorous species may develop, a premium one with high levels of Omega 3 and another low price, but poor in Omega amino acids.

Figure 5. Estimated global use of fish meal and oil by the salmon farming industry projected to 2020



Blue: total feeds used, red: mean % fish meal, green: mean % fish oil.

Source: Tacon and Metian (recited from Bostock *et al*. 2010)

2.2. Discharges

32. Aquaculture activities interact with the surrounding environment. As aquaculture continues to intensify and expand, discharges of organic wastes, nitrogen and phosphorous may result in local environmental degradation. This is a main source of criticism of aquaculture and explains why strict restrictions on aquaculture expansion are in place in many countries. The use of antibiotics has also been a concern because of the potential harm to humans and the environment when dissipated into the surrounding water and taken up by other aquatic species.

33. Some proportion of feed provided to farmed species is diffused to surrounding water columns or accumulated on the bottom. The faeces from farmed fish are also diffused to water columns or accumulated on the bottom. In total, this can release more nutrients than can be assimilated by the surrounding environment. As a result, poor water quality, eutrophication[7] or dead zones may appear. Eutrophication may lead to reduced dissolved oxygen and hypoxic[8] or dead zones which may result in fish kills, excessive phytoplankton and macroalgal growth. The latter can reduce light penetration and be harmful to submerged aquatic vegetation or induce harmful algal blooms which may result in mass fish kills and decrease biodiversity due to changes in nutrient composition (Selman *et al*., 2008).

34. In order to manage discharges from aquaculture operations, many countries have implemented command and control measures such as feed quotas and maximum permissible discharge loads. For example, Denmark introduced strict environmental regulations to control water pollution from aquaculture

[7] Eutrophication is the over-enrichment of water due to natural or artificial addition of nutrients such as nitrogen and phosphorus.

[8] Hypoxic refers the condition of low oxygen level insufficient to sustain animal life.

activities based on a maximum allowable feeding, statistical standard for nitrogen, phosphorus and organic matter, a minimum level of oxygen in the outlet water, and a limit on water intake (Jarlbæk and Børrensen, 2012). However, incentive-based policies such as transferable discharge permits, taxes and subsidies can be more efficient ways of dealing with problems due to their flexibility and increased incentives for innovation. In February 2012, the Danish Ministry of Environment enacted a new regulation which introduces the option for fish farmers to voluntarily choose regulation on nitrogen discharges instead of feed quotas.

35. Fallowing, cleaning and integrated multi-trophic aquaculture such as combined farming of fish, filter feeders (mussels or sea cucumber, for example) with aquatic plants (like algae and kelp) are also possible policy options. Seaweed and molluscs not only remove discharges, nutrients and particulates from the water column including from aquaculture activities but also transform a substantial portion of them into their tissues. The following Box 2 presents an overview of shellfish aquaculture.

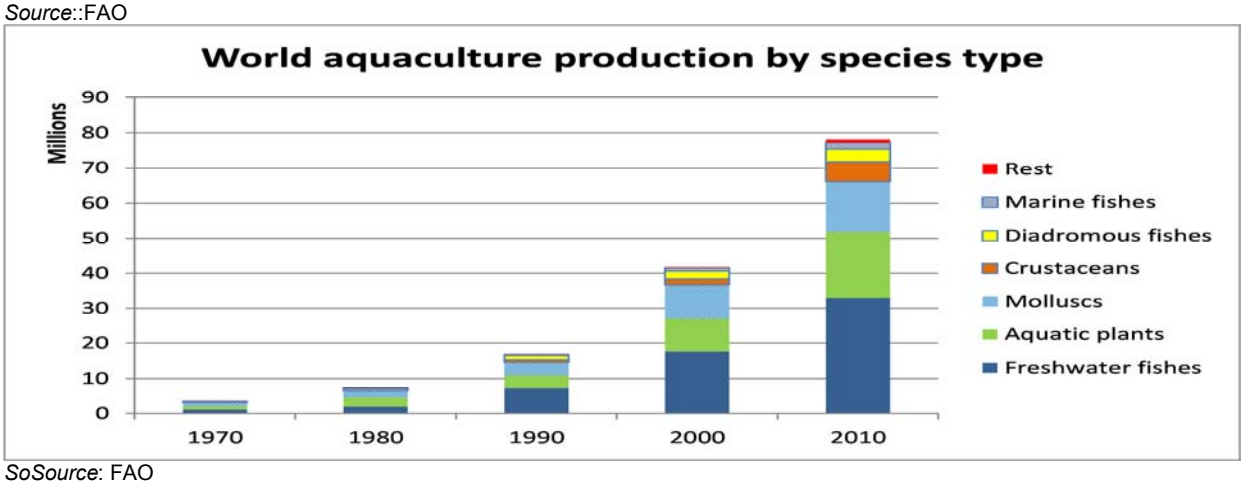
Box 2. Shellfish[9] aquaculture

Freshwater fishes, aquatic plants and molluscs together have accounted for more than 80 % of the world aquaculture production since 1970. Shellfish aquaculture has also increased considerably over the same period and accounted for about 94% of the world molluscs produced in 2010. Especially, shellfish aquaculture has drawn special attention from academia and policy makers due to the environmental services as well as social and economic services it provides.

Table 3. World aquaculture production, 1970-2010 (Unit: thousand tonnes)

Type	1970	1980	1990	2000	2010
Freshwater fishes	1 096	1 941	7 140	17 585	32 890
Aquatic plants	958	2 641	3 765	9 306	19 006
Molluscs	1 068	1 837	3 609	9 758	14 156
- Shellfish	1 062	1 787	3 311	8 324	13 294
Crustaceans	10	87	755	1 691	5 724
Diadromous fishes	258	486	1 207	2 251	3 598
Marine fishes	51	187	318	977	1 840
Rest	6 413	12	45	156	878
Grand total	3 447	7 189	16 840	41 724	78 092

Source::FAO



SoSource: FAO

[9] "Shellfish" in this context are filter-feeding molluscs, including clams, oysters and mussels.

In general, shellfish do not need to be fed in the rearing process because they are primary consumers unlike other aquaculture species. Shellfish feed on and filter nitrogen and other organic and inorganic materials in the water column. In doing so, shellfish contributes to improved water quality and habitat and stock restoration by reducing eutrophication symptoms and enhancing light penetration and providing oxygenation into water column in addition to providing social and economic benefits including food, job creation and poverty alleviation.

Ferreira *et al.* (2009) simulated the value of European shellfish aquaculture with five EU farms (ones in Scotland, France, Slovenia, Italy and Portugal) farming four major species (blue and Mediterranean mussels, Pacific oyster, and Manila clam). According to the study, the European shellfish farms remove 55 000 tonnes of nitrogen per year, which is equivalent to the nitrogen load of 17 million people. A study on mussel farming on the Swedish west coast (Lindahl *et al.*, 2005) shows that mussel farming can be an innovative and strategic environmental management tool to recycle nutrients from sea to land. In this region, a hectare of mussel farm with vertical suspenders attached to horizontal longlines may consume the equivalent of 20 hectare of the annual phytoplankton production and produce about 300 tonnes of mussels in 12-18 months (Lindahl and Kollberg, 2009). Also, a kilogram of fresh mussels in this region are reported to assimilate 8.5~12g of nitrogen, 0.6~0.8g of phosphorous, and about 40~50g of carbon (Lutz 1980; Peterson and Loo 2004). The mussels containing the excess nutrients can be used as sea food for human consumption or fertilisers on farmland or feedstuff for livestock. The value of removing nutrients by mussel farming was estimated by simple comparison of abatement costs with other abatement measures (Lindahl, 2005) and by the cost savings by the replacement of other abatement measures such as improved agricultural operations, improved sewage treatment and use of wetlands etc. (Gren *et al*, 2009). Though the estimated marginal costs varied considerably depending on the growth rate of the mussels and the market for the mussels produced, mussel farming had lower marginal costs (cost savings between 2-11%) than many other abatement measures in the region (Gren *et al*, 2009). A rural person is reported to discharge 3.5-4kg of nitrogen per year (Anonymous, 2003), so 350-400kg of mussels per year is the production of mussels needed to abate it. A compensation scheme for mussel farmers for the nitrogen discharge can be devised based on this information.

From the integrated multi-trophic aquaculture (IMTA) cases shellfish farming can provide additional benefits compared to the monoculture case. A Farm Aquaculture Resource Management (FARM) model results for a 3.2 ha oyster farm cultured with a finfish farm in Sanggou Bay, northeast China show that nitrogen removal becomes seven times more and oyster production becomes thirty times more compared to the oyster monoculture case (Ferreira *et al*., 2011).

Notwithstanding these benefits, shellfish aquaculture has been blamed for some negative externalities such as eutrophication from bio-deposition on the sediments or damaging sediments. Burkholder and Shumway (2011) reviewed 62 ecosystems and found only four ecosystems with sustained system-level impacts while the other 58 ecosystems have either negligible or localised significant impacts from bivalve shellfish framings. Those negative externalities mostly occur when in high density culture in a poorly flushed area or when harvested mechanically.

Overall, the negative effects from shellfish farming are local phenomena in exceptional cases or negligible compared to the overwhelming land-based nutrients loading and the huge benefits from shellfish aquaculture (Burkholder and Shumway, 2011).

Source : S. E. Shumway (2011).

36. In general, production of aquatic animals leads to lower emissions of nutrients than terrestrial animals except for chicken. Bivalves extract nitrogen and phosphorus from the water column (Table 4)[10] and can even be used to mitigate or remedy environmental degradation (Box 5).

10. For terrestrial animals, a share of (ideally all) nutrient emissions are recycled into fertiliser for crop production. Terrestrial nutrient emissions can also impact river and coastal areas and can create dead zones like the recurring one in the Gulf of Mexico.

Table 4. Comparison of sustainability indicators for animal protein production system

	Feed conversion (kg feed/ kg edible weight	Protein efficiency (%)	N emissions (kg/tonne protein produced	P emissions (kg/tonne protein produced)	Land (tonnes edible product/ha)	Consumptive freshwater use (m3/tonne)
Beef	31.7	5	1 200	180	0.24-0.37	15 497
Pork	4.2	25	800	40	1.0-1.20	3 918
Chicken	10.7	13	300	120	0.83-1.10	4 856
Finfish (average)	2.3	30	360	48	0.15-3.70	5 000
Bivalves	not fed	not fed	-27	-29	0.28-20.00	0

Source: Phillips, Beverige and Clarke 1991; FAO 2003; Hall *et al*. 2011; Bouman *et al*. 2013 (recited from Notes June 2013, The World Bank)

37. In different settings phosphorous and sludge from aquaculture production can be a valuable resource and capturing and re-using the resource is a new area for technology and regulatory development (Nordic Council, 2012). For example it may be a useful input in composting.

38. Choosing appropriate sites for production is often the key to reducing or eliminating impacts from discharges. In many cases just moving operations to deeper water with stronger currents can significantly reduce impacts as has been the case in Turkey (Box 3). Modelling carrying capacity to inform siting of operations can be of great assistance.

Box 3. Moving farming sites in different locations: The case of Turkey

Aquaculture in Turkey has developed fast and has come under great pressure due to pollution as well as its unsightly appearance and unpleasant smell which caused conflict with tourism. Cage farms that were entirely concentrated by the near coast until 2006 were subject to major criticisms.

In January 2007 the Ministry of Environment issued a communiqué which stipulated that net cage farms shall be sited in locations which have at least 30 meters deep water column, at least 0.6 nautical miles away from land and have at least 0.1 m/s of current speed. The same communiqué classified the sites where these farms can be located based on eutrophication. All of the existing farms that were located in near shore locations in Turkey have been moved to locations which meet these criteria. During this period three provinces where aquaculture was common were identified as potential aquaculture areas and farms were moved to these locations.

After these farms were moved short and midterm problems have been resolved. Since this change to offshore system required quite a lot of investment, however, many farms without sufficient capital were taken over by larger companies.

Source : TAD/FI(2012)11/ADD1

39. The important message is that there are solutions even if some of them may be expensive or operationally challenging. Fully re-circulated systems, for example, can eliminate local discharges and escapees although they still have discharges that need disposal (typically on land). And extensive production systems can recycle nutrients using multi-trophic aquaculture. Finally, identifying a maximum load on the environment for each kind of discharge and making emission permits transferable between farms and among industries also will allow for a more efficient allocation of resources.

2.3. Escapees

40. The environmental effect of escapees is an important challenge in aquaculture especially in sea-cage farming. Interaction between wild and farmed fish may pollute genetic pools and reduce the survival

capability of wild species. The escaped species may also compete with wild stocks for feed or become the dominant species, impacting biodiversity. If farmed fish are not indigenous to the area of production the escaped fish becomes an invasive species that may disturb the ecosystem. The escapees may also spread diseases or pathogens to the wild stocks.

41. Reliable and complete escapee data are not available on a global scale. However, Norway has collected comprehensive data on escapees. Fredheim *et al*. (2010) state that there are over 325 million Atlantic salmon held in sea-cages in Norway which is far greater than the wild salmon population of about 1 million. Since the escapee rate is small at 0.1-0.3% it may not be a sufficient incentive for farmers to actively prevent escapements. However, there may be an indirect cost to the industry and society as escapees undermine the industry's reputation and can be detrimental to ecosystems (Fredheim *et al*. 2010). As part of the regulatory reforms that have developed in the recent years in Chile progress has been noted in both preventive and mitigation measures. In particular, escapees have been dealt with through the regulation of the security of farming structures.

42. Based on the data from the sea-cage salmon farming in Norway the causes of the escapees can be broadly categorised into structural equipment failure (68%), operational related-failure (8%), biological (17%) and external factors (8%) which are also species dependent (Jensen *et al*. 2010). Though the structural failures are not frequent they tend to lead to incidents with a large number of escapees. In contrast operational failures usually lead to small incidents but are more frequent. Thus structural failures are most important to be addressed in preventing escapees (Fredheim *et al*. 2010).

43. Norway introduced in 2004 a technical standard for marine fish farms including regulations for design, dimensioning, production, installation and operation. A revision in 2011 strengthened the regulations further. In addition, the Norwegian government has imposed an upper limit on the number of fish to be kept in each net pen. Combined, these two measures effectively reduced the overall risk of escapees both in terms of the numbers and as a proportion of number of fish in sea-cages (Fredheim *et al*., 2010).

44. There are some policy lessons to be learned from the Norwegian experience (Jensen *et al*. 2010 and Fredheim *et al*., 2010) including:

- Establish mandatory reporting system of all escapees;
- Establish a mechanism to collect, analyse and learn from the mandatory reporting;
- Conduct mandatory technical assessments on the cause of large-scale escape incidents;
- Introduce a technical standard for sea-cage aquaculture equipment;
- Conduct mandatory training of fish farm staff;
- Pay local fishermen to catch the escapees; and
- Conduct R&D for better equipment, sterilisation and understanding species behaviour.

45. The degree of genetic separation between the wild and farmed populations is key to mitigating potential genetic impacts, as is the size of the wild population. Modelling such potential impacts can help aquaculture managers select proper strategies, as is currently done in the United States and the European Union.

2.4. Diseases and parasites

46. Aquaculture activities may transfer non-native and native diseases and parasites to surrounding production areas (e.g. ISA introduced in Chile) and to wild species through various ways such as eggs and fingerling transactions, equipment, fish-to-fish contact or currents. This often leads to a decrease in production and may sometimes carry significant economic losses and pose a threat to wild fish populations.

47. Asche *et al*. (2010) argue that disease is always present in any animal husbandry industry so disease control should be an essential part of animal farming including in aquaculture. Indeed disease outbreak was one of the most serious concerns among delegates to the "Green Growth and Aquaculture Workshop" Yeosu, Korea (TAD/FI(2012)11/ADD1). The Chilean case can happen elsewhere; rapid expansion mainly driven by short-term economic interest and in the absence of appropriate regulatory framework leads to acute problems (Box 4). Good governance is very important in controlling disease. Addressing individual cases only when problems appear via allopathic measures such as heavy reliance on the use of antibiotics is less effective than good precautionary measures (OECD, 2010).

48. Precautionary measures include spatial planning to allow for periodical fallowing and relocation of farming sites, regulations to keep a certain distance among farms, limits on stocking density, vaccination of smolts and reducing the use of antibiotics. Such measures will all help to limit disease outbreaks.

49. The Chilean ISA outbreak in 2007 inflicted major economic losses on the sector and job loss in both farming and processing. the Chilean Government worked in close co-operation with industry to address the disease outbreak, demonstrating the value of a long term collaborative approach to aquaculture. Following the ISA crisis, Chile has been innovative in the design and implementation of precautionary measures.

Box 4. The recovery of the Chilean salmon industry

Over the last three decades the Chilean salmon industry has been impressively successful both in technical and commercial terms. Today Chile is the second largest producer in the world. However, regulatory framework did not properly address biological risks and other social, economic and environmental issues. The industry's priority was on production, sales and overall economic benefits from aquaculture growth.

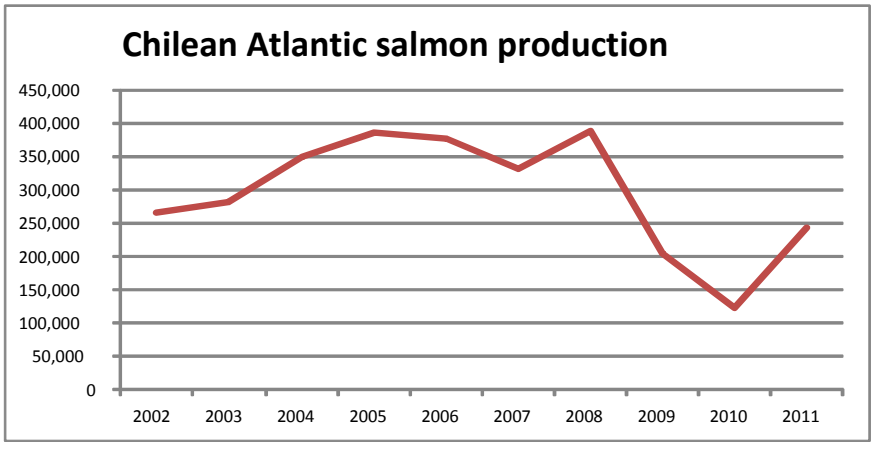
Once the virus (infectious salmon anaemia: ISA) outbreak occurred in 2007 this lack of a good regulatory framework impaired the industry's ability to respond. Production was hard hit by ISA, decreasing by 67% (from 376 476 tonnes in 2006 to 123 233 tonnes in 2010), accompanied by a significant fall in the number of Atlantic salmon farms In operation (from 375 in 2007 to 66 in 2009) and a 50% loss of direct and indirect jobs (around 25 000 lay-offs).

Some of major reasons for the outbreak included the high concentration of farms within a limited area, the absence of zone management programs, poor sanitary control on farms, high stoking numbers on farms and a lack of transparency in the industry.

With a rapid public-private co-ordinated effort, basic infectious disease control measures were implemented to increase biosecurity on farms and included a quality assurance of diagnostic laboratories and mandatory reporting. At the same time collaboration among the government, financial sector and industry was developed to finance the industry so that it could continue to operate. New laws and regulations were implemented to facilitate the industry's recovery in the long term.

Measures that have since been adopted include spatial planning to allow periodical fallowing and relocation of farming sites, regulations on distance between farms, limit on stocking density, vaccination of smolts, reducing use of antibiotics and modification of the regulation of import of eggs to make it consistent with international standards of the OIE (World Organisation for Animal Health) and to raise the level of sanitary protection in the country.

In 2011, the production volume began to increase and the stocking of fish in salt water during 2010 and 2011 increased. The production is expected to be restored to the 2006 level sometime between 2013 and 2015.



Several lessons have been learned from this crisis including: (1) development of R&D programs to provide timely information to support effective regulations and enforcement; (2) development of a biosecurity system covering the entire value chain; (3) understanding of the dynamics and biological carrying capacities; (4) establishment of effective zone management programmes; (5) reduction in drug treatments; and (6) maintaining good communication between industry stakeholders and government.

Source : Chilean Government, Under-secretariat for Fisheries and Aquaculture

50. Sri Lanka's case of white spot disease outbreak in 2004 also caused huge economic loss to the tiger shrimp aquaculture industry (Box 5 and Figure 9). While most Asian countries experiencing the same disease outbreaks changed to *Penaeus vannamei* farming to prevent reoccurrence of the disease Sri Lankan producers stuck with tiger shrimp farming and took various measures such as shrimp farming zoning and introduction of crop calendar with farmers' active involvement to revive the shrimp farming industry.

Box 5. The revival of tiger shrimp industry from white spot disease: the Sri Lanka's case

Since its inception in 1980s, tiger shrimp (*Penaeus monodon*) farming has been the most lucrative commercial aquaculture activity in Sri Lanka, especially in North Western and Eastern parts of the country. The industry recorded its peak performances in 2000 by producing 4 855 tonnes of farmed shrimps earning USD 69.4 million worth of foreign exchange, but there was not much focus on biosecurity and sustainability.

Once white spot disease occurred in 2004 shrimp farming industry was severely affected by the outbreak resulting in a drop of production by two-thirds to 1 570 tonnes in 2005. The problem worsened because a majority of the farms depended on the Dutch Canal for the water intake and discharge. This facilitated disease spread from farm to farm through this common source of water.

Although most Asian countries changed to *Penaeus vanna*mei farming to prevent recurrence of white spot disease Sri Lanka resisted moves by most farmers to change. The government of Sri Lanka introduced measures supported by a legal framework to revive the shrimp farming industry. These measures include zoning of the shrimp farming area into zones and sub-zones; introducing a crop calendar; formation of a farmer organisation for each sub-zone; introduction of best management practices; active involvement of farmer organisations for decision–making and for the implementation management measures; avoiding high stocking densities; monitoring shrimp hatcheries and quality of post-larvae; and screening of broodstocks and post larvae for white spot disease.

The adopted measures resulted in the revival of the shrimp farming industry. The production volume today has reached around 3 500~4 500 tonnes and the percentage occurrence of white spot disease decreased from 9.2% in 2005 to 2.9% in 2010.

Source : TAD/FI(2012)11/ADD1)

2.5. Space competition

51. Aquaculture requires space on land and in water to operate. As aquaculture expands suitable sites have become scarcer and in many regions this has become one of the constraints on further growth. There are also other economic sectors such as fisheries, recreation, transportation and energy production which compete for space with aquaculture. This takes place not only at sea but also in harbours and in inland water aquaculture where access to aquifers may be limited or where the carrying capacity of the land and water bodies has been exhausted.

52. To address these competing uses aquaculture should be considered as a part of an integrated spatial planning approach. Spatial planning can designate suitable zones for aquaculture and other sectors, a good way to address many issues regarding aquaculture development and conflict resolution among stakeholders (Díaz, 2010 and TAD/FI(2012)11/ADD1).

53. Furthermore, in terms of maximising social welfare the scarce space should be allocated to a sector which produces the greatest welfare to society (Nielsen *et al*. 2012). When stringent environmental regulations are imposed on aquaculture operations one way forward is to assess the social contribution created by the aquaculture activity and compare this across competing sectors. This could lead to better opportunities for aquaculture in the future.

54. With growing pressure on land and marine resources, a sound approach to spatial allocation is vital to avoid conflict and wasted opportunities. The report *Integrated Ocean Management and the Fisheries Sector: Interactions Economic Tools and Governance Structures,* discussed at the 107th Session of COFI, considered how to address the problems associated with user conflicts and identify the best ways to deal with them (Charles, 2011) (Box 6).

Box 6. Moving towards a zoning structure in the Norwegian aquaculture?

Production of farmed salmon in Norway has grown continuously over the course of a 40-year period, and in 2011, for the first time ever, Norwegian production of salmon surpassed 1 million tonnes, doubling since 2002. With expanded production has followed an increase in the area allocated for salmon farming - from 9 km^2 in 2000 to 59 km^2 in 2011. Historically however, aquaculture sites were allocated by virtue of a case by case approach, meaning there was no master plan in place for the overall structure of aquaculture sites. A viable and efficient site structure is an essential element in mitigating environmental concerns related to salmon farming and to facilitate future growth. In addition, competition for space from different user groups such as recreational users, fishers and the petroleum industry has made it increasingly difficult for salmon farming companies to get access to new sites.

In order to ensure industry optimisation and sustainable growth the Norwegian government has sought to explore the possibilities of an efficient zoning structure for aquaculture. A zoning committee was appointed. Its main suggestion was to divide the coastline into production areas separated by corridors. Each production area should further be divided into at least four zones with coordinated smolt release and fallowing (rotating principle). This is believed to reduce disease outbreaks and help to better manage and implement current and future environmental indicators and sustainability goals. Several challenging issues were raised during the committee's hearings. These included 1) knowledge gaps for establishing suitable production zones, 2) challenges for small farm owners located in only one or two zones, and 3) the municipalities' responsibility for spatial planning processes in coastal waters.

Source: Norwegian Ministry of Fisheries and Coastal Affairs, 2012.

2.6. Externalities from other sectors

55. Aquaculture may suffer from externalities induced by other sectors. Since water is of utmost importance for aquaculture activities, other activities that deteriorate water quality or decrease water availability may produce negative externalities on aquaculture operations. In fact, there are increasing impacts from land based activities, such as agricultural run offs, municipal sewage and industrial waste, which deteriorate water quality and that can have potentially negative impacts on aquaculture, both in inland and marine-based farming. Agricultural run-offs are generally the greatest contributor to eutrophication in many countries (Díaz, 2010).

56. There are 415 eutrophic and hypoxic coastal systems in the world of which 169 areas are hypoxic areas. Particularly sensitive zones include the Gulf of Mexico and east coast of the United States, north-east Atlantic and seas around United Kingdom and the southern coast of Japan and Korea (Selman *et al*., 2010, see www.wri.org/map/world-hypoxic-and-eutrophic-coastal-areas).

57. Since multiple externalities and economic activities are involved it is not possible to correct these by addressing aquaculture alone. Rather, co-ordinated regulation of externalities among different sectors can internalise different players' externalities in their management decision and ensure the highest possible value is produced (Nielsen *et al*., 2012). A focus on coherence and a willingness to co-operate across government agencies/ministries and with a wide variety of stakeholders who have an economic interest in this shared resource is necessary for this process to succeed.

58. For example, incentive-based policies, such as transferable discharge permits, could be applied to both the aquaculture and agriculture sectors, providing an optimal solution for each. The polluter-pays principal can also be a helpful model to correct this kind of externality problem.

59. Addressing multiple externalities can increase the complexity of legal and institutional arrangements. The one-stop shop approach taken in Norway and the state of Michigan in the United States can reduce the burden of administrative process by providing concerted and streamlined services through one channel (OECD, 2010a).

60. In France, application of spatial planning frameworks to address externalities has produced mixed results (Box 7). This experience shows that spatial planning and bringing together different stakeholders can be more difficult that it seems, especially when the potential value stakes are high.

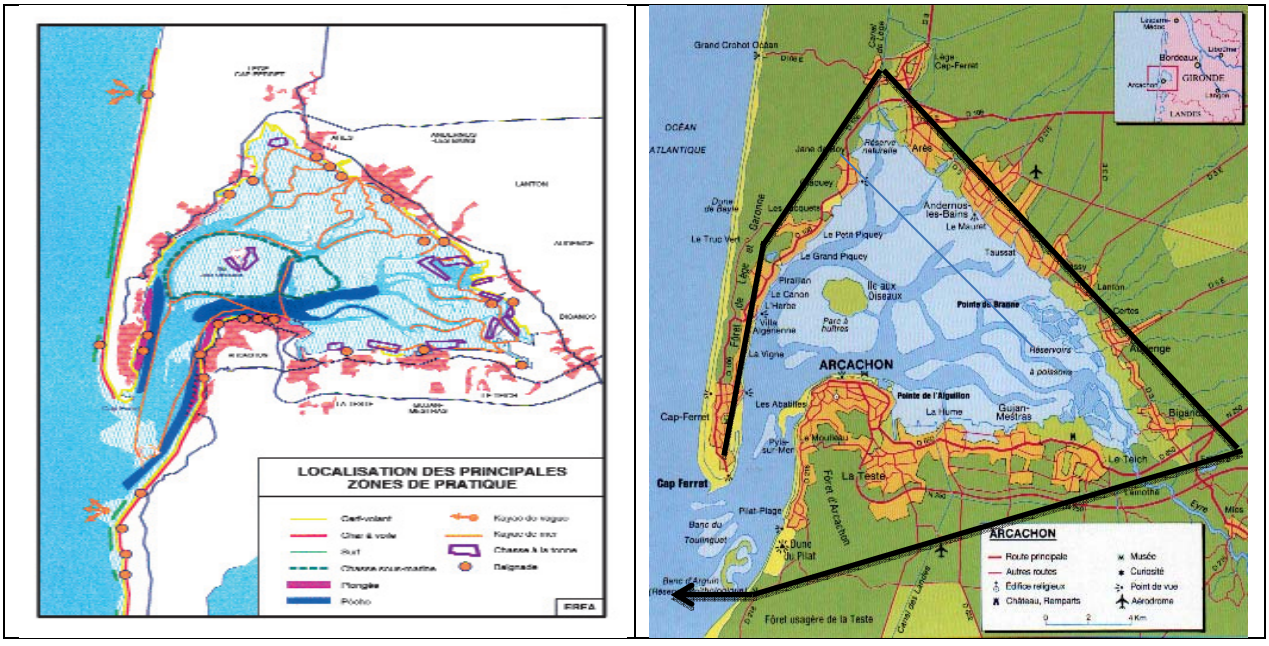
Box 7. Dealing with externalities from other sectors: the French experience

In France, the main externalities on aquaculture operations from other sectors are due to the competition for water use (agriculture, livestock, industry, urbanisation, tourism) and the competition for the use of sites (urbanization and marine tourism). The problem of pesticides and other chemicals is no longer a priority with the introduction of strong European and national regulations.

The Arcachon basin is located in the west-southern coast of France and a multipurpose area used for: oyster farming with 15 000 tonnes of annual commercial production and the main region for spat production in France; tourism and urbanisation with 6 million nights during the summer season (equivalent to 250 000 inhabitants: three times the normal population of this area); sailing boats with 12 000 boats moored inside the basin; and a paper mill, which is one of the most important in France, uses the neighboring pine tree production (1 million hectares of pine trees).

The main externalities on aquaculture operations identified were: a competition for the use of the surface area of the Basin (15 000 ha at high tide, but 5 000 ha at low tide); the risks due to urban and industrial pollution; and the access to the sea (physical access and cost of coastal land).

To preserve the aquaculture activities against these externalities, a regional marine spatial planning called the Schéma de Mise en Valeur de la Mer (SMVM) was implemented. The SMVM of the Arcachon Basin determines the role of the different sectors in the maritime and coastal area in order to define the compatibility between different uses and specific protective measures. It was developed under the responsibility of the state, in close consultation with the various stakeholders and sets guidelines for the development, protection and equipment that will shape the future of the Basin. It has the same legal status as a territorial development law. Another important action taken was construction of a great circular collector to receive all wastewater from urban origin and also from the paper mill. All these effluents were sent to the open sea after treatment.



Unlike the success story in the Arcachon case externalities imposed on trout farms in Brittany failed to be appropriately addressed.

Brittany was the most important French region for the production of trout during the 1970s producing about 15 000 tonnes. But the increasing production of pigs in Brittany (14 million pigs annual production), has had an important impact on trout production. In addition, this development of pig production has also an impact on the water quality of the coastal zone. The main problem is to take into account the 24 000 direct jobs induced by the pig production.

Presently, no solution has been found and trout production has decreased by 40% during the last 20 years. This could have been avoided with developing planning tool which could determine the role of different sectors of the maritime and coastal area in defining the compatibility between different uses and specific protective measures.

Source : TAD/FI(2012)11/ADD1

2.7. Energy use

61. Energy use in aquaculture depends on many factors including farming methods (i.e. cage vs. recirculation, intensive vs. extensive farming), species cultured (i.e. carnivorous vs. herbivorous vs. non-feed species such as seaweed and mollusc), regions and energy mix etc. In general, recirculated aquaculture systems, intensive aquaculture systems and carnivorous species farming are likely to demand more energy than cage systems, extensive systems, herbivorous and non-fed farming systems (e.g. oysters, mussels) respectively.

62. Ayer and Tyedmers (2008) carried out life cycle assessments of four different salmon farming systems in Canada and found that there were substantial differences in energy use among four production modes (Table 6). Feed dominates cumulate energy demand (CED) both in conventional marine net-pen system (87%) and marine floating bag system while electricity and fuel dominates CED in land-based saltwater flow-throw system and land-based freshwater recirculating system (90%), even though they use an equivalent amount of feed.

63. Marine net-pen outperforms closed-containment systems in energy efficiency mainly because marine net-pens utilise ecosystem services (i.e. ocean currents and tidal action) in supplying fresh sea water and dissolved oxygen and flushing out wastes while closed-containment systems have to provide those using energy. Gronroos *et al*., (2006) studied Finnish rainbow trout farms and found that there were also big differences in energy use among different production modes. One interesting observation in their study is that while feed production dominated total energy use in a net-pen system, it accounts only a fifth of total energy use in a land-based recirculating system. The high cost of energy in many areas serves as a significant impediment for the development of closed recirculating systems. A recent study (Feasibility Study of Closed-Containment Options for the British Columbia Aquaculture Industry, 2010, DFO, Canada) concluded that closed recirculating systems are not suitable for salmon farming as the high operating cost (mostly energy) made it economically unviable. This may change in the future but for now such systems seem viable for high-value species only or in areas where energy cost is very low. However, closed-containment systems have other environmental advantages such as less eutrophication and escapees and so properly valuing these environmental costs is important to choosing the ideal system.

Table 5. Life cycle impacts associated with the production of 1 t of live-weight fish from the four culture systems analysed with all closed-containment systems assumed to be operating on the average Canadian electricity mix

	ABD (kg Sb eq)	GWP (kg CO_2 eq)	HTP (kg 1,4-DB eq)	MTP (kg 1,4-DB eq)	ACD (kg SO_2 eq)	EUT (kg PO_4 eq)	CED (MJ)
Net-pen	12.1	2073	639	822,000	17.9	35.3	26,900
Bag	13.9	2250	840	574,000	18	31.9	37,300
Land-based flow-through	38.1	5410	2570	3,840,000	33.3	31	132,000
Land-based recirculating	72.5	10,300	54,380	6,510,000	63.4	11.6	233,000

Source: Ayer and Tyedmers 2008. Notes: ABD=abiotic depletion; GWP=global warming potential; HTP=human toxicity potential; ACD=acidification; EUT=eutrophication; and CED=cumulative energy demand.

64. Energy use among the same production systems with the same species can vary across regions. Pelletier *et al*., (2009) did life cycle assessment on salmon farming systems (marine net-pen) in Norway, the United Kingdom, Canada and Chile and found that there were also substantial differences in material/energy use and environmental impacts across countries (Table 7). Feed production had a dominant influence on all categories analysed, for example, feed accounts for 93% of farm-gate cumulative energy use and 94% of global warming and acidifying emissions. Despite the fact that they are producing essentially the same product, there were substantial differences of between 40%~80% in on farm level energy use compared with Norway, the most efficient one. The big difference in farm-gate cumulative energy use can be attributed to feed milling (21~54% difference compared to Norway) and food

conversion ratio (19~35% difference). Such major differences in the same production system across countries suggests that there is significant room for improvement especially through efficient feed sourcing and better feed conversion ratios. It also highlights the considerable cost efficiency of some species across countries and hence competitive advantage.

Table 6. Aggregate life cycle inventory data for salmon farming and salmon feed milling in Norway, the United Kingdom, Canada and Chile in 2007

	Norway	UK	Canada	Chile
inputs per tonne of salmon				
feed (t)	1.103	1.331	1.313	1.493
feed transport (t-km)	290.3	321.7	316.0	298.7
smolts (kg)	17.4	22.2	16.0	15.0
smolt transport (t-km)	1.2	3.9	3.2	3.0
total on-farm energy use (MJ)	646.8	904.0	933.7	1199.0
farm-level emissions (kg N/P)[a]	41.1/5.2	58.7/8.5	51.4/13.6	71.3/12.6
inputs per tonne of feed				
energy for feed milling (MJ)	902.6	1090.1	1393.2	1118.7
feed composition[b] (%)				
crop-derived meals/oils	35.3/6.1	32.3/1.1	43.4/5.1	36.9/5.8
animal-derived meals/oils	—	—	16.8/3.1	15.1/0
fish-derived meals/oils	33.1/25.5	40.5/26.1	20.9/10.7	25.1/17.1

Source: Pelletier *et al.*, 2009.

65. In conclusion, there is substantial scope for reducing energy use in aquaculture in that there are significant differences in energy use as well as other environmental aspects across countries, different production modes and different species. Innovations in feed ingredients and farming facilities, introducing best management practices in feeding and introducing more efficient and efficient regulations can help realise this potential. Combining aquaculture and new energy sources (such as windmill or sun energy) may also provide green growth opportunity in terms of energy use in the near future.

2.8. Governance

66. Governance can be defined as *the exercise of political, economic and administrative authority necessary to manage a nation's sector, which includes the institutions and mechanisms that are put in place to deliver public policy* (TAD/FI(2012)15). Governance is central to capture fisheries management due to the common property nature of the resource. In aquaculture, however, government intervention is of a different nature because aquaculture operations by nature require private investment and human intervention through the whole production cycle (i.e. procurement of site, seed, rearing and harvesting etc.) and are functionally more similar to agriculture than to wild capture fishing.

67. Competent governments' involvement and support for aquaculture through various policies was identified as a key factor in explaining the reason for differences in aquaculture development among seven Southeast Asian aquaculture countries (Cambodia, Indonesia, Malaysia, Myanmar, the Philippines, Thailand and Viet Nam). The capacity of public officials in a country mattered for the success of aquaculture development (Hishamunda *et al*., 2009). A recent study (Fukuyama, 2013) argues that the quality of government is the result of an interaction between capacity and autonomy, which is an inversed U curve with bureaucratic autonomy on the horizontal axis and the curve shifts upward right as capacity of bureaucrats increase. As the capacity of bureaucracies increase, they can be granted greater autonomy which improves responsiveness, flexibility and innovation in problem solving. Thus investments in human and institutional can help spur green growth, including in aquaculture.

68. In addition to a long tradition of seaweed aquaculture for food consumption, Korea has proactively invested in innovative research projects together with academia to create new opportunities for seaweed aquaculture. Since 2006, several national seaweed projects have been proposed such as using seaweed to reduce greenhouse gas emissions (GHG), to develop biomass energy sources and to develop environmentally friendly fish cage (Box 8). This case shows how government's vision and action can support green growth in aquaculture through R&D investment.

Box 8. Seaweed aquaculture for green growth: Korea's case

A five-year project on the reduction of greenhouse gas (GHG) emissions using seaweed was conducted starting in 2006. The project was funded by the Ministry of Maritime Affairs and Fishery and later the Ministry of Land, Transport and Maritime Affairs of Korea. The project uses innovative research on seaweed to develop new baseline and monitoring methods for the CDM and Project Design Document (PDD) of the Kyoto Protocol. Concurrently, members of the project and the APPA have been playing a key role in obtaining international recognition of seaweed as a GHG sink (Kang *et al*., 2008; Chung *et al*., 2011). The new concept of the Coastal CO2 Removal Belt (CCRB) has been established for natural and/or man-made plant communities in the coastal region to accomplish CO2 removal in the same way as a forest and that can be implemented on various spatial-temporal scales. About 10 tonnes of CO2 per ha per year could be removed in the pilot scale CCRB farm with perennial brown alga *Ecklonia*, estimated by the biomass increment and decrease in the dissolved inorganic carbon in the water column.

The biomass project was conducted by five Ministries of the government with a funding of USD 178 million. Each ministry has different projects but the final goal is to develop biomass energy sources, find bio-materials and reduce CO2. The Ministry of Food, Agriculture, Forest and Fisheries (MIFAFF) undertakes the "*Seaweed biomass production for green energy project*" with an objective of finding a substitute for 30% of gasoline consumption and increasing employment in this sector by 40 000 jobs by 2020.

An Integrated multi-trophic aquaculture (IMTA) project was modified as an environmentally friendly fish cage to include a tourist view point located on the eastern coast of Korea. The fish cage pilot was built in 2011 and the project will run from 2011 to 2013.

Source: TAD/FI(2012)11/ADD1

69. Although growth in EU aquaculture production has been small over the last decade, Aquaculture has the potential to boost growth and jobs both in coastal and inland areas of the European Union. The European Commission recently issued strategic guidelines to promote aquaculture development in the European Union, identifying key challenges facing the sector and policy measures to address them (Box 9).

Box 9. Strategic guidelines for the sustainable development of EU aquaculture

The European Commission in close consultation with stakeholders identified four main challenges facing the sector and presented proposals to address those challenges to unlock the potential of EU aquaculture.

- Simplify administrative procedures to reduce red tape and uncertainties. For example, licensing procedure in several EU member states often take 2-3 years while average licensing time for aquaculture farms in Norway has been reduced to 6 months from 12 months since the introduction of a single contact point. The burden of administrative costs (time) is substantial to aquaculture farmers given that most aquaculture farmers are SMEs.

- Introduce co-ordinated spatial planning to secure sustainable development and growth of aquaculture. Spatial plans can help reducing uncertainty, facilitating investment, identifying suitable sites and taking into account environmental aspects.

- Enhance the competitiveness of EU aquaculture with an improved market organisation and structuring producer organisations.

- Promote a level playing field for EU operators by exploiting their competitive advantages of high quality products complying with high environmental, animal health and consumer protection standards. New labelling and voluntary certification scheme can serve for this purpose.

The guidelines also presents a new governance to support EU aquaculture:

- Multiannual national strategic plan based on EU strategic guidelines for the promotion of sustainable aquaculture.

- Complementarity with European Maritime and Fisheries Fund.

- Exchange of best practices through peer review seminars to develop a mutual learning process.

- Aquaculture advisory council to utilise the knowledge and experience of all stakeholders for evidence-based decisions.

Source : European Commission (COM(2013)229final)

2.9. Stakeholder participation

70. Broad and active stakeholder participation in policy-making, planning and management is expected to produce more effective and informed policy responses while facilitating implementation. In addition, stakeholder participation can give policies more legitimacy and augment trust in government. Stakeholder participation makes it easier to develop more effective policies by bringing more information and experience into the process, building support while reducing opposition and conflicts among stakeholders (Sen, 2001). Therefore stakeholder participation can help make policies more effective, improve performance in production and with regard to environmental impacts as well as help on the public perception of the aquaculture industry.

71. Many countries encourage stakeholder participation in their aquaculture management process though the level of participation may vary. In Sri Lanka shrimp farmers are actively involved in the formulation and implementation of the crop calendar through their aquaculture organisations to avoid high risk periods in respect of stress factors, sustainability of water quality and post larvae quality (TAD/FI(2012)11/ADD1). Not only has this process resulted in a more realistic calendar by taking into

account more site-relevant information and experience but also helped implementation by increasing farmers' understanding and acceptance of the process.

72. The Japanese aquaculture industry put a priority on increasing production until the late 1990s. This resulted in excessive culturing density and excessive feeding potentially causing environmental and economic damage. In 1999, the Sustainable Aquaculture Production Assurance Act was enacted which emphasises the importance of the role of fisheries organisations and other local organisations. By the law Fisheries Cooperative Associations are asked to prepare a "Plan concerning the improvement of aquaculture ground" including measures for the prevention of infectious disease of aquatic animal and plants. While the Plan is authorised by the competent Prefectural Governor, Fisheries Cooperative Associations play an important role in the aquaculture management process (TAD/FI(2012)11/ADD1).

2.10. Gender equity

73. Women have an important role in fisheries and aquaculture. Worldwide, fish products support the livelihoods of 520 million people many of whom are women (FAO 2009, WorldFish Center 2009). Women are the main providers of health care and contributes to food security and poverty alleviation at the household level. Furthermore their roles at a macro level are significant contributing 47% of the labour force in the fisheries sector based on available statistics and case studies (FAO, World Bank and WorldFish, 2009). If statistics for aquaculture were included, these records could be higher.

74. Although women are more involved in aquaculture activities than in capture fisheries, gender inequalities remain important in both sectors. The inequalities may be more significant in aquaculture given the strong involvement of the women in the sector (Box 10).

Box 10. Gender inequality issues in aquaculture

In aquaculture, women are engaged in all activities along the value chain while in capture fisheries their most prominent role is documented in post-harvest, processing and marketing. Aquaculture, especially in Asia shows that women's labor contribution is often greater than men's. Women are reported to constitute from 33 percent of the rural aquaculture workforce in China to between 42 and 80% in freshwater and cage culture in Indonesia and Viet Nam. Hence, women could gain considerable economic independence and empowerment through their work in aquaculture. In this context, microcredit programs in Asia for example have promoted women's access to economic opportunities and employment.

The main issues of gender inequality in in the fisheries and aquaculture sectors include:

- Unrecognised, undervalued and/or unpaid contribution when working for a family enterprise
- Exclusion from decision-making bodies
- Limited access to credit, training, storage facilities and new technologies
- Lack of Information and data on gender

The following actions are required to in order to enhance gender equality in aquaculture:

- Providing working women with a legal/professional status and rights
- Support for improvement of women's work (training, funding opportunities)
- Development of research for gender and policy
- Recognising contribution (direct and indirect) of women to the economy
- Improve inclusion of women in decision making processes

Source : FAO, 2011, WorldFish Center 2009.

3. Developing a Policy Framework for Green Growth in Aquaculture

75. Green growth is fundamentally about increasing production while managing and reducing externalities. It can be achieved through technological developments (innovation), better management practices and improved regulations. Policies that offer flexibility to producers in fixing environmental problems and which provide incentives to innovate can help lead to improved growth. However, it is challenging to identify the right set of policy measures across a much diversified industry. This chapter will identify an optimal regulatory framework for green growth in aquaculture and discuss the benefits of an active innovation strategy to underpin a regulatory framework for green growth.

3.1. What is an optimal regulation for green growth in aquaculture?

76. Externalities occur from a number of market failures and market imperfections such as public goods, monitoring costs, asymmetric information problems and market incompleteness which make market price fail to fully reflect impact (or damages) caused by economic activities (Serres *et al*., 2010). As discussed above, aquaculture practices produce externalities with impacts on other economic sectors. Externalities can be solved by effective regulations or the emergence of community action (Ostrom, 1990)

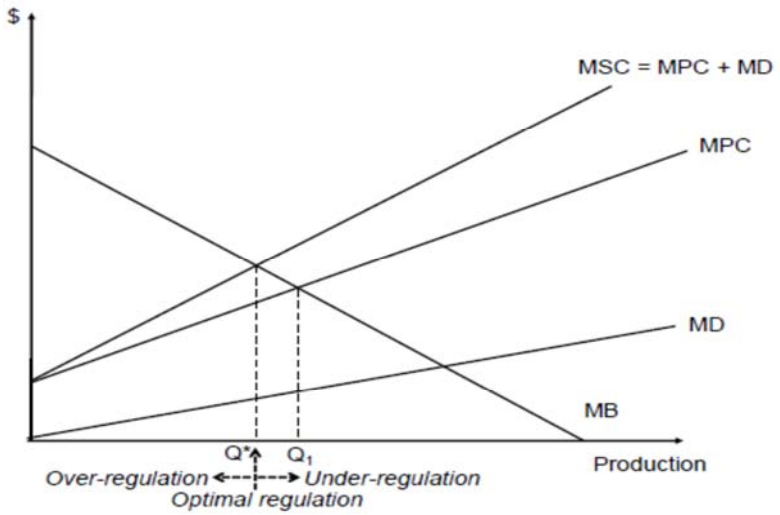
or bargaining between actors in a market if there are no transaction costs (Coase, 1960). In practice, however, where there are many players involved or significant transaction costs externalities are unlikely to be corrected without some form of policy intervention.

77. Optimal regulation equates the marginal cost of reducing emissions to the marginal benefit of doing so in terms of reduced environmental damage (Box 11). If these costs and benefits are well-known, quantity-based regulation can be used to set allowable discharge levels. It should also be taken into consideration that a regulatory approach does not always work optimally if there are information deficiencies and/or asymmetries. However, if there are risks or uncertainties of substantial or irreversible environmental degradation and species extinction, or if a society puts higher value on the environment than the benefits of aquaculture production, regulatory policy measures such as performance standards, technology standards or ban of aquaculture practices can be more effective than incentive-based mechanisms to correct for the externality.

78. Regulations can be informed by best practices and systems that have proven success in mitigating environmental risks and other unwanted impacts. Taking advantage of these lessons learned can ensure that the risks from aquaculture are reduced to acceptable levels while offering a high degree of certainty.

79. Regulations have to be carefully designed in order to ensure that the cost of compliance is as low as possible and that regulatory restrictions do not stymie innovations. To help minimise the cost of regulation, flexible approaches such as cap-and trade or a polluter-pays approach can complement a regulatory framework.

Box 11. Optimal regulation and optimal pollution level



MSC: marginal social cost; MPC: marginal private cost; MD: marginal damage; MB: marginal benefit

The optimal level of production is Q^* where the marginal social costs equal to marginal benefits. To the left of Q*, regulation is stricter than needed, i.e. over-regulation. To the right of Q*, regulation is weaker or absent than needed i.e. under-regulation There is room for green growth by moving towards Q^* for example by adopting incentive-based policies such as pollution taxes or individual transferable pollution quotas.

Source: Nielsen *et al.*, 2012.

80. For aquaculture to grow sustainably it must continue to address the externalities it causes, and share this information with stakeholders. The policy tools addressing externalities can be grouped in two categories, market-based instruments and non-market instruments (Box 12).

Box 12. Policy tools addressing externalities

Market-based instruments aim to address externalities and promote green growth mainly through price signals designed to equalise the private and social costs and benefits of economic activities undertaken by private agents. These include taxes, charges and fees, tradable permits, and subsidies. Non-market instruments aim at addressing externalities through means other than price signals. They include direct environmental regulations (e.g. technology standards, performance standards and ban of certain activities), active technology support policies and voluntary approaches including information-based instruments.

In principle, market-based instruments provide agents with incentives and flexibility to search for the least cost ways of meeting environmental targets and thus are more cost-effective than non-market instruments. Non-market instruments generally do not meet cost-effectiveness criterion because they provide no intrinsic mechanism for meeting environmental targets at the least economic cost. However, there are cases where non-market instruments will be more cost-effective or appropriate than market-based instruments. These include:

- when monitoring and enforcement costs and information problems are large,
- when emissions cannot be observed or easily monitored and there are no appropriate proxies for emissions,
- when relevant resources or environments to be affected are too important or sensitive to allow temporary deviation from policy targets,
- when information is lacking and costly to obtain, which leads to a weak response to price signals.

The best choice of instruments will differ across countries, environmental areas, region-specific circumstances, the nature and size of the predominant market failures and institutional capacities of respective countries etc. In addition, a combination of instruments will usually be more appropriate given the presence of several interacting market failures. The following table summarises the main features of policy tools for externalities.

	Market-based instruments		
	Strengths	**Weaknesses**	**Conditions for favorable use**
Cap-and-trade permit systems	Tend to equalisation of abatement costs Continuous incentives to innovation Certainty over emission levels Can raise revenue Once in place will be defended by stakeholders	High start-up costs Steep learning curve Lower adoption incentives due to costs Potential price volatility Competitiveness & income distribution issue	Public-good market failure is not dominated by monitoring and information costs. Sufficient institutional capacity (experience) and sufficient size of market Damage depends on overall amount of a pollutant not on specific location or timing of emission sources Precise control over emissions is available at reasonable cost Cross-border spill-over effects are important
Taxes or charges on pollution or exploitation of natural resource	Tend to equalisation of abatement costs Can raise revenue Continuous incentives to innovation Implementation through existing institutions	Potentially high monitoring costs Lower adoption incentives due to costs Uncertainty about emission level Lower adoption incentives due to costs Competitiveness & income distribution issue	Public-good market failure is not dominated by monitoring and information costs. Pollution sources are small and diffuse Environmental damage depends on overall amount of a pollutant and not on specific location or timing of emission sources Temporary deviations in emission levels have little damage on environment Precise control over emissions is available at reasonable cost

Taxes or charges on a proxy (input or output)	Implementation through existing institutions Lower monitoring costs than permits or direct taxes	Loss of static and dynamic efficiency relative to charges at source	Control of direct pollution discharge difficult or costly Close and stable relationship between use of input or output as proxy and targeted pollutant Several pollutants associated with single input or output
Subsidies	High adoption & compliance incentives than permits/ taxes	Potentially large budgetary costs May trap excessive resources Uncertainty about emission level	Enforcement of alternative pricing instruments is difficult or very costly Activity to be subsidised is a strong substitute for targeted "dirty" activity Subsidy programme can be designed in a relatively simple way, for a time-limited period and with minimal secondary effects
Non market instruments			
Command and control Performance standards	Leave flexibility to search for cheapest option Higher adoption & compliance incentives than pricing measures Certainty on emission level	Do not naturally tend to equalise marginal costs Potentially high administrative costs More information required than for permits and taxes	Pollution control at the source of emissions is infeasible or very costly No adequate proxy for pollutant that could be object of taxation Weak response of agents to price signals Pollution emissions can be measured from application of technology
Command and control Technology standards	Higher adoption & compliance incentives relative than pricing measures Low monitoring costs Certainty on emission levels	No flexibility to search for cheaper abatement costs not easily adaptable to new costs and benefits info. No incentives to innovate	Pollution control at the source of emissions is infeasible or very costly No adequate proxy for pollutant that could be object of taxation Administrative costs of performance standards are too high Abatement costs are relatively homogeneous across agents
Active technology support policies	High adoption and compliance incentives High incentives to invest in R&D of new technologies	Do not directly address externalities Potentially large costs/ Uncertainty on emission levels	Technology areas where market size and learning-by-doing effects are dominant Infrastructures in areas where network considerations are important
Voluntary approaches	Contribute to information gathering and dissemination on costs and benefits High adoption incentives	No intrinsic mechanism to encourage adoption of least-cost options Uncertainty on outcomes, Risk of collusion among participants	When the authorities can put strong pressures (credible threat of follow-up actions) Where information is not too costly to provide

Source : Serres *et al.*, (2010).

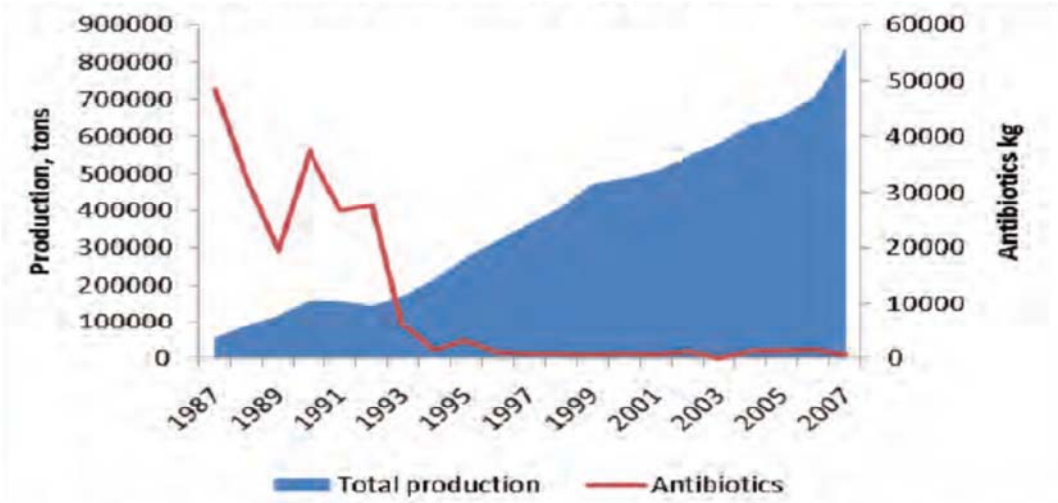
3.2. The role of innovations for green growth in aquaculture

81. An important part of any green growth strategy is promoting innovation. Ideally, innovation can lead to more production using the same level of natural resources while reducing negative impacts on the environment (OECD, 2011b). For this reason, most governments provide incentives for innovation by rewarding firms for undertaking R&D. Government expenditures on research and development is also common as innovations can bring broad benefits and can be considered a public good. Small scale farmers form the majority of producers in most countries, but often lack resources to innovate on their own. An

industry-wide approach to innovation activities in aquaculture (through industry organisations, fish farmer organisations, specialised university laboratories etc.) and a strategy for the diffusion of the results of the innovation can bring broad benefits. Also, public intervention may be needed to "kick start" innovations.

82. Technological innovations have played a very important role for growth in every aspect of aquaculture operations, such as control of life cycle, feed, facilities, reducing negative environmental impacts, to name a few. Asche (2008) summarised how innovations have contributed to aquaculture development: control over biological processes allowed systematic research which provided productivity improvements and potential for specialisation, which expedited many innovations in aquaculture. For example, the single innovation of a vaccine in 1991 reduced production cost by 5-10% and contributed to a dramatic decrease in antibiotic use in Norway while production volume increased more than 15 times (from 47 200 to 744 222 tonnes) between 1987 and 2007 (Figure 6).

Figure 6. Use of antibiotics in the Norwegian aquaculture industry



Source: The Norwegian Directorate of Fisheries and the National Health Institute from *Strategy for an Environmentally Sustainable Norwegian Industry 2009*.

83. As of 2010, a number of Danish trout farms adopted new recirculation systems. The most advanced model fish farm re-circulates at least 95% of water, reduces water intake about 15-25 times, and reduces discharge of total nitrogen, total phosphorous, and organic material by respectively 36%, 62% and 94% compared to the traditional farms (Jarlbæk and Børresen, 2011). In Denmark the most important factor limiting growth in trout aquaculture is nitrogen and phosphorous discharges in inland waters. Hence, in order to limit this pollution water purification processes/systems have been developed in freshwater aquaculture. The main reasons for changing to this innovative system are strict environmental regulations combined with strict regulations of using weirs subject to maximum feed quotas, statistical standard for nitrogen and phosphorous organic matter, minimum level of oxygen in the outlet water and a limit on water intake etc. (Jarlbæk and Børresen, 2011). Thus, on the one hand, the strict regulations have hindered the aquaculture development in Denmark, but it has also accelerated innovation in the sector. Several initiatives have been launched with the aim to increase the Danish aquaculture production in general such as exploring new concepts for aquaculture production with reduced environmental footprint.

84. The Norwegian salmon industry has sought to reduce production costs in many ways. Optimisation of holding facilities and handling and feeding equipment have contributed their share of the success in reducing production costs. However, the Norwegian selective breeding program[11] for salmon

[11] According to AquaGen, "In the last 40 years the progress in selective breeding has contributed to:

starting in the 1970s and a lowering of the fish feed conversion ratio combined with a lower use of fishmeal and fish oil in the feed have been the most important contributing factors to this success (OECD, 2010). The supply industries and the government have played important roles in this process. In Norway most farms are small family-owned companies with little resources for R&D have been dependent on their suppliers for this type of research (Box 13).

Box 13. Innovations strategies and green growth: Norwegian salmon farming case

The Norwegian salmon industry has experienced tremendous growth since the late 1960s due mainly to innovation in all areas related to salmon farming. There is a direct relationship between R&D, innovation and productivity growth in Norwegian salmon farming where successful R&D results in innovation has led to major productivity growth (Asche *et.al.,* 2012). The supply industry and the government have played a vital role in this process. Three historically important sources of productivity growth have been identified: 1) innovations in key technological areas; 2) increased know-how in all areas; and 3) economies of scale throughout the value chain (Asche *et.al.,* 2012).

Salmon farming firms can be listed under one of four categories, depending on their innovation strategies (Aslesen, 2007):

1. The family firm is a small family-owned and run company with little resources for R&D. Companies of this category do not have a real innovation strategy and rely on experience-based knowledge.

2. The coastal enterprise is a more professionally-run company than the family firm but has no interest in doing R&D. Companies of this type are mainly concerned with efficiency and cost control and they pursue an "anti-innovation" strategy by consciously avoiding new technologies until they have been proven to work by other companies.

3. Research-based entrepreneurs control parts of the value chain that require continuous R&D, pursue radical innovations and are happy to share their innovations with other companies in the cluster.

4. A company which is part of the science-based process industry is a fully integrated company which is able to apply its skill and capabilities to build a competitive advantage based on innovation.

Historically, most salmon farming companies in Norway have been small family-run firms that are dependent on their suppliers for innovations and new technologies. Currently there are only few companies that can be categorised as research-based entrepreneurs or part of the science-based process industry while quite a number of companies are still pursuing anti-innovation strategies.

As most salmon farming companies have lacked the means and capabilities to appropriate and internalize the benefits of their R&D-activities there are disincentives for salmon farming companies to take on large R&D investments. As such government funded research, which historically has been integral to the innovation system of Norwegian salmon farming, will continue to play an important role in the future. However, Asche *et al.* (2012) argue that productivity growth in salmon farming has stalled since the mid-1990s, coinciding with a drop in R&D intensity. Asche *et al*. (2012) hold that salmon farming companies themselves may need to increase their R&D-capabilities if the industry is to produce the kind of incremental and especially radical innovations that has been driving productivity growth in the past.

Figure 7. Production cost per kilo and production of salmon, tonnes

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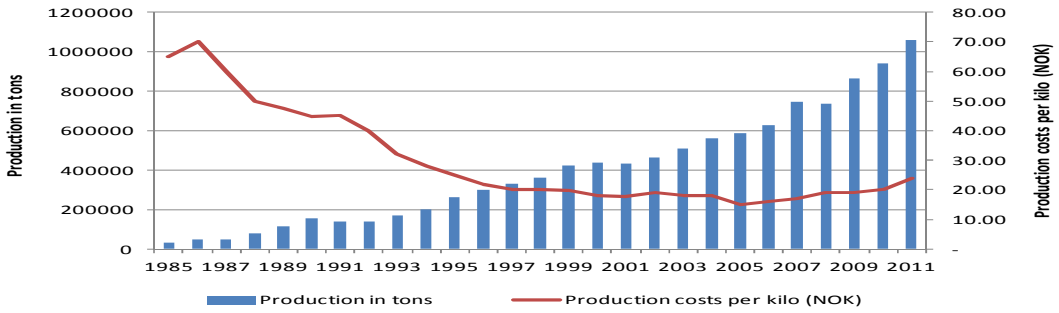
- A reduction in production time from smolt to harvest size from 24 to 14 months
- More efficient use of feed in that less feed is used per kilo meat produced
- Higher survival rate, for example, resistance to the viral disease infectious pancreatic necrosis (IPN) has increased
- Better filet quality in the areas of fat and color".

Source: http://aquagen.no/En/Breeding+Genetics/?module=Articles;action=Article.publicShow;ID=468;



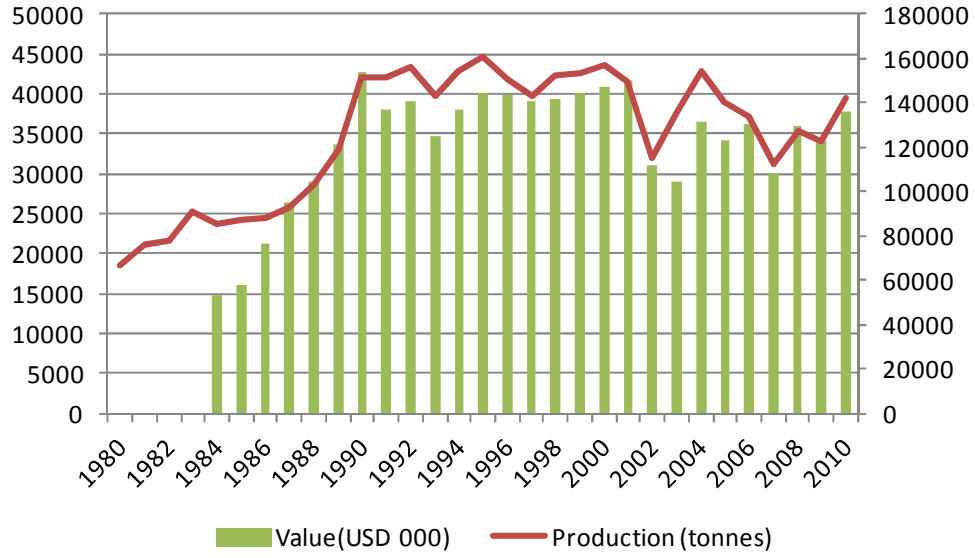
Source: Norwegian Ministry of Fisheries and Coastal Affairs, 2012.

4. Effects of Green Growth Policies

85. Many countries have already incorporated some green growth measures in their regulatory frameworks. However, little is known about the effects of adopting green growth measures in aquaculture policies and whether they have fostered or hindered the competitiveness of the industry in the global market for fish and fish products. Since about 50% of fish and fish products in the world are traded, the impact on competitiveness can have potentially important implications. While there is not much information available for in-depth analysis, there are several cases that provide some indication of effects of green growth policies on competitiveness in aquaculture development.

86. Denmark introduced a farm-specific feed quota system in the 1990s to prevent eutrophication and pollution from aquaculture production. Since then, Danish aquaculture production has decreased from 44 730 tonnes (USD 145 million) in 1995 to 39 507 tonnes (USD 136 million) in 2010 (Figure 8). The regulation has been criticised because of its inefficiency and lack of flexibility, which has led to the sub-optimal regulation of the sector (Nielsen, 2012). There was a rapid growth in production until 1990; since then the production has stagnated and later decreased (Figure 8). Nielsen (2012) showed that *changing this regulation to individual transferable quotas on nitrogen could increase Danish aquaculture production by 16% to 55% and profitability by five to ten times while keeping the current pollution level.* A new regulation for fish farming entered into force on 15 February 2012 giving the option to fish farmers to voluntarily choose regulation based on discharge with among others specific nitrogen limits instead of feed quotas. It is likely that this shift in regulatory framework will make the Danish trout industry more competitive. Other recommendations with the aim to encourage sustainable growth are still under consideration.

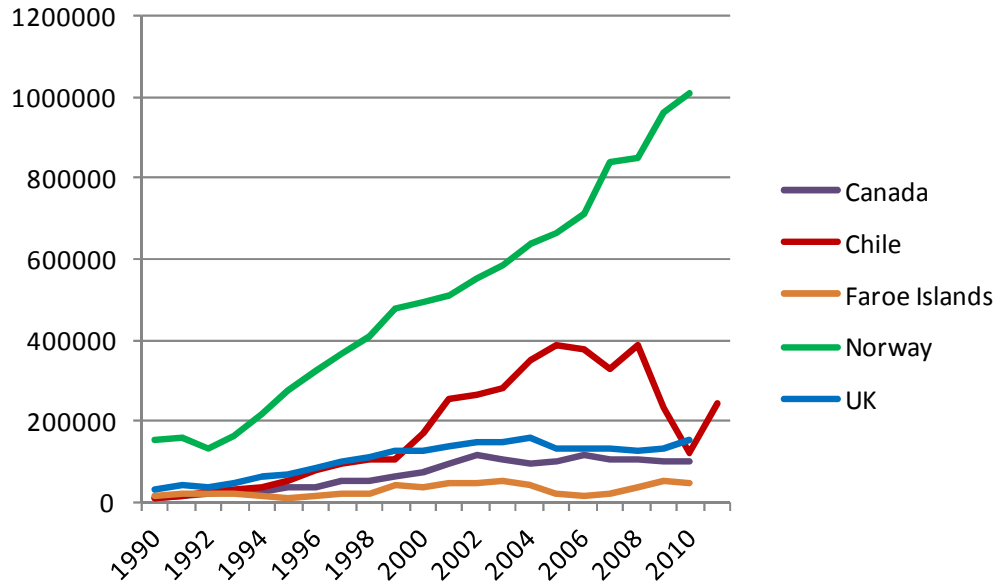
Figure 8. Danish aquaculture production between 1980 and 2010



Source: FAO Fisheries and Aquaculture Information and Statistics Service.

87. Chilean responses to the ISA crisis provide some lessons on the results of green growth policies. The ISA crisis led to a substantial decrease in the production of Atlantic salmon, a significant fall in the number of Atlantic salmon farms and a significant loss in direct and indirect jobs (Chile, 2012) (Figure 9). Though not fully recovered yet, there are signs of recovery and effects of the green growth policy. Production began to increase in 2011 followed by a reduction in the use of antibiotics which in 2008 was 350 times more than Norway per kilo of salmon produced (Chile, 2012, Asche *et al*., 2010).

Figure 9. Atlantic salmon production among major countries



Source: FAO Fisheries and Aquaculture Information and Statistics Service.

88. A compelling case has been put forward by Pelletier *et al.* (2009) (see Table 6) which have analysed carious factors through a life cycle assessment process of salmon farming across the four major producers Norway, United Kingdom, Canada and Chile. Among the four countries their analysis suggest that Norway comes out top of the group in terms of cost effectiveness which is interesting as Norway has pursued the most aggressive green growth policy.

5. Indicators

89. In order to know whether aquaculture is moving on a green growth path specific indicators to measure the progress are needed. Green growth, by its nature, has two dimensions i.e. green and growth, not easily captured by one single indicator. Also, the wide variety of production systems and species whose environmental effects may be positive or negative requires a set of indicators for each system. More generally, good indicators should be able to *monitor trends and structural changes, attract attention to issues that require further analysis and possible policy action and help measure how well policies are performing with respect to green growth* (OECD, 2011d). The key principles suggested by the OECD may help us to select relevant green growth indicators for aquaculture (Box 14).

Box 14. Key principles in selecting indicators to monitor progress in green growth

Policy relevance	The indicator set should have a clear policy relevance and in particular: • Provide a balanced coverage of the key features of green growth with a focus on those that are of common interest to OECD member and partner countries • Be easy to interpret and transparent • Provide basis for comparisons across countries • Lend itself to being adapted to different national contexts and analysed at different levels of detail or aggregation
Analytical soundness	The indicators should be analytically sound and benefit from a consensus about their validity. They should further lend themselves to being linked to economic and environmental modelling and forecasting.
Measurability	The indicators should be based on data that are available or that can be made available at a reasonable cost and that are of known quality and regularly updated.

Source : OECD, 2011d. Note: These principles and criteria describe the "ideal" indicator; not all of them will be met in practice.

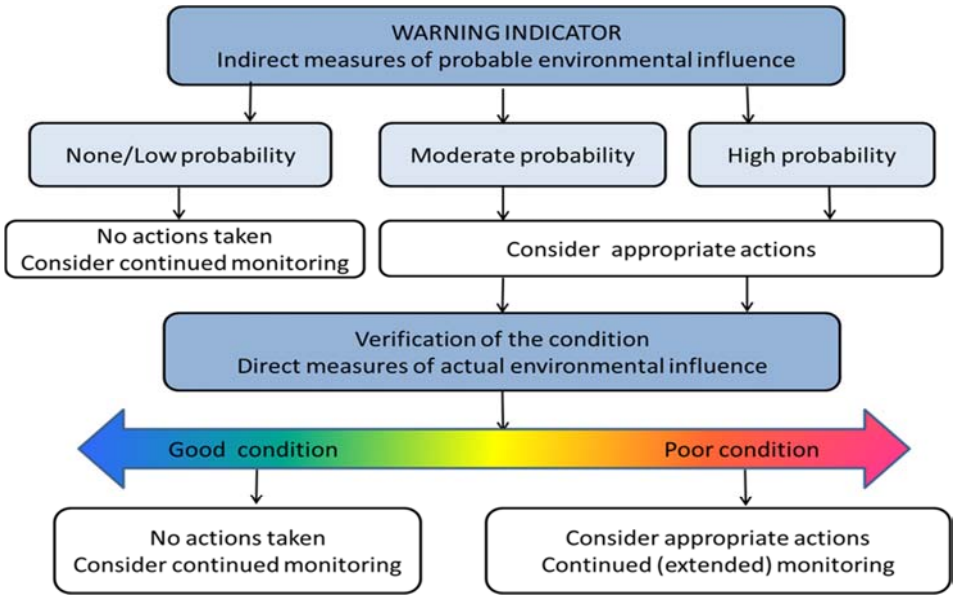
90. Based on these key principles several green growth indicators are proposed for a number of aspects of aquaculture production (Table 7). However, the proposed indicators do not pretend to be exhaustive or final.

Table 7. Proposed list of green growth indicators for aquaculture

Indicators	Aspects to be measured	Relevant fields
Feed conversion ratio (FCR)	Resource use efficiency (amount of feed ingredients such as fishmeal and fish oil, feed composition, feeding technology, feed loss, fish growth and disease), productivity, amount of discharge	Fed farming systems
Water quality	Environmental impact on surrounding waste, disease risk	Fed farming systems
Escapees	Biological risk	Fish farming systems except RAS system
Medicine	Disease risk, human health risk	All farming systems
Energy use	Contribution to climate change, Resource use efficiency	All farming systems
Water use	Resource use efficiency	Freshwater farming systems
Land use	Resource use efficiency	Inland farming systems
GDP contribution	Economic impact	All farming systems
Job creation	Economic impact	All farming systems

91. In Norway work is ongoing on establishing a set of measurable indicators of green growth in the salmon farming sector. The most important environmental challenges to solve for the Norwegian aquaculture industry in the short-term are escape of farmed salmon into the wild and the spreading of sea lice from aquaculture sites. The Norwegian government has initiated a work to develop and implement a concept of *indicators of sustainability*, together with action limits, to manage these two environmental challenges (Figure 10). The concept is based on a proposal from the Norwegian Institute of Marine Research and the Norwegian Veterinary Institute, with contribution from the Norwegian Institute for Nature Research. The government will stimulate further research and will evaluate and continuously update both indicators and action limits taking into account state of the art knowledge.

Figure 10. A concept of sustainability indicators in Norway



Source: Norwegian Ministry of Fisheries and Coastal Affairs.

6. Key Findings

92. Several key findings can be drawn from the discussion in this Study.

- Green growth is feasible in aquaculture: There are advanced technologies, best management practices, regulations and governances available. Also there is substantial scope for green growth in aquaculture in that there are significant variations in environmental impacts between regions, production modes and species as well as in productivity.

- Green growth is important in aquaculture not only to increase production while maintaining environmental quality, but also to make it more acceptable to the public and thus increase its competitiveness in the market.

- Green growth in aquaculture is an on-going process, not an end, and in this regard developed countries and developing countries can learn from each other's experience. Many developing countries have already adopted green growth policies in various forms.

- Sharing best practices in rearing process or policies or institutional arrangements internationally can help both individual farms and countries moving toward green growth. Special assistance might be appropriate in this regard for developing countries.

- Adopting green growth policies affects economic, social and environmental outcomes as well as the competitiveness of aquaculture sector. In some cases adopting a green growth agenda will lead to lower production costs and enhance competitiveness.

- Governments play an important role in the promotion of green growth in aquaculture by providing a predictable working environment, delivering innovation through R&D, introducing biosecurity measures and by setting incentives to produce within acceptable norms etc.

- Environmental externalities and space competition are key issues to be addressed by aquaculture policy makers to ensure sustainable growth of aquaculture.

- Improved regulation can lead to growth. Effectively addressing externalities is key to unlocking future growth potential, especially in OECD countries.

- The co-culture of bi-valves can be effective in reducing nitrogen and phosphorus discharges. Market development initiatives for the produced bi-valves can help spur co-culturing, as can finding a way for producers to capture the value of their water cleaning effects.

- Innovation in technology in all aspects of aquaculture such as domestication of new species, vaccine, feed ingredients, feeding, and rearing material and system can help green growth at the production level while addressing the environmental challenges.

- Innovations in institution and governance can bring needed flexibility and adaptability to management systems.

- Involving of all stakeholders can yield more effective and informed policies, improve implementation and create incentives for self- enforcement. Introducing appropriate biosecurity measures is the key safeguard to sustainable growth in aquaculture given the trend of globalisation and the increase in intensive aquaculture. The introduction of non-native species should only be done with utmost vigilance.

- Spatial planning such as integrated coastal zone management can help identify suitable farming sites, reduce uncertainty, facilitate investment, take into account environmental concerns, and help avoid conflicts among users.

- Introducing green growth policies may increase cost to producers in the short run but can be turned into a competitive advantage in the long run, notably by informing consumers through certification schemes or labelling. In this respect both public authorities and private producers have an important role to play in improving the image of the aquaculture industry.

- For government and international organisations dealing with aquaculture development it is imperative that the quality of statistics be improved. This concerns both reliability of data and coverage.

- In parallel with improved statistics, effective monitoring and evaluation frameworks needs to be developed to ensure that actions are taken and that they lead to concrete benefits. This will also help other countries still considering green growth in aquaculture (sharing experience) and can help create best practice.

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TRADE AND AGRICULTURE DIRECTORATE
FISHERIES COMMITTEE

TAD/FI(2013)10
For Official Use

ENERGY USE IN FISHERIES: POLICY RESPONSES

23-25 October 2013

This document is presented to the 112th Session of the Committee for Fisheries under item 3 iii) of the draft agenda and is distributed for DISCUSSION.

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NOTE FROM THE SECRETARIAT

This document follows the report *A Green-Growth Perspective on Energy Use in Fisheries and Aquaculture* [TAD/FI(2012)1/FINAL]. That document was a stocktaking exercise on the determinants of energy use whose purpose was to set the stage for the work that appears in this report. That document was approved by the COFI at its 110th Session in April 2012.

This companion document considers policy options to improve energy efficiency in fish production and makes some recommendations for reform. It is presented to the 112th Session of the COFI for discussion. This document will also form part of the "Green Growth in Fisheries" synthesis document a first draft of which is expected for the 113th Session.

EXECUTIVE SUMMARY

Reducing energy use and related carbon emissions is an important goal in most OECD countries, motivated by concerns regarding energy security, reliance on fossil fuels, and climate change. For fisheries, there is an added interest in energy efficiency as fuel costs are often the largest cost item for fishers.

Previous work on energy use in fisheries and aquaculture [TAD/FI(2012)2/FINAL] identified three tracks to follow in improving energy use in fisheries:

1. ***Improve the management system***. A healthy stock status increases catch per unit of effort and so can deliver increases in energy efficiency as well as better long run results for the sector generally. In some cases, specific restrictions on gear types can increase energy efficiency. When the stock is below the optimal size the best way to enhance energy efficiency is to improve the status of the stock.

2. ***Change fishers' behaviour***. Fishers make choices based on the information available to them and the incentives they face. Helping fishers to understand how their choices affect their energy use has been shown to lead to significant improvements. Also, identifying and modifying regulations that inadvertently encourage energy-intensive methods of fishing can provide opportunities for fishers to improve efficiency.

3. ***Make better use of technology***. While new investments in improved technologies such as vessel and gear design tend to be relatively expensive ways to increase efficiency compared to the alternatives, there is scope for profit- and efficiency-enhancing technical improvements in fisheries.

Energy efficiency is an important goal, but it must be achieved in the context of the other objectives for the fishery—such as healthy stocks, profitable fishers, social and environmental responsibility. When following these tracks towards improved energy efficiency, the following policy principles can help to ensure that progress does not come at the cost of the overall health of the fishery and profitability of fishers.

- The first principle to improve energy efficiency is to ***get prices right***. The literature on carbon taxation makes it clear that pricing externalities is a crucial part of ensuring that fuel is used optimally. In this respect, fuel tax concessions are a step backwards, making fuel less expensive than it should be to achieve the best outcomes.

- The second policy principle is to ***give fishers as much flexibility as possible***. If fishers are to change their behaviours to improve efficiency, the regulatory environment will have to give them the opportunity and space to do so. Market-based approaches are well known to improve efficiency by promoting sector adjustment. Community-based or other devolved approaches that give fishers more self-determination can also help. Allocation of fishing opportunities according to gear or vessel type prevents switching to more efficient gears and should be avoided. Restrictive policies should be reviewed to determine if their objectives can be met in other ways that allow fishers to make efficiency-enhancing improvements.

- The third principle is to ***avoid subsidies where possible.*** Using budgetary support to promote certain practices or reduce costs is appealing because of their direct connections to objectives

and ability to deliver value to the recipients. However, past experience indicates that subsidies are often less able to deliver results than anticipated. Moreover subsidies can expand capacity and desired effort, and therefore put strains on the management system and the resource stock.

- The fourth principle is to ***mandate improvements***. Setting targets for improvements provides incentives for innovation and creates benchmarks for success. In parallel, support and encourage innovation through targeted support to research and development to help defray the costs of achieving set targets. Use adaptive management techniques to track progress and identify and remove obstacles to improvement.

- The fifth principle is ***build energy efficiency objectives into fisheries management***. Energy efficiency has to become a normal consideration in the policy development process. Different elements of energy policy such as standards and training in combination with incentive programmes can be useful when combined with other parts of the system such as catch allocation to increase their overall impact. This could be done by making access to certain other support policies contingent on the recipient having participated in auditing or training exercises or conforming to a voluntary or mandatory standard.

Fishers can improve their energy efficiency either through general productivity improvements or through specifically targeting the efficiency of energy use. Productivity improvement has been a matter of policy interest for some time, as has been improving the effectiveness of management systems. In this sense, making better use of and improving existing approaches is a sensible way to promote innovative improvements in energy efficiency.

Fuel tax concessions are a popular policy, and successful reform will require recognising and replacing the benefits that these policies deliver to fishers. One way to do this is to follow the "feebate" model, where revenues raised by taxation of fuel are returned to the sector as a direct subsidy that does not impact fuel consumption but delivers the same income transfer.

Improving energy efficiency starts with reforms that ensure that the existing policy set is operating as well as it can. That doesn't mean that there is nothing to be done in terms of directed energy policy. Support to research and development to bring new innovations is a longstanding and useful policy tool—though one that works best when it provides broad latitude for technology development and avoids picking specific technologies to promote. Providing fishers with information support to help them make better decisions regarding their operations, through energy audits and training and the like, is also fruitful to do. Making access to support policies contingent on meeting energy efficiency objectives can help spur improvements and participation by fishers.

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ENERGY USE IN FISHERIES: POLICY RESPONSES

Introduction

1. Reducing energy use and the energy intensity of production is a growing priority in many countries. This is in response to several factors, most importantly concerns about climate change, fossil fuel use, and geopolitical risk. The fisheries sector is not immune to this policy priority and will be called upon to find ways to improve and contribute to national objectives and targets.

2. In addition, fuel expenditure is for many fisheries the most important cost item, so finding ways to improve energy efficiency can improve the bottom line for fishers. There are many reasons why fishers may not be using the most energy-efficient approaches. And there is some potential for policy to put improvements in place to address this.

3. The paper *Green Growth and Energy use in Fisheries and Aquaculture* [TAD/FI(2012)2/FINAL] identified some of the main determinants of energy use. These were categorised as the impact of the rules imposed by the fisheries management system, the choices made by fishers, and the capital employed in fisheries, as embodied in fishing vessels, material and gear. This paper follows up on that report by investigating how policy can help improve energy efficiency.

4. One of the main concerns in formulating policy to improve energy efficiency is the need to ensure policy coherence with the other objectives of fisheries management. Improving energy efficiency is important but must not be done at the cost of an inefficient or unprofitable fishery sector, and should not compromise stock management. The best policy solutions are those that enhance energy efficiency while at the same time improve profitability and other social, economic and environmental goals.

5. In this document, the term "fishery management system" will be used to mean the regulations and institutions involved in stock management and harvesting activities of fishers. Fisheries policy is composed of the fisheries management system plus other programmes or policies that deliver services, incentives, benefits or otherwise impact fishers. For example, TAC setting is part of the fishery management system, but a fuel tax concession is a policy affecting the price of fuel and the decision on fuel tax concessions are often taken outside fisheries management institutions. It makes sense to consider these elements of the policy set separately because of their different objectives and natures.

6. The need for green growth arises when "business as usual" does not fully account for environmental limits and social concerns. The OECD "Green Growth Strategy" (GGS) represents a set of principles and approaches that aim to ensure that policies promote economic growth that is sustainable and matched to public objectives. The GGS emphasises a focus on being specific about the process of achieving reform and measuring progress (Figure 1).

Figure 1. The OECD approach to Green Growth

Source: Adapted from OECD 2010, *Interim Report of the Green Growth Strategy: Implementing our commitment for a sustainable future: Meeting of the OECD Council at Ministerial Level* C/MIN(2010)5 Paris, 27-28 May 2010

7. Green growth implies policies that either incrementally reduce resource use per unit of value added (relative decoupling) or keep resource use and environmental impacts stable or declining while the economy is growing overall (absolute decoupling). In the context of fisheries, this should be modified to understand that the primary resource (fish stocks) is managed at some optimum level while the economic value delivered from that resource is continually increased, through improved value and via productivity improvements that reduce production costs and the use of other resources (such as fossil fuels).

Governments have at their disposal a wide range of instruments for achieving green growth (Table 1). In general, no one instrument or type of instrument can be singled out as more appropriate or efficient. The optimal mix of policy instrument depends on the objective to be achieved, and the environmental, economic, social and political context in which the instrument will operate.

Table 1. Green Growth Policy Toolkit

	Green growth policies
Environmental regulations and standards	• Strengthen rules and standards • Improve enforcement of environmental regulations and standards and certification
Support measures	• Remunerate provision of environmental public goods (ecosystem enhancement, stock enhancement) closely targeted to environmental outcomes • Target environmental outcomes where feasible, otherwise target actions and operations • Target public investments in green technologies
Economic instruments	• Impose charges/taxes on use of environmentally-damaging inputs such as fuel • Implement trading schemes for carbon emissions • Address policy constraints (governance, etc.) in less developed economies
Trade measures	• Lower tariff and non-tariff barriers bearing in mind the potential impact on environmental concerns such as sustainable resource use. • Eliminate export subsidies and restrictions • Support, well-functioning markets
Research and development	• Increase public research on sustainable production systems • Promote private R&D through grants and tax credits • Undertake public/private partnerships for research
Development assistance	• Allocate more development aid for environmentally sustainable initiatives • Raise profile of fisheries in Poverty Reduction Strategies • Allocate more funding for fisheries in Aid for Trade projects
Information, education, training and advice	• Increase public awareness for more sustainable patterns of consumption such as via eco-labelling and certification • Incorporate best practices in training, education and advice programmes throughout the entire value chain

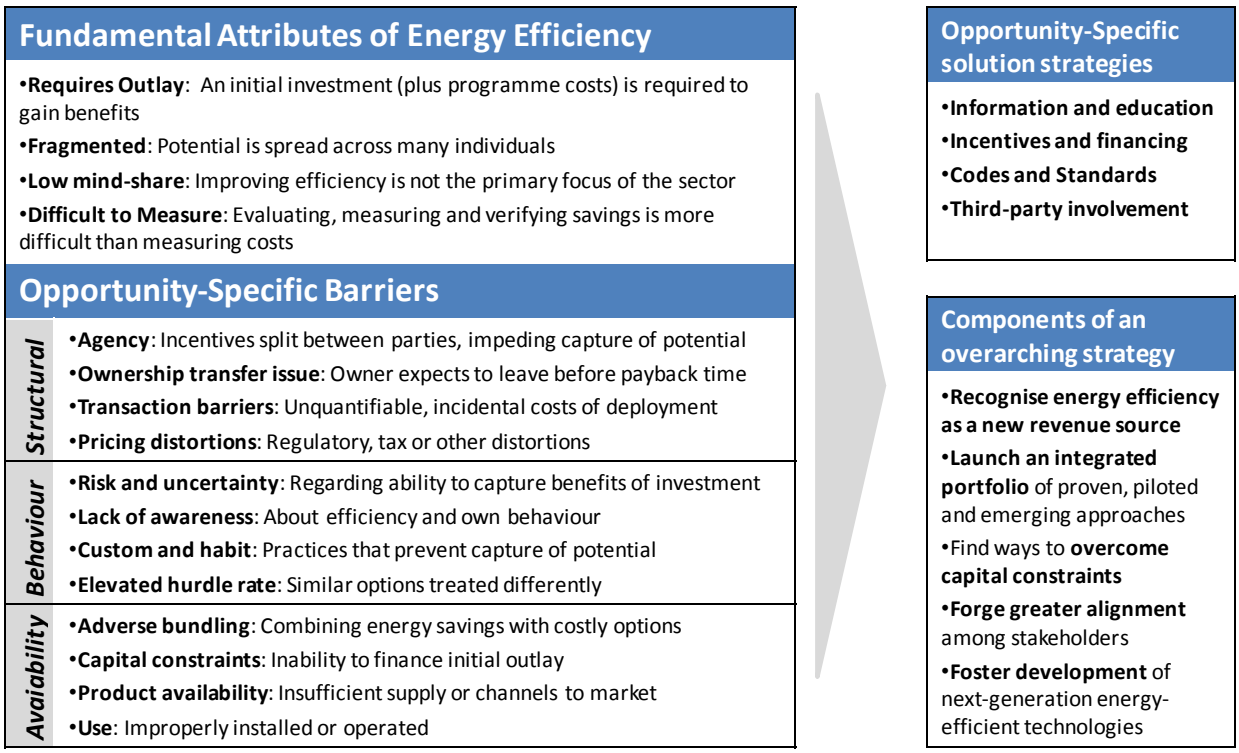
Source: Adapted from OECD (2012) Policy Instruments to Support Green Growth in Agriculture - Main Report [COM/TAD/CA/ENV/EPOC(2012)32/FINAL]

Barriers to improving Energy Efficiency

8. The paper *Green Growth and Energy use in Fisheries and Aquaculture* [TAD/FI(2012)2/FINAL] identified several examples of improvements in energy efficiency that would also lead to improved profits for fishers. Why are such potentially beneficial changes not made? There are a number of reasons why energy efficiency techniques or technologies are not implemented in practice, and understanding these can help shape policies to overcome these barriers to progress.

9. In an study of the potential benefits of improved energy-efficiency, Granade et. al (2009) identify and classify a number of barriers, and provide some suggestions for overcoming them (Figure 2). These barriers have to do with individuals recognising the benefits of adopting new approaches, and being able to afford and obtain those benefits without undue risk.

Figure 2. Challenges associated with pursuing energy efficiency



Source: Adapted from Granade, Hannah Choi, Jon Creyts, Anton Derkach, Philip Farese, Scott Nyquist and Ken Ostrowski (2009) Unlocking Energy Efficiency in the US Economy, McKinsey and Company.

10. The broad and fundamental nature of these barriers means that pursuing energy efficiency in fisheries and aquaculture will often mean a rethink of current policy approaches and practices in the fishery. New policies on their own are unlikely to be able to overcome existing barriers to improvement, even when those improvements are profit-enhancing for fishers and beneficial for society as a whole.

General approaches to energy policy

11. Most OECD countries have policies in place to promote energy efficiency. Some of these already impact the fisheries sector, while others set out an approach that could be applied to fisheries and aquaculture.

12. Japan has one of the most comprehensive energy policies and achieves a relatively high level of GDP per unit of energy consumption. Japan has set minimum energy performance standards (MEPS) for appliances and electronic equipment. The "Top Runner" programme introduced in 1998 required that new domestic and imported products must match the efficiency of the best performing examples at the time the standard was set. This applied to gasoline- and diesel-fuelled cars and trucks as well as many other items. Japan requires appliance energy labels, including the international Energy Star logo. (Geller *et al.* 2006).

13. Japan has a mix of voluntary and mandatory measures for industry. The Energy Conservation Centre offers energy audits for businesses and requires businesses of certain sizes to have a certified energy manager and develop energy conservation plans.

14. In the United States, Corporate Average Fuel Economy (CAFE) standards for motor vehicles have contributed to a significant increase in average fuel efficiency of vehicles. Appliance standards reduced the energy use by refrigerators and freezers by 70% between 1972 and 2001 (Geller 2003). Recent legislation regarding minimum energy efficiency of light bulbs has led to the de-facto elimination of incandescent bulbs in the US market. Mandatory energy codes for buildings exist in many states.

15. Between 1961 and 2008, the US government has made nearly USD 172 billion (in 2005 dollars) in R&D expenditures for the development of advanced energy technologies and for the necessary underlying basic science (Dooley 2008).

16. In Europe, Sweden supported commercialisation of high-efficiency appliances through bulk procurement programmes. Germany pursued a voluntary agreement with industry to reduce CO2 emissions intensity by 20% between 1990 and 2005. In exchange, businesses could receive low-interest loans and the government agreed to postpone new energy regulations. In the Netherlands, the country entered into agreements with industry to develop and implement energy efficiency plans with the government providing technical and financial assistance for upgrades.

17. Ireland, Finland, Denmark, Germany, the Netherlands, Norway, Sweden, Switzerland and the United Kingdom have put in place taxes on carbon emissions. The EU Emissions Trading Scheme (EU ETS) uses a "cap and trade" approach to internalise the costs of carbon emissions for firms.

18. These national experiences identify a number of approaches with potential application to the fisheries sector. These include:

- Setting efficiency standards for new equipment;
- Using energy efficiency labels to inform consumers (fishers);
- Setting efficiency standards for operations;
- Reaching agreement with stakeholders regarding efficiency objectives, with or without related incentives. This can be negotiated as an alternative to traditional regulation;
- Education, audits and planning services provided to fishers, with participation either voluntary or mandatory. Subsidies to investment could be tied to completed energy audits or the creation of an energy efficiency plan;
- Direct government research into basic and applied science of energy efficiency;
- Taxation or regulation of energy inputs or carbon emissions.

Optimal policies in the presence of externalities: Pigouvian taxes.

19. Policy commitments to reduce greenhouse gas emissions are a main reason why energy use in fisheries is important. Specifically, carbon emissions are an un-priced externality of fuel use. The standard economic analysis of optimisation in the presence of externalities gives important insights as to how policies can deal with this situation. First among these policies are taxes designed to "internalise" the externality by bringing prices for fuel equal to the true social cost. Such a tax is termed a "Pigouvian tax" and is an important means to optimise fuel consumption in terms of maximising social welfare.

20. To derive the Pigouvian tax for fuel consumption, start with a social objective function that maximises consumer surplus minus the costs of production and the costs of the externality (in terms of environmental impact or other things).

$$MAX \int_{s=0}^{Q} P(s)ds - c(\varepsilon)Q - D(\varepsilon Q),$$

where P(Q) is the inverse demand function, c(ε) is the cost of production as a function of emissions ε and D(εQ) is the external damage function. If the fisheries manager was setting emissions directly, they would do so according to the first order condition that arises with taking the derivative of the above with respect to emissions:

$$-c'(\varepsilon) = D'(\varepsilon Q^*),$$

that is, equate the marginal cost of reducing emissions to marginal damage resulting from emissions at the optimal production level.

If the fisheries manager wishes to find the optimal production level given the external damage caused by emissions, this is done by taking the derivative with respect to quantity, which leads to the condition that sets price equal to marginal cost, including external costs:

$$P(Q^*) = c(\varepsilon^*) + D'(\varepsilon^* Q^*)\varepsilon^*.$$

21. Optimal production and emissions is obtained by imposing a tax on fishers equal to the damage caused by their emissions, $\tau = D'(\varepsilon^*)$. These two first-order conditions describe optimal choices for regulatory or tax-based (market) control of emissions from fisheries, respectively.

22. Defining the optimal tax serves as a useful focus to understand what policy fundamentally has to achieve. Without pricing energy at an amount equal to its social cost, including externalities, there is little hope of an optimal use of energy by fishers. A Pigouvian tax allows the optimal level of fuel use to be identified (by market outcomes) and achieved (through the incentives it provides) in a single policy. Any other approach requires a highly uncertain process by which the government identifies and achieves, through regulation or subsidy, a specific fuel consumption or efficiency target.

23. Applying a Pigouvian tax still leaves quite a bit of flexibility regarding policy options, both in terms of how the tax is applied and complementary policies to mitigate any undesirable consequences. Pigouvian taxes can be combined with other policies such as standards, mandates or subsidies. Such policy combinations make sense when a "first-best" option is not available (Bennear and Stavins 2007).

Fuel tax concessions

24. Fuel tax concessions (FTCs) can be considered as a Pigouvian tax with a negative value. But where Pigouvian taxes are explicitly intended to correct a negative externality, FTCs can have a number of objectives. For example, FTCs are used to boost revenue and profits for fishers, to ensure that certain energy-intensive fisheries segments continue to operate, to buffer the production impacts of increasing fuel prices or to reflect the fact that fuel taxes are a user fee for roads and other infrastructure. Some objectives of FTCs may in fact be more readily achieved through other policies. Direct payments are a more efficient way to increase income, for example.

25. The impact of FTCs can be broken down into two main effects. These are an output effect where lower input costs lead to additional effort in the fishery, and a substitution effect where more fuel will be

used relative to other inputs by virtue of the changed cost ratio with respect to other outputs. FTCs are commonly considered to be an environmentally harmful subsidy inasmuch as they subsidise fossil fuel use.

26. The effect of an FTC on output is strongly conditioned on the management system in place. If effort is effectively controlled, then the FTC will not change effort. It is possible however for the FTC to lead to a higher level effort if the fishery than would be the case without the FTC. This is the case, for example, if a fishery is dependent on FTCs to remain economical, as otherwise fuel costs would be too high to allow a profitable fishery.[1] Even though that fishery may be under effective control, eliminating the FTC would lead to a reduction of effort (perhaps even shutting down the fishery), while increased fuel subsidies would not increase effort. This is an example of an asymmetrical, non-marginal impact of an FTC.

27. Even if FTCs do not increase effort in well-controlled fisheries, they can increase the desired amount of effort; the amount of effort that would prevail in the absence of management controls. Greater divergence between desired and permitted effort levels increases pressure on fisheries management and can lead to unintended IUU fishing.

28. Some degree of input substitution in response to FTCs is to be expected, as the ratio of the cost of fuel to the cost of other inputs declines. The extent to which this happens depends on the flexibility of the fishery, defined as the potential substitutability of inputs in the production process (see Annex 1). Fisheries will always be less flexible in the short run than in the long run. In the long run, fishers can change vessel, gear and crew configurations, and investment decisions will take FTCs into account. It is commonly assumed that short run inflexibility will always apply, but for any policy of significant duration the higher long run flexibility is more relevant when considering its potential impact.

29. Annex 1 provides a mathematical analysis of the impacts of FTCs on the basis of the Gordon-Schaefer model. That analysis demonstrates that FTCs can impact fisheries, and that impact depends on a number of different variables (Table 2).

Table 2. Parameter values and FTC impacts

Parameter	A high parameter value will make the decrease in harvest at MEY
Price elasticity	Smaller
Catchability	Smaller
Intrinsic growth	Larger
Cost of effort	Larger
Maximum stock size	Smaller

Source: Waldo (2013) The impact of fuel tax concessions in fisheries. Consultant's report to the OECD.

30. Fuel tax concessions are used in most OECD countries. Where they are in place, they likely increase the energy intensity of fishing and are therefore incompatible with the goal of increasing energy efficiency. Despite this, fuel tax concessions remain popular and resistant to change. Recognising the negative consequences of FTCs and the optimality of a Pigouvian tax approach to fuel pricing for fisheries is unlikely to be enough to lead to a policy change.

1. The example of a fishery that depends on FTCs to exist is essentially a speculative one. Without actually eliminating an FTC, it is impossible to know the extent to which a fishery depends on it, even if fuel costs are high. Moreover, other means of exploiting the fish stock are likely to be available, so while the gear used may change, it is unlikely for a fishery to be entirely abandoned.

31. Nevertheless, finding acceptable routes to reform for FTCs is an important part of improving fuel efficiency. The key to success is identifying the benefits provided by FTCs and finding other means to achieve them that do not have the negative side-effects of FTCs. It should be possible in principle to identify policy alternatives that lead to superior outcomes in terms of total social benefits and are acceptable to stakeholders who benefit from existing FTCs.

32. One possible approach is **reinstrumentation**, which means changing policy instruments while leaving intact the same level of policy transfer. This has been used successfully in several contexts and is part of OCED advice on practical reform strategies (OECD 2008). This could involve for example calculating the financial transfer of the FTC and delivering the equivalent amount in the form of a direct payment, aid to investment, or other form of support. For reinstrumenation to be successful, new policies must be seen by beneficiaries as delivering the same benefit as the old ones with a high probability.

33. In some cases reinstrumentation can deliver increased benefits at the same cost. The income gain from a fuel tax concession is less than that from a direct payment of the same amount, as the fisher needs to take a particular action (purchasing fuel) to benefit from the FTC. Inasmuch as the FTC changes fishers' behaviour, it introduces additional costs and adds deadweight losses. Direct payments such as fixed income payments do not suffer from this problem and are more efficient ways of transferring income (Martini 2011).

34. Another approach is to use a combined **tax-rebate scheme**. Such programmes combine a tax with a fixed payment that redistributes the tax revenue back to those who pay the tax (see for example Fischer 2001). The tax revenue is distributed in a manner that does not depend on the actions of individuals, but only on average behaviour of the sector as a whole. As a result, the rebate does not influence choices as the recipient cannot get a higher payment by changing their behaviour. The associated tax does depend on the actions of individuals (they pay tax according to how much fuel they use), and provides an incentive to conserve. This can be an effective way of altering incentives while still delivering support.

35. In the case of FTCs, the value of the concession can be calculated as the total change in the transfer delivered by the FTC divided by the number of fishers (Box 1)[2]. Without the FTC, fishers will pay fuel tax according to their individual fuel use, but receive a rebate that depends only on the average fuel consumption of the fleet. Individually they will have an incentive to conserve fuel, but the sector as a whole receives the same fuel cost-reducing transfer as before.

2. In practice, the rebate has to be calculated by fleet segment such that fishers receive a rebate equal to the average amount of tax paid by fishers *of the same type*. This will prevent large transfers of funds from larger to smaller fleet segments.

Box 1. Replacing an FTC with a tax-rebate scheme

Eliminating an FTC is like imposing a tax with the same rate per litre as the concession. To see how an FTC could be replaced by a tax-rebate, or "feebate" programme, use the following calculations:

1. Eliminate the FTC; fishers now pay an additional amount of fuel tax equal to the rate of the FTC.

2. Calculate the tax paid by each vessel type as the additional tax rate per litre multiplied by the measured fuel consumption by that vessel type.

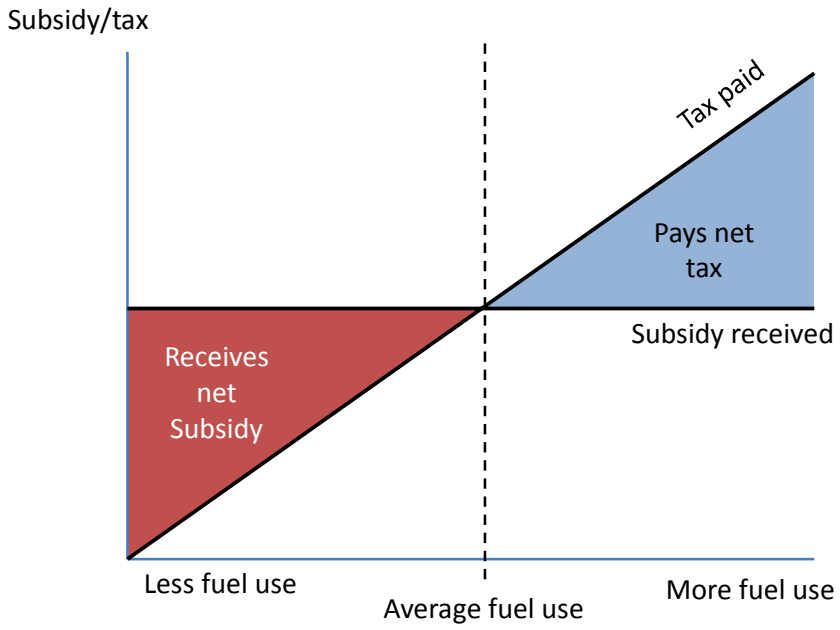
3. Calculate the rebate for each fisher as the average amount of fuel tax paid by that vessel type divided by the number of vessels of that type.

The rebate has to be calculated by fleet segment such that fishers receive a rebate equal to the average amount of tax paid by fishers of the same type. This will prevent large transfers of funds from larger to smaller fleet segments.

If there are a large number of vessels, the payment received by the fisher is not affected by the amount of fuel they actually consume, because this forms only a small amount of the overall average. So the payment will not result in the fisher spending more on fuel than they would have otherwise. By having to pay tax on their fuel use, they have an incentive to conserve fuel as they will pay less tax as a result.

36. This approach works because in terms of promoting energy efficiency, a fuel subsidy is bad only to the extent that it increases fuel consumption. By taxing at the margin and rebating according to the average, fishers receive a payment that defrays the cost of fuel but does not provide an incentive to use more of it. That is, they pay a higher price for fuel, which gives them an incentive to conserve, but receive a payment according to the average fuel consumption of a similar vessel, thus reducing the impact of high fuel costs on profits. This is similar to a "feebate" system (Greene et. al. 2005); a fisher who uses above-average amounts of fuel will pay a tax in net terms, while those with lower than average fuel consumption will receive a net subsidy (Figure 3). Overall, the new system is revenue-neutral with respect to the existing system of FTCs.

Figure 3. Combined tax and subsidy "feebate"



Energy efficiency, Productivity and Innovation

37. The standard economic analysis of the use of an input such as fossil fuels that has a negative externality associated with it (risk of climate change, etc.) prescribes imposing a Pigouvian tax that incorporates the cost of the externality into the price of the input. This tax is the subject of a later section of this document. The intent of such a tax is to provide incentives to substitute other inputs for the one generating the externality. However, if there are no easy substitutions for energy this approach can be an expensive way to reducing energy use, in terms of costs to fishers and lost fisheries production.

38. Over the long run, technological innovation can solve what appears to be conflict between economic activity and environmental quality (Fisher *et al.* 2003). A Pigouvian tax can lead firms to adjust inputs while using the same technology (input substitution) or to adopt existing technology alternatives (capital investment). Such a tax also stimulates R&D spending by increasing its return on investment. Carraro and Siniscalo (1994) assert that the R&D and innovation effect is larger than the direct input substitution effect when it comes to the tax's impact on fuel consumption. When the pace of innovation is driven by input or output prices, it is said to be endogenous, and becomes part of the control problem for the policy maker.[3]

39. According to Zanetti and Abate (1993), most large companies respond to environmental polices not by switching inputs and reducing output as commonly believed, but by technological and organisational changes. If most adjustment comes from changing technologies, and if environmental policies tend to promote technology innovation, then it makes sense to ask what policy tools do the best job of promoting faster or cheaper technology innovations? Should such policies be in addition to or instead of the a Pigouvian tax?

40. If innovation and technological change is the most important route of adaptation, then a case could be made for a mixed policy that combines a Pigouvian tax with policies that support innovation. This is in particular the case when the output-reducing effect of the Pigouvian tax is to be avoided (when consumer welfare is important, for example). In fisheries this is less likely to be an issue; for well-controlled fisheries output will not be greatly affected, and in poorly controlled fisheries, output reduction is likely required in any case.

41. The rate of optimal technology adoption depends on the process by which innovations take place. Learning-by-doing models (LbD) assume that technology costs reduce over time as a technology is used. That is, experience in use is the key to technology maturation. R&D models on the other hand assume that a technology can be developed and its costs reduced before it is implemented. The LbD model of innovation implies a more rapid adoption of technology, while R&D models imply waiting until costs of a new technology are reduced sufficiently to justify it in the marketplace (Gerlagh *et al.* 2009).

42. Most countries have policies in place to encourage R&D and innovation, such as R&D tax credits and accelerated depreciation of capital expenditures. A fisheries-specific policy in this area would need to answer the questions "Why are existing policies not sufficient for fisheries?" and "why would a policy applied to fisheries not be more widely available?" Or, as Gerlagh *et al*. (2009) put it, "*Since energy related R&D makes up only a small portion of economy-wide R&D expenditures, we consider it a natural assumption that R&D subsidies are exogenous to the climate change policy problem"*. In addition, there

3. Technological change is often assumed to be exogenous, in particular in quantitative models. An example of exogenous technical change is the assumption that productivity on average grows 2% per year. Total sector productivity is a function of all the technology vintages in place at a given moment. Higher fuel costs can increase the pace of adjustment.

are well-known problems with capital subsidies to fisheries promoting overcapacity, making such subsidies directed at technology adoption risky to broader fisheries objectives. Gerlagh et. al. further point out that if targeted private R&D subsidies are not feasible, the optimal emissions (fuel) tax could be even higher than the Pigouvian tax. That is, extra fuel taxation is needed to accelerate R&D development.

43. That doesn't mean that governments have no specific role to play in promoting innovation in fisheries. The optimal policy when the benefits of innovation are not fully appropriable involves some combination of a Pigouvian tax and a subsidy for innovation.[4] The risks involved with payments for fleet modernisation as a particular example of an innovation subsidy means that public investment in research is likely a better approach. Government R&D can focus on maximising the social value of research (by advancing basic science, for example) in a way that would not be profitable for private R&D.

44. In summary, Pigouvian taxes set to match the external cost of energy use reduce energy consumption through three mechanisms: Output reduction, input substitution, and technical change. Technology adoption and R&D are endogenous and can be influenced by price changes. In the long run, technology adaptation and innovation is the most important channel of impact, though in the short run input substitution may dominate. Output changes are unlikely to be important in well-managed fisheries, though the impact on profits may be more significant.

Energy Efficiency Mandates

45. The debate regarding whether to use price-based tools such as taxes or quantity-based tools such as quantity regulations dates back at least to Weitzman (1974). For Weitzman, the choice hinged on the nature of an information problem for the regulator and relative elasticities of demand and supply. Briefly, quantitative approaches are better when the results of price-based approaches are highly uncertain and price-based approaches are better when the costs of meeting a quantitative standard are unknown (but potentially high).

46. Equally important in choosing between a price-based regulation (tax) and a quantity-based regulation is the feasibility of each in being implemented in a way that will allow their policy objective to be achieved. If demand for fuel is very inelastic, the tax required to reduce consumption to the desired level may be unacceptably high, making a tax approach by itself impossible. In this case, a quantitative approach can be a less costly means of meeting the objective.

47. While some have proposed quantitative limits on fuel use for fishers (Mitchell and Cleveland 1993), such a policy approach seems unlikely to be accepted. However, efficiency mandates equivalent in spirit to the Corporate Average Fuel Economy (CAFE) requirements in the United States (Box 2) or the CO2 emission standards for vehicles in the European Union have some potential for application in fisheries. These standards are implemented in terms of efficiency of fuel use, not absolute quantity of fuel consumed. They operate in tandem with fuel taxation and so are part of a more complex policy approach to fuel efficiency.

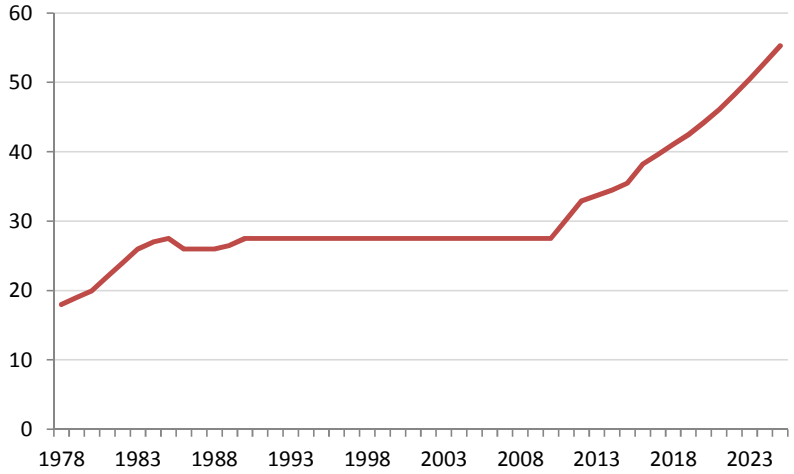
4. Appropriable means the benefits can be kept private to the inventor. Innovations tend to add to the general knowledge base such that everyone in the sector eventually benefits. This makes innovation similar to a public good, justifying government intervention. There is also the theoretical possibility of an optimal innovation tax (instead of a subsidy) when competing researchers race to patent ideas and thereby over-invest in R&D.

Box 2. Corporate Average Fuel Economy (CAFE) Standards in the United States

One proven way to improve energy efficiency in the US transportation sector is the Corporate Average Fuel Economy (CAFE) programme. The programme was established by the Energy Policy and Conservation Act of 1975, and was one of the main forces behind a 35% increase in new vehicle (cars and light trucks) fuel economy between 1978 and 1985.1 Without these improvements, the United States would be consuming an additional estimated 2.8 million barrels per day of gasoline, or about 25% of current demand.

New CAFE standards call for a dramatic increase in the efficiency of cars and trucks in the United States over the next decade, matching the gains achieved at the start of the programme.

CAFE Standards for Passenger Cars, 1978-2025



Source : World Resources Institute (2013) *Corporate Average Fuel Economy (CAFE)* http://www.wri.org/publication/content/10333, NHTSA data.

48. Efficiency mandates would require vessels to achieve a specific degree of fuel economy. This is most practically measureable as fuel consumption at some benchmark level of power output in KW, as this is a function purely of the vessel characteristics - the power rating of the engine compared with its rate of fuel consumption at power. However, this neglects the important role of skipper behaviour in determining the ultimate efficiency of the vessel in operation.[5]

49. It is possible in principle to measure observed fuel economy using logbook data, recording quantity landed and fuel consumption. It is likely that enforcement of this would be difficult if fishers were easily able to take on unrecorded fuel.

50. An efficiency mandate based on the characteristics of the vessel design and power plant is more enforceable, and the effect would be similar to subsidies for vessel modernisation. The difference is that with a mandate, the cost of meeting the standard is borne by the vessel owner and not shared by the

5. The official fuel economy of a vehicle for purposes of the CAFE standard is determined by its performance during a simulated standard driving profile, thus holding the impact of driver behaviour constant across all vehicles.

government (through the subsidy). Using efficiency mandates versus subsidies is mainly a question of distribution of costs (owner or taxpayers) and mandatory versus voluntary approaches.

51. Efficiency mandates may be best seen as part of an overall policy package. Access to certain support programmes (including for capital improvements) could be made contingent on meeting the standard set by the mandate. Mandates operate as a *de facto* benchmark for success and can be used to measure the progress that is made by other policy initiatives. Mandates with long phase-in periods, that allow trading of credits among fishers, or that are conditional on other factors such as vessel or fishery size need not be onerous. Meeting a mandate may be less expensive to the fisher than an equivalent efficiency gain made through fuel taxes, and can generate fewer competitiveness concerns as it impacts fixed costs more than variable costs.

Energy Efficiency Promotion: Guidelines, labels and training.

52. The evidence suggests that the choices fishers make in their operations strongly determine energy efficiency, and that certain changes can lead to significant benefits. Moreover, it has also been shown that when fishers are informed about those potential benefits, they will adopt new practices readily (SEAFISH 2006). Examples such as the effects of using fuel meters on fuel efficiency demonstrate that information and feedback are powerful tools to improve energy efficiency.

53. There are many ways to help inform fishers of the consequences of different fishing strategies and investment choices. Beyond tools such as fuel meters and trip-planning software are training and auditing sessions and information products (such as labels) that indicate the relative energy performance of different gears or equipment. Energy audits for fishing vessels have proven useful in identifying improvements in operations and equipment (Notti *et al.* 2012). These different approaches may work even better when used together, along with other incentives to promote adoption of new practices.

54. For example, the Environmental Farm Plan (EFP) programme in Canada combines in-class training sessions with an on-farm audit, the development of an action plan, and subsidised implementation of that plan. (Box 3). The subsidies were a significant incentive to participate in the programme. EFPs were combined with a consumer information and branding campaign that sought to capitalise on the programme to improve the reputation of the sector in general and participants in particular. Signage and labels for EFP participation were developed as marketing tools for farmers.

Box 3. Environmental Farm Plans in Canada

Each step of the EFP process is voluntary and participants can decide how far to progress in the programme. There are three main steps to the process:

- Step 1. Attend an EFP Workshop. This provided participants with instructions and help on how to progress through the risk assessment and action plan development contained in the EFP workbook.
- Step 2. Create and submit an EFP action plan for a confidential review by a group of locally-appointed farmers. They would offer suggestions on helping to achieve its environmental goals.
- Step 3. Implement the EFP Action Plan. Investments to achieve the plan were co-funded with a cap on total support for each farmer.

EFPs were part of a national programme that ended in 2009. Eligibility for some programmes were contingent on having completed the process, and the government had an objective of achieving 100% coverage by the end of the programme.

Source : Ontario Ministry of Agriculture and Food (2013) *Canada-Ontario Environmental Farm Plan* http://www.omafra.gov.on.ca/english/environment/efp/efp.htm

55. Sector-based research and training organisations can play a useful role in assisting fishers. For example, SEAFISH is co-funded through an industry levy and provides a number of services, including training, standards development, meeting and co-ordination services, drafting technical guidance and providing market information (Box 4). A co-operative structure between government and fishers (e.g. public private partnership approach) can help ensure that spending supports government objectives while at the same time remaining useful and relevant for fishers.

Box 4. SEAFISH in the United Kingdom

Seafish was founded in 1981 by an Act of Parliament and supports all sectors of the seafood industry for a sustainable, profitable future. It is the only pan-industry body offering services to all parts of the seafood industry, including catching and aquaculture, processors, importers, exporters and distributors of seafood and restaurants and retailers.

Seafish is funded by a levy on the first sale of seafood landed and imported in the United Kingdom. It aims to support and improve the environmental sustainability, efficiency and cost-effectiveness of the industry, as well as promoting sustainably-sourced seafood.

Services are grouped into six themes as follows:

- **Information** - support for industry's business decisions
- **Safety** - creating a safer working environment at sea
- **Environment** - protecting the environment at sea and on land
- **Regulation** - understanding, interpreting and responding to legislation for industry
- **Standards** - supporting quality and efficiency standards
- **Consumers** - the authoritative voice on seafood for consumers

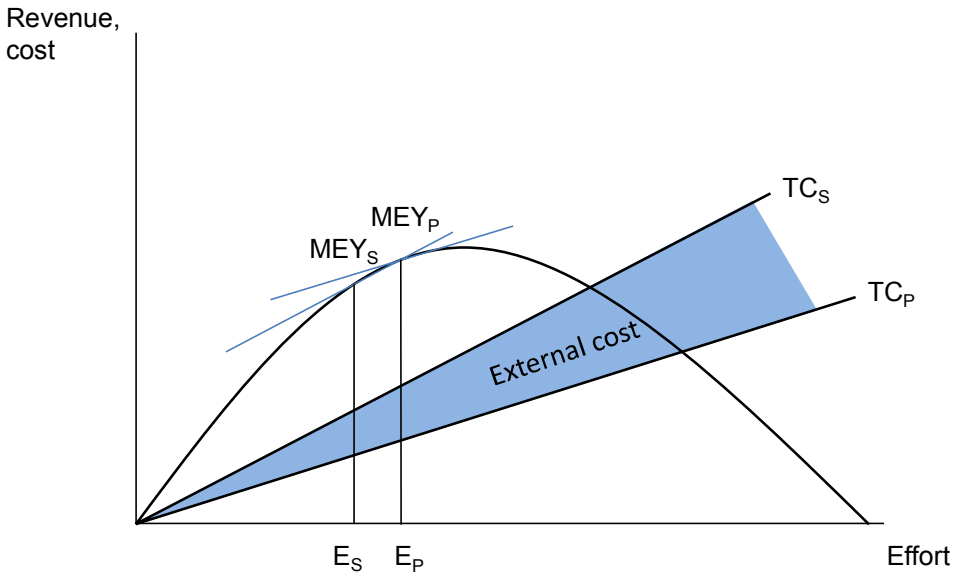
Source : SEAFISH (2013) *About Seafish* http://www.seafish.org/about-seafish/

Impacts of fisheries management on energy use

56. The fisheries management problem can be summarised as finding and maintaining the optimal stock of fish given the biological and economic characteristics of the fishery. That optimal stock has long been considered that which leads to MSY, Maximum Sustainable Yield, though more recently the recognition of the importance of maximising the economic value of the fishery has led to the adoption of MEY as a target in several fisheries[6].

57. If energy use generates an externality, then there is an optimal stock size and harvest level that takes that externality into account and which can be determined using the same techniques as for MEY. The costs of fishing effort can be redefined to include external costs and the optimal stock management level follows from that (Figure 4). This produces the optimal level of effort from a societal perspective (E_S) and an optimal harvest level (MEY_S). Assuming that external costs increase with effort is sensible as fuel use is a major variable cost such that more effort requires more fuel use. Fuel use and external costs (such as created by carbon emissions) are taken to be proportional.

Figure 4. External costs and optimal harvest level



58. The optimal harvest with an external cost of energy use is lower and the stock maintained at a higher level (MEY_S instead of MEY_P). This increases the catch per unit effort and reduces the energy-intensity of fishing. If the fishery is managed under an ITQ system and there is a tax imposed on fuel use equal to the external cost, than fishers will optimally wish to target MEY_S and additional management controls are not needed. If external costs are constant (not changing with the amount of effort) or if MSY is the management target, then external costs have no influence on optimal stock or harvest levels.[7]

6. Many biologists prefer MEY not because of its economic features, but because it is also seen as more precautionary; it leads to a higher maintained stock when compared to MSY. Harvests are less, but profit per unit harvest is higher. But if more precaution is required, MEY is convenient but not intended for that purpose. Only coincidentally will MEY be the right stock target if precaution is warranted.

7. If MSY is the target, this is not affected by costs. If MEY is the target, the point of tangency of costs and revenue is not changed by a fixed externality that shifts the cost curve up parallel to the private cost curve.

Sound management

59. The above analysis demonstrates that there is a rationale for taking energy efficiency into account, in particular when MEY is the target and external costs are increasing with effort. However, it is likely more important to ensure that the stock is effectively managed, whether the target is MSY, MEY_P or MEY_S (Box 5). Improving the stock status when it is in a degraded condition can bring large gains in energy efficiency (Mitchell and Cleveland 1993).

60. The reason why sound stock management is so important is that smaller stock sizes require significantly more effort to catch the same amount of fish relative to a situation where the stock is abundant. This is because fish are harder to find and less densely distributed, requiring more steaming and trawling time to capture them.

61. For example, Arnason (2010) estimates that fuel consumption by the Icelandic fleet declined by 45% between 1990 and 2009 while the value of catch increased by 27% as a result of improved management and recovery of fish stocks. Ziegler and Hornborg (2013) found the same result for *nephrops* in Sweden. Improved stock status leading to higher catch per unit effort was identified in [TAD/FI(2012)2] as offering the highest efficiency gains compared with all alternatives. Overall efficiency improvements of up to 50% are possible (Arnason 2010).

Box 5. The importance of sound stock management

The energy intensity of a fishery can change dramatically over time as the abundance of fisheries resources change, fleets expand, the average size of vessels increase, vessels travel further to fish, and become more technologically advanced. For example, Brown and Lugo (1981) estimated that between 1967 and 1975, while the fuel consumed by the U.S. fishing fleet (excluding vessels under 5 GRT) increased from 150 to 319 million gal/year, the catch did not increase accordingly. As a result, the fossil energy input to edible protein energy output ratio for the US fleet increased from 8:1 to almost 14:1 over the same period. Similarly, Mitchell and Cleveland (1993) found that between 1968 and 1988, the fuel energy input to edible protein output ratio of the New Bedford, Massachusetts fleet rose from ~6:1 to over 36:1.

Source : Tyedmers, Peter (2001), "Energy consumed by North Atlantic Fisheries". In Fisheries Impacts on North Atlantic Ecosystems: Catch, Effort and National/Regional Datasets (D. Zeller, R. Watson, and D. Pauly, eds.), Fisheries Centre Research Reports 9(3), pp. 12–34.

62. Sound management of fish stocks is not simply an energy issue, and there are many reasons why fisheries managers struggle to maintain the stock at an optimal level. Improved profitability and savings on fuel are good reasons for fishers to get behind efforts to improve stocks, but the institutions and incentives have to be right for this to happen. *The OECD Handbook for Fisheries Managers* [TAD/FI(2012)7/FINAL] discusses how fisheries managers can make progress towards reform and *Rebuilding Fisheries: The way forward* (OECD 2012c) provides specific advice on how to recover fisheries.

Fleet size, tradability and flexibility

63. Concerns about the impact of fleet overcapacity on the profitability of fishers are nothing new. Overcapacity can reduce the overall energy efficiency of the fleet by reducing CPUE. "It is now acknowledged that EU fishing fleets expend vast quantities of energy and that low overall efficiency is caused not by high oil costs but rather by structural deficiencies (EFTP 2012)". Ensuring an efficient fleet capacity one of the general objectives of fisheries management that also has clear overlap with energy efficiency.

64. Allowing fishers to trade quota or effort among themselves is seen as an effective means of reducing overcapacity. It also tends to favour more efficient operators, reinforcing any energy efficiency gains. However, uncontrolled consolidation is regarded in many countries as undesirable, so trading is either prohibited or limited in those jurisdictions.

65. Concerns about concentration and distribution of fishing opportunities ultimately must be addressed in a way that does not limit the ability of the fishery to achieve improvements in energy efficiency. Tradability is likely an important part of any approach to sector rationalisation and so the question becomes how to achieve this in practice. The document *Using Market Mechanisms to Manage Fisheries: Smoothing the Path* (OECD 2006) points out that there are a number of different approaches to market mechanisms, raising the hope that an approach that is compatible with other social objectives can be found.

66. Allowing fishers to form co-operatives where they jointly agree on the assignment of fishing opportunities and sharing of proceeds is one approach. Other community-based approaches such as community-based quota, or devolved management have also been proposed as a way to empower fishers to self-organise as a community in a way that allows them to maximise the income potential of the fishery while preserving self-determination as a community.

Effort controls

67. Many fisheries are managed using effort controls that restrict days at sea, length of season, or other factors such as vessel size, power, or crew levels. Effort controls that target inputs other than energy will tend to increase energy use per quantity landed. This is because of the substitution effect where fishers substitute energy (or other inputs) for the restricted input in order to try to maintain a desired harvest level.

68. Seasonal restrictions and days at sea limits tend to increase the tempo of fishing and so can be expected to reduce energy efficiency as fuel consumption increases more than linearly with steaming and trawling speed. Crew restrictions can lead to input substitution where mechanical power replaces human power (smaller crews on more powerful vessels), and so should also increase the amount of energy expended per quantity harvested. Vessel power limits have an ambiguous impact on energy efficiency. Lower-power vessels may use less energy per unit time spent fishing, but may have lower overall efficiency because of economies of scale.

Gear restrictions

69. Restrictions on gear use can act to increase or decrease fuel efficiency. Without gear restrictions, fishers will choose the most profitable gear given some fixed capital constraint (vessel type, financing limits). More profitable gears are likely more energy efficient, but need not be so, especially when highly energy-consumptive gears are more polyvalent. For example, if trawl gear can be used by the fisher in a number of different fisheries for which he has access, it may be preferred to using passive gear even if such gear is more efficient for a specific fishery.

70. Gear restrictions that favour passive over active gears have the potential to reduce energy use per unit harvest. Driscoll and Tyedmers (2010) observed that a seasonal ban on active gears in a US herring fishery led to significant improvements in energy efficiency: *Our results indicate that because of the five-fold lower fuel intensity of purse seining, relative to midwater trawling (21 L/ton versus 108-118 L/ton), the seasonal ban on midwater trawling has the potential to markedly reduce overall fuel use and greenhouse gas emissions associated with the herring fishery. These results indicate that management decisions can strongly influence energy demands and resulting greenhouse gas emissions of fisheries. We*

urge those involved with fisheries management to take this into account when developing policy and management measures (Driscoll and Tyedmers 2010).[8]

71. While the impact of gear restrictions will depend on the specifics of their implementation, in general it can be said that flexibility in gear choice should be given to fishers when possible. This is likely on balance to improve both efficiency and profitability, even if in specific cases gear restrictions can lead to significant efficiency gains (Box 4). Gear restrictions can have distributional consequences when they limit fishing opportunities for specific groups or individuals. The users of different gear types may be different fishers from different areas and with different traditional levels of access to the fishery in question.

Box 6. Trawling vs. traps for *nephrops* in Sweden

Energy use in the fishing phase [when trawling] is extraordinary. To catch 1 kg of Norway lobsters using conventional trawling, 325 MJ are used in the form of diesel. For the creel fishery this figure is 80 MJ (of which approximately 10% comes from the bait herring fishery). In the creel fishery Norway lobster represents 97% by weight and 99% by value of the landings, and 2.2 l of diesel were used per kilogram of *nephrops* landed. In the conventional trawl fishery, Norway lobster represents 27% by weight and 59% by value of the catch, and 9.0 l of diesel were used per kilogram of *nephrops* landed. Obviously, there is a pronounced difference in energy use between the fishing methods.

Consequently, there are great potentials for improvement by replacing conventional trawls with creels. However, the safety and working conditions must be improved and the risk of recruitment overfishing must be mitigated by protecting berried females. A hypothetical future situation using currently available technology, in which 50% of Norway lobster landings are caught using trawls and 50% using creels (compared to 80% using trawls and 20% creels in 2005) would lead to 37% less seafloor impact, 36% less fish discard and 38% less discard of undersized *nephrops*, as well as a 27% lower fuel consumption, while providing consumers with the same amount of Norway lobsters.

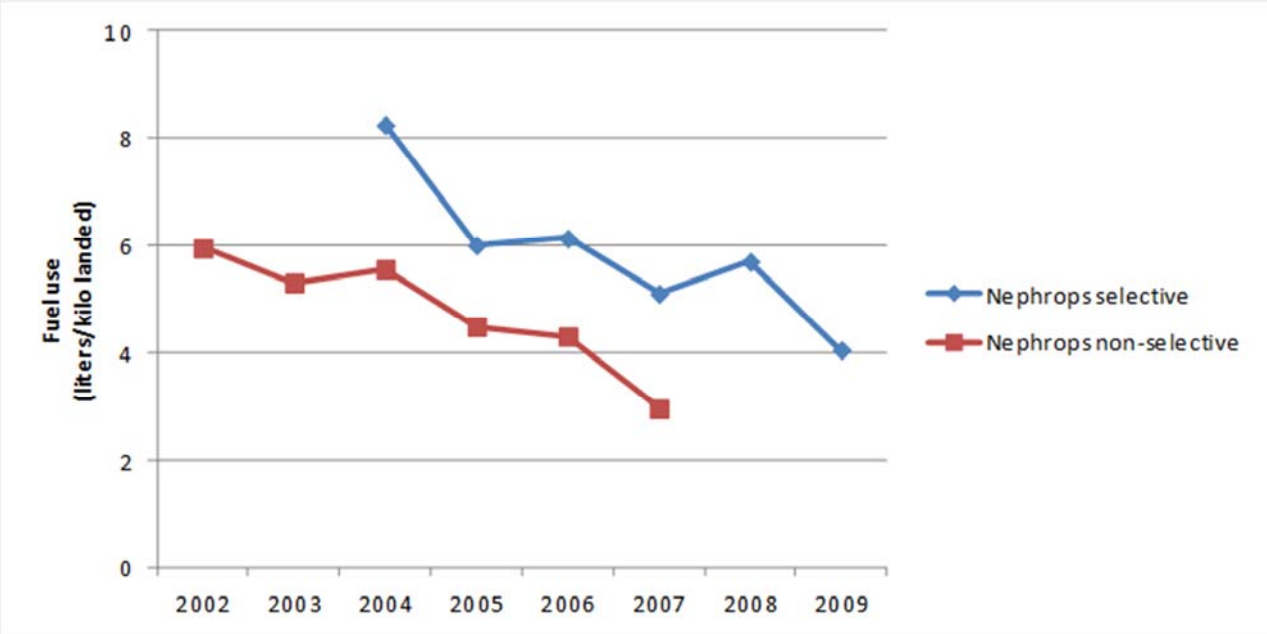
Source : Ziegler, Friderike and Daniel Valentinsson (2008), "Environmental life cycle assessment of Norway lobster (Nephrops norvegicus) caught along the Swedish west coast by creels and conventional trawls—LCA methodology with case study", *International Journal of Life Cycle Assessment*, vol 13, pp. 487-497.

72. Hornborg *et al.* (2012) found that there is a trade-off between protection of non-target species and fuel efficiency. Highly selective gear (containing exclusion devices, for example) tends to be less efficient at catching the targeted species (Figure 5). This is an example of multiple policy objectives (efficiency and species selectivity) being in conflict, though this need not always be the case (Ziegler and Valentinsson 2008).

8. This gear restriction was put in place for reasons other than energy efficiency.

Figure 5. Gear selectivity and energy efficiency of *Nephrops* trawl

litres per kilo landed



Source: Ziegler F, Hornborg S.(2013) "Stock size matters more than vessel size: The fuel efficiency of Swedish demersal trawl fisheries 2002–2010", *Marine Policy* http://dx.doi.org/10.1016/j.marpol.2013.06.015i

73. Restrictions on gear type or characteristics can have strong impacts on profits and participation in fisheries. Such high levels of side-effects make these a poor candidate for use as a policy directed primarily at energy efficiency. A better approach would be to establish a process to evaluate the impact of gear regulations on energy efficiency, in particular when changes to existing regulations are being considered. This would help inform the decision on whether reforms of existing gear regulations should be considered and identify the energy-efficiency benefits of such reforms.

Distribution of rights or quotas, by area, gear, or fleet segment

74. Fishing technology changes over time as research and investment improves the operation of fishing vessels. Over time this can mean that one gear type is replaced by another as the most profitable or efficient way to exploit a fishery. Ideally, the fishing fleet should respond to these changes by shifting resources or techniques in an optimal fashion.

75. The management system can facilitate or slow this approach depending on the details of its implementation. Most major OECD fisheries are limited entry, so there are some restrictions as to who may operate in the fishery. If those rights are transferable, the pace of adjustment over time should be more rapid as access to capital is higher and adoption of technological improvements is less dependent on the capital replacement cycle of a fixed set of fishers.

76. Fishing rights are often subdivided by fishing area, the size or type of vessel, home port or gear used by the fisher. This can help explain why fishers using different gears can exploit the same fishery; each gear type is allocated a share of the fishery. This is not the only reason for multiple gears to be used, but where such allocations exist, they can be a barrier to improved energy efficiency.

77. Energy efficiency would be improved by removing most restrictions of this kind and allowing trading of fishing rights between fishers. However, in many cases such an approach is not compatible with social objectives of policies (rural distribution of fishers, preservation of traditional or artisanal techniques, etc.). When this is the case, alternative approaches that preserve social objectives are required. What alternative is best depends on the social objective. Some possible alternatives include:

- Providing for the formation of **fisheries co-operatives** where members are defined according to socially desirable or economically relevant characteristics can preserve targeted fisher types. Within these co-operatives, fishers may be allowed to share, rent or trade quota, which can be expected to increase profitability and efficiency (Criddle and Strong 2013).

- **Community-development quota** can provide rights to indigenous or traditional groups that allow them to benefit from participation and ownership in a fishery even if a significant share of the fishery is allocated to more efficient producers (Ginter 1995).

- Grant **increased quota** (or more advantageous fishing days or locations) to more efficient gear types. This can also match well with the establishment of efficiency standards or energy planning and auditing. Participation in these programmes can be a criterion for access to special benefits.

Institutions and organisations

78. Paying crew as profit share instead of fixed wage subsidises fuel use indirectly as part of the costs of higher fuel consumption are eaten by the crew.

79. The centrality of the price of fuel in energy policy has been emphasised in this report. The recommendation to do away with FTCs in favour of a fuel tax rate that is equal to the social costs imposed by fuel use is complicated by the fact that FTCs are not always a sector-specific policy, and that responsibility for these programmes rests with finance ministries. The involvement of multiple government agencies can make it difficult to make fuel tax policy coherent with overall fisheries policy regarding energy use and efficiency.

80. Fuel tax concessions are offered to many sectors, in particular natural resource sectors such as agriculture and mining, and often for industrial uses as well. For this reason a fisheries-specific approach to reform can raise issues of fairness across different groups in the economy and can leave fishers feeling unfairly singled-out. Ideally, tax incentives for fossil fuel use should be addressed as part of overall energy policy keeping in mind commitments to phase out environmentally harmful subsidies.

81. Even if FTCs and similar policies are handled by financial agencies or ministries, this does not mean that sector-specific policies do not exist. Fishers have successfully lobbied for concessions in the face of high fuel prices in some countries, indicating that sector-based approaches can be taken. The issue here is the involvement of the government ministry or management agency responsible for fisheries. It is possible that these government bodies can mediate on behalf of fishers with financial ministries, or fishers may lobby finance ministries directly. When fisheries ministries or managers are not involved, the risk is for poor policy coherence. On the other hand, if the fisheries ministry suffers from characteristics of regulatory capture, they may seek to aid fishers in lobbying for benefits (Dal Bó 2006, Singleton 2000). National-level objectives for energy and fossil fuel use can be helpful.

82. For fishers operating on the high seas, operating in multiple jurisdictions offers the opportunity to search for the most favourable tax treatment for fuel purchases. When fleets can purchase fuel abroad, national policies may be ineffective. The only answer to this is international co-operation in taxation of fossil fuels, an issue that is the subject of some discussion (see for eg. Bruvoll *et al.* 2011).

Structural Adjustment and Credit policies

83. Non-tradable licences or licences attached to particular vessels limit the capital pool available for investment. This is because potential licence holders who wish to invest in the sector cannot do so if they cannot acquire a license. Also, licenses that are not tradable are more difficult to value and are less bankable assets.

84. Improving access to capital can help the rate of technology adoption. There are many examples of programmes that provide support for investment, such as for vessel refit, gear replacement, or re-engining to improve fuel efficiency. Programmes can also aid access to capital without specifying the nature of the investment by through credit programmes that provide low-interest loans, loan guarantees or similar banking services. These can promote investment without being as directive as a support programme for a specific purchase.

85. Investment policies and capital aids increase the rate at which existing capital is replaced in a fishery and so technical improvements will be embodied more rapidly into the fleet. Meeting efficiency standards for new equipment, as discussed above, can be a condition for access to capital support, further increasing the energy efficiency benefits of capital and credit programmes.

86. However, investment aids have the potential to increase capacity. This is particularly troublesome where fisheries are fully or over-exploited and where existing excess capacity leads to social pressures. For this reason these programmes are sometimes made contingent on scrapping of older capital to minimise the overall impact on capacity. Whether this is effective in limiting capacity expansion is controversial.

87. Ideally fishers, acting rationally, use the optimal technology given their economic incentives. This would imply that there are no economic gains to be had from changing to a more efficient technology. But not all fishers operate at the same level of energy efficiency and the rate of technology adoption is patchy, even within a fleet segment or fishery, which raises the possibility that there is some scope for promoting the use of more energy efficient approaches to fishing.

88. The reason for this has to do with the cost of acquiring information. Policies promoting energy efficiency improvements can make it cheaper for fishers to identify cost-effective investments and speed their rate of adoption (Barrett *et al*. 2002). Policies can play a co-ordinating role, helping to encourage collective learning. By supporting early-adopters, new technologies can be more quickly proven and accepted.

89. Decommissioning schemes can help increase the average energy efficiency of the fleet by removing less efficient vessels from the fleet. The cost-effectiveness of such an approach is an important consideration. It is unlikely that the energy-efficiency benefits of decommissioning schemes alone would be worth the cost of such a programme. Energy efficiency can be one rationale for decommissioning schemes, but recasting existing programmes as energy efficiency initiatives risks "greenwashing" them.

90. If decommissioning or modernisation programmes are considered as a means to promote energy efficiency, an estimate of the cost per unit improvement achieved should be made, preferably for each individual participant. This would allow ranking of applicants such that those delivering the most benefit for a given cost are prioritised and so funds are used as efficiently as possible. This also allows comparison with other approaches, such as training programmes or supporting R&D that can help put the cost-effectiveness of these programmes in perspective.

Conclusions: An approach to efficiency-enhancing policy reform

91. Energy efficiency is something that countries have been concerned about for some time. In fisheries the benefits of conserving energy go beyond reducing pollution, mitigating global warming and increasing energy independence, it also is important to the bottom line. For this reason, fisheries management policies should take their impacts on energy efficiency into account with a view to improving efficiency whenever the opportunity arises.

92. In order to put their management systems on this path, governments should start by setting objectives for progress. This sets a benchmark against which success will be measured and gives stakeholders a clear signal regarding the actions they must take. Next, a comprehensive policy review and planning process should be established to identify where existing policies can inadvertently worsen energy efficiency and which integrates energy efficiency objectives into the fisheries management policy set. Having a clear plan based on a sound understanding of the impacts of current and alternative policies will help ensure that all objectives for the fishery, including for energy efficiency, are effectively met at least cost.

93. Meeting energy-efficiency objectives should start with soft approaches: Help fishers to understand and plan improvements in their energy use through training, auditing and other informational services. Negotiate with the sector to establish voluntary agreements regarding actions to be taken. Establish energy efficiency standards for different types of equipment and identify the best performing technologies. Promote the use of fuel meters and other technologies that offer feedback to fishers regarding their energy performance.

94. Since many of the actions that improve energy efficiency also improve profits, significant progress can be made through soft policy tools. However, barriers to progress in energy efficiency will likely remain. Fishers may avoid changes in their operations when they are uncertain of the results, or that lie outside their traditional skill sets. The incentives faced by fishers through short seasons or day-at-sea limits may lead them to energy intensive approaches such as fishing faster or further from port. Any change may be resisted by those who fear they may lose out in the process, and distribution of benefits is a concern for both governments and fishing communities.

95. Setting the fishery on a path to efficient growth means getting the incentives right, and a big part of this is the price of energy. A fishery cannot be sustainably built on the premise that fishers can purchase fuel for less than the economic or social cost of producing it. Therefore, making sure that the price of fuel is equal to its true cost and value to society is in important step. Fuel tax concessions for fishers (and other sectors) work against this principle, leading to overconsumption of fuel, distorted incentives, and worse outcomes for society. Eliminating these should be a priority. Indeed, governments should work to ensure that the price of fuel reflects its full external costs by using the principle of Pigouvian taxation, setting an energy tax equal to the external costs of its use. This is the polluter-pays principle by another name.

96. As a practical matter, however, Pigouvian taxes are not always feasible to apply. The proper rate of such a tax can be difficult and contentious to determine, and if demand is very inelastic the required tax rate can be very high. Moreover, fisheries ministries are usually not in control of FTCs or fuel taxation, which is under the competence of other government agencies and which are generally applicable to a number of primary resource sectors. Reforming taxes requires a co-ordinated approach across sectors.

97. Consequentially, many governments have chosen to use a mix of instruments to promote fuel efficiency, such as the combination of fuel taxes and CAFE standards for automotive fuel economy in the United States. This allows for improved efficiency without the large income transfers that can be generated

by a Pigouvian tax. Combining defined efficiency standards with mandates for progress and a reasonable tax on fuel can be a pragmatic and effective approach to improved energy efficiency.

98. Alternatively, the distributional impacts of a Pigouvian tax can be addressed by redistributing the tax receipts. This can help address one of the main concerns regarding FTC reform, which is maintaining the benefits that such concessions provide to fishers. In particular, defraying high fuel costs is a key objective. Returning fuel tax revenue to fishers according to the average fuel consumption of a similar vessel achieves this objective while still ensuring the price of fuel sends the right signal for consumption.

99. Subsidies and incentives are common policy tools used to increase energy efficiency in different sectors of the economy. While there may be a role for such tools in fisheries, they must be approached with a heightened level of caution. That is because these policies can aggravate existing capacity problems and reduce the capability of the fisheries management system to effectively control effort and harvest. A better approach may be to ensure that fishers are aware of and can access existing programmes that are supportive of energy efficiency, such as R&D or investment credits and incentives in the tax code. Another option may be to make access to support policies contingent on fishers meeting a high standard of energy efficiency or participating in training or other programmes designed to help fishers improve the efficiency of their operations.

100. Green growth for fisheries will ultimately require more efficient use of resources and continual improvements in productivity. A comprehensive policy approach that integrates proven approaches into the larger policy set in a coherent way will help the sector contribute to national objectives for reduced fossil fuel consumption and to secure sustainable profits for years to come.

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ANNEX 1: THE IMPACT OF FUEL TAX CONCESSIONS IN FISHERIES

101. Fuel tax concessions are a common element of fisheries policy, and depending on the management regime, can influence the choices of fishers regarding the energy-intensity of their operations. Understanding the fundamental economics of fuel tax concessions in fisheries is an important first step in developing good policy.

102. This section presents a bio-economic model with logistic growth of the fish resource and a Schaefer production function (Schaefer 1957) to derive the steady-state equilibriums for stock size (S), fishing effort (E) and harvest (H). These are used for doing comparative statics regarding changes in fuel costs.

The bio-economic model[9]

103. A bio-economic model consists of a biological part and an economic part. Below, both these are discussed separately and then combined into the model used for the discussion on fuel tax concessions. All results derived are in long run equilibrium, i.e. both the fish stocks and the fleet have had time to adjust. We do not discuss the adjustment process, e.g. from an equilibrium with concessions to an equilibrium without.

104. We use a logistic growth function for the biological model, i.e. the fish stock is expected to grow according to

$$G(S) = gS\left(1 - \frac{S}{S_{max}}\right)$$

where *G(S)* is the growth of the stock, *S* is the stock size, S_{max} is the largest possible stock size (the stock supported by a pristine ecosystem), and g is the intrinsic growth rate. The intrinsic growth rate is the growth at very small stock levels.
In the economic model we assume that the harvest (*H*) is a function of effort (*E*), stock size (*S*), and a catchability coefficient (*e*)

$$H = eES$$

105. The total cost of harvesting (*C*) depends on the amount of effort spent according to

$$C = wE$$

where *w* is the unit cost of effort, e.g. the cost of performing one day of fishing. The revenue (*R*) generated from fishing are

$$R = PH$$

where *P* is the price of fish. The revenue is simply the amount harvested times the price the fisherman gets for the fish. The profit is the difference between the revenues and the costs.

9. The notations for the bio-economic model follow Perman et. al. (2003), where a more detailed presentation of the model is available for the interested reader.

Bio-economic equilibrium

106. For the bio-economic model to be in equilibrium both the biological and the economic sub-models need to be in equilibrium simultaneously. The biological equilibrium occurs when the harvest equals the stock growth

$$G(S) = H$$

When this is the case, the stock size does not change since the entire growth is harvested.

107. The economic equilibrium depends on the management system at hand. In an *Open Access* situation there are no limits on the expansion of the fleet and new investments and entrants will increase the fleet as long as it is profitable to enter the fishery. This will increase the total effort and costs of effort at the same time as the increasing fishing pressure decreases the stock size. The process will continue until there are no profits left and the equilibrium will occur when $R = C$, i.e. profits are zero.

108. The economic situation is different in a management system where the manager seeks to reach *Maximum Economic Yield (MEY)*. This is where the harvest (yield) generates the maximum economic return from the fishery. Thus, the economic equilibrium is where the profit is maximised, but still under the biological equilibrium condition that harvest equals growth.

Graphical illustration of equilibrium

109. The equilibriums for Open Access and MEY are shown in Figure A1. The X-axis shows the effort and the Y-axis shows the harvest in volume and the costs and revenues in monetary terms. The cost curve is represented by C which is effort multiplied with the unit cost of effort,

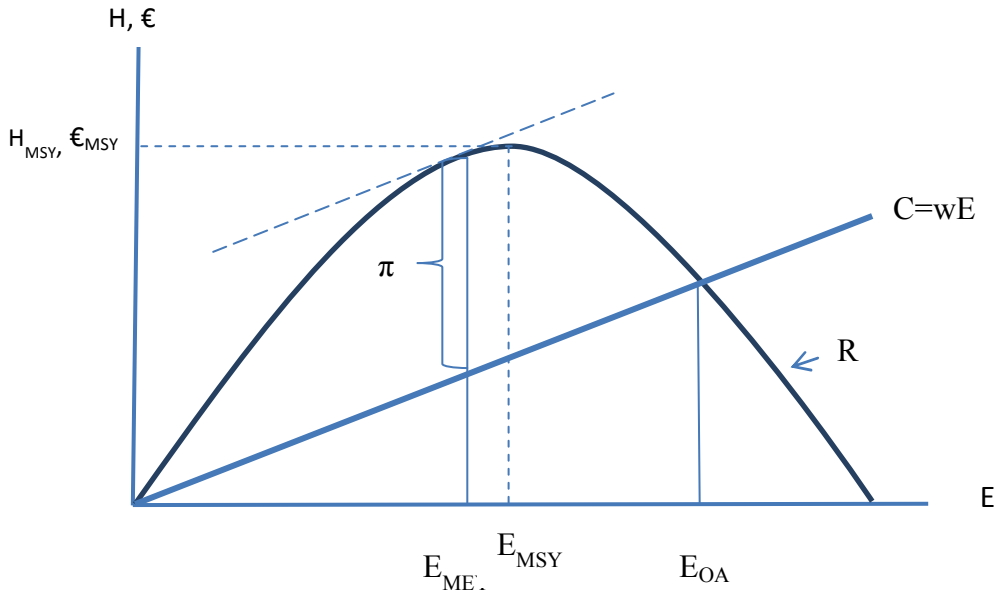
$$C = wE$$

and the revenue curve is represented by R which is the long run equilibrium harvest for different levels of effort times the price of fish

$$R = PeES_{max}\left[1 - \frac{e}{g}E\right]$$

Thus, for each level of effort there is a unique revenue corresponding to the R curve in Figure A1. The Maximum Sustainable Yield (MSY) from the fish stock is labeled H_{MSY}, which is caught at an effort of E_{MSY}.

Figure A1. The Bionomic model

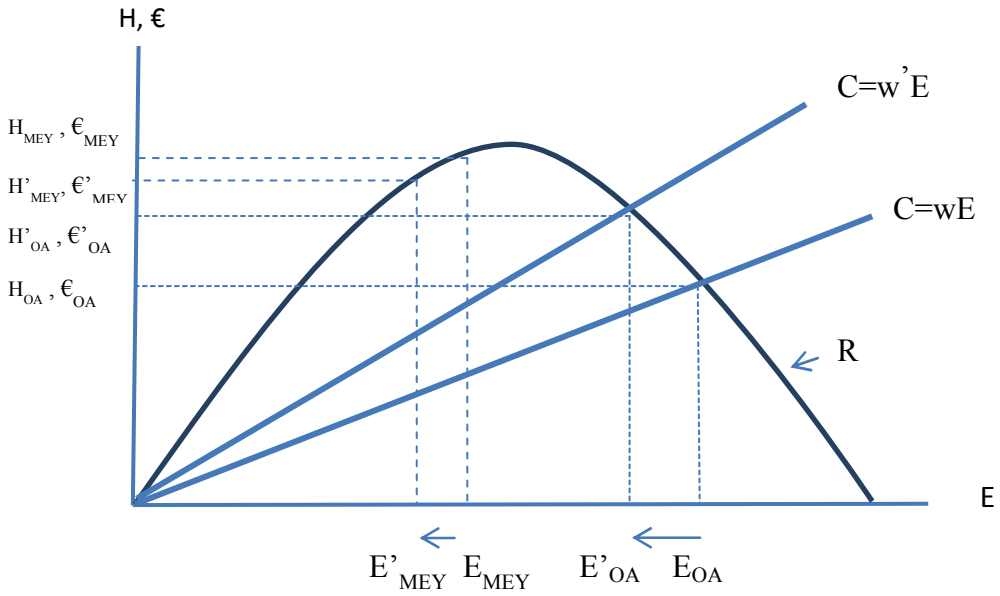


110. In the Open Access case the cost curve and the revenue curve intersects at the Open Access equilibrium effort (E_{OA}) where profit is zero. In the MEY case the profit is positive, represented by π at the effort level E_{MEY}. Profit is the difference between the revenue and cost curves at the effort level corresponding to effort maximising the profit. This corresponds to the effort where the slopes of the cost and revenue curves are equal.

Graphical illustration of a fuel tax

111. Figure A2 shows the change in effort and sustainable harvest from reducing fuel tax concessions such that the unit cost of effort increases from *w* to *w'*. The graphical representation of this is an upward shift in the cost curve from *C=wE* to *C=w'E*.

Figure A2. Reducing Fuel Tax Concessions



112. As is clear from the Figure the effort is reduced in both Open Access (from E_{OA} to E'_{OA}) and MEY fisheries (from E_{MEY} to E'_{MEY}). In the MEY fishery the total harvest is reduced from H_{MEY} to H'_{MEY} due to the increase in costs. In the Open Access case harvest increases from H_{OA} to H'_{OA} since higher costs makes it is less profitable to fish down the stock. In the Open Access case the profit is still zero since the cost and revenue curves intersects at a new long run equilibrium. In the new MEY equilibrium the fishery shows a lower profit due to the increase in the cost for effort. However, we note that the increase in fishing costs represented by the difference between the cost curves w'E and wE at the E'_{MEY} level of effort is collected as tax revenues.

113. The magnitude and even direction of the change occurring due to fuel tax concessions will depend on the shape of the cost and revenue curves. This is determined by the parameters in the model; the cost of effort (w), the price for fish (P), the catchability coefficient (e), the intrinsic growth rate (g), and the maximum stock size (S_{max}). In order to analyse how the parameters affect the fishery's response to tax concessions an analytical solution to the model is needed.

Analytical solution

114. For both the Open Access and MEY fisheries it is possible to solve for analytical expressions of the equilibrium values of S, H and E. These are expressed as S^*, H^*, and E^* respectively, and presented in Table 1A.

Table A1. Steady state equilibriums for Open Access and MEY for S, E and H.

	Open Access (OA)	Maximum Economic Yield (MEY)
Effort	$E^* = \frac{g}{e}\left(1 - \frac{w}{PeS_{max}}\right)$	$E^* = \frac{1}{2}\frac{g}{e}\left(1 - \frac{w}{PeS_{max}}\right)$
Stock	$S^* = \frac{w}{Pe}$	$S^* = \frac{1}{2}\frac{PeS_{max} + w}{Pe}$
Harvest	$H^* = \frac{g}{P}\frac{w}{e}\left(1 - \frac{w}{PeS_{max}}\right)$	$H^* = \frac{1}{4}g\left(S_{max} - \frac{w^2}{P^2e^2S_{max}}\right)$

Source: Perman et. al. 2003.

The effect of introducing a fuel tax

115. From Table A1 it is possible to investigate how a change in fuel taxes, i.e. in *w*, affects the equilibrium levels. The impact is the partial derivative with respect to *w*. In Table A2 the expressions for the derivatives with respect to *w* of the equilibrium levels S^*, E^* and H^* are presented. For each case the sign of the effect is shown at the end of the expression. If the expression is positive (negative), the equilibrium level will increase (decrease) when introducing a fuel tax.

Table A2. The effect of a fuel tax

	Open Access (OA)	Maximum Economic Yield (MEY)
Effort	$\frac{\partial E^*}{\partial w} = -\frac{g}{Pe^2 S_{max}} < 0$	$\frac{\partial E^*}{\partial w} = -\frac{g}{2Pe^2 S_{max}} < 0$
Stock	$\frac{\partial S^*}{\partial w} = \frac{1}{Pe} > 0$	$\frac{\partial S^{**}}{\partial w} = \frac{1}{2Pe} > 0$
Harvest	$\frac{\partial H^*}{\partial w} = \frac{g}{Pe}\left(1 - \frac{2w}{PeS_{max}}\right) \gtrless 0$	$\frac{\partial H^*}{\partial w} = -\frac{gw}{2P^2e^2S_{max}} < 0$

116. Below, the effects on effort, stock and harvest is discussed in depth. However, we first observe from Table A2 that the signs of the effects are clear in all cases but for the harvest in Open Access. Further, an effect on effort and stock in MEY is half the effect compared to Open Access, and thus part of the discussion below is made parallel for the two cases rather than separated in different sections.

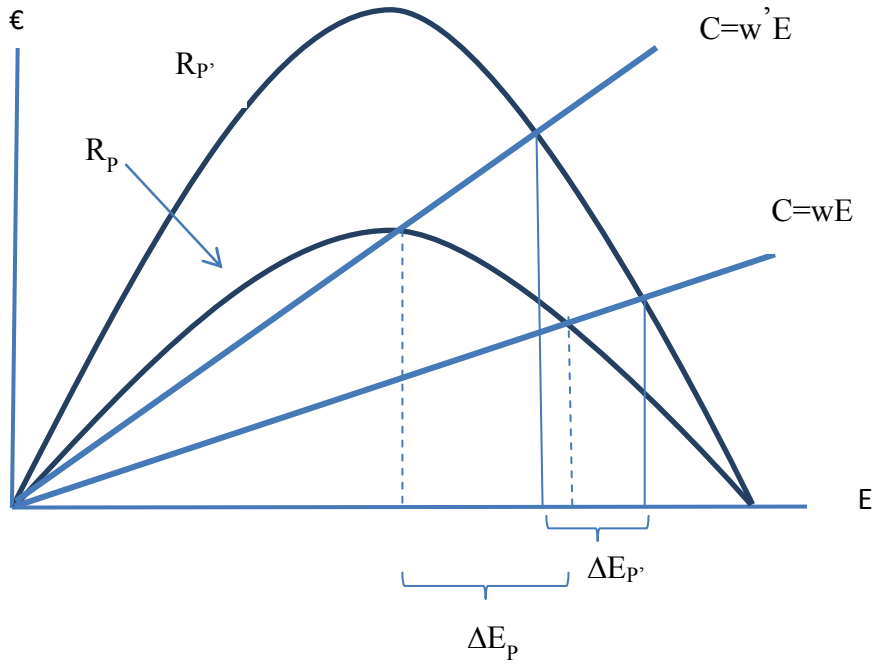
Effort

117. An increase in fuel costs will decrease the level of effort for both the MEY and Open Access cases, as is shown by the negative signs in Table A2. The magnitude of the change depends on fish price (P), catchability (e), maximum stock level (S_{max}), and the intrinsic growth rate (g).

118. P, e and S_{max} will reduce the effect, i.e. high values imply that the absolute value of the decrease is smaller.[10] Intuitively, high prices and fish that are easy to catch will make the effort remain high despite higher costs. The effects can be shown graphically. Figure A3 shows how the fishery responds to fuel tax concessions for different values of P. Larger P will increase the revenue curve (R) as shown in Figure A3 where $P' > P$. ΔE_P represents the change in effort at price level P, and $\Delta E_{P'}$ represents the change in effort at price level P'. Increasing variable costs from w to w' will affect the effort differently depending on P, where $\Delta E_P > \Delta E_{P'}$.

10. See Appendix B for an illustration of the role of the catchability coefficient.

Figure A3. Different responses to fuel tax concessions



119. A larger intrinsic growth (*g*) implies that the effect on effort from an increase in *w* is larger (see appendix A). However, we observe that *E* is larger in the bioeconomic equilibrium to start with since the highly productive stock can sustain a larger fishery (the partial derivative of *E** with respect to *g* in Table A1 is positive). The results are summarised in Table A3.

Table A3. How the model parameters influence the effect on effort from abolishing tax concessions

Parameter	A high parameter value will make the decrease in effort
Price	Smaller
Catchability	Smaller
Intrinsic growth	Larger
Maximum stock size	Smaller

Stock

120. Regarding the stock level (*S*), we observe that the stock level will increase when the fuel costs increase. Intuitively, an increase in cost will make the fishery less profitable and effort (*E*) will decrease as discussed above, and thus the stock level increases. However, the magnitude of the increase depends on the price of fish (*P*) and catchability (*e*). The higher the price of fish is and the easier it is to catch the fish, the smaller will the stock effect be. The results are summarised in Table A4.

Table A4. How the model parameters influence the effect on stocks from abolishing tax concessions

Parameter	A high parameter value will make the increase in stock
Price	Smaller
Catchability	Smaller

Harvest

121. The effect on harvest from a change in w in Open Access depends on whether the equilibrium effort is above or below E_{msy}. If it is below ($E<E_{msy}$), i.e. to the left of E_{msy} in Figure A1, an increase in w will cause the equilibrium harvest to decrease since the growth in the stock declines due to a larger stock size. If $E > E_{msy}$ an increase in w will cause stock growth to increase due to a larger stock size, and thus the equilibrium harvest will increase.

122. In a MEY fishery, the effect on harvest from an increase in w will always be negative. This is because the effort is lower than E_{msy} in equilibrium. The effects of the parameters for MEY are summarised in Table A5.

Table A5. How the model parameters influence the effect on harvest from abolishing tax concessions in MEY

Parameter	A high parameter value will make the decrease in harvest at MEY
Price	Smaller
Catchability	Smaller
Intrinsic growth	Larger
Cost of effort	Larger
Maximum stock size	Smaller

Total Allowable Catch (TAC) and Effort controls

123. Pure Open Access or MEY fisheries are rarely present in marine fisheries. Most fisheries are under some kind of public management, implying that a management body is responsible for regulating the fishery according to society's objectives with the fish resource. In this section we analyse management using TACs and effort controls to regulate catch and access to the fishery. Since fuel tax concessions are assumed to be a long term management and the bio-economic model is based on long term equilibrium, we accordingly focus the analysis on the long term effects also in the TAC and effort control cases. This implies that the management body has the possibility to adjust the management (e.g. TACs) when stock and effort change.

124. The effect of abolishing fuel tax concession in a TAC system will depend on how the TAC is allocated among fishermen. We analyse two cases; Individual Transferable Quotas (ITQ) and a fishery with a TAC and free entrance.

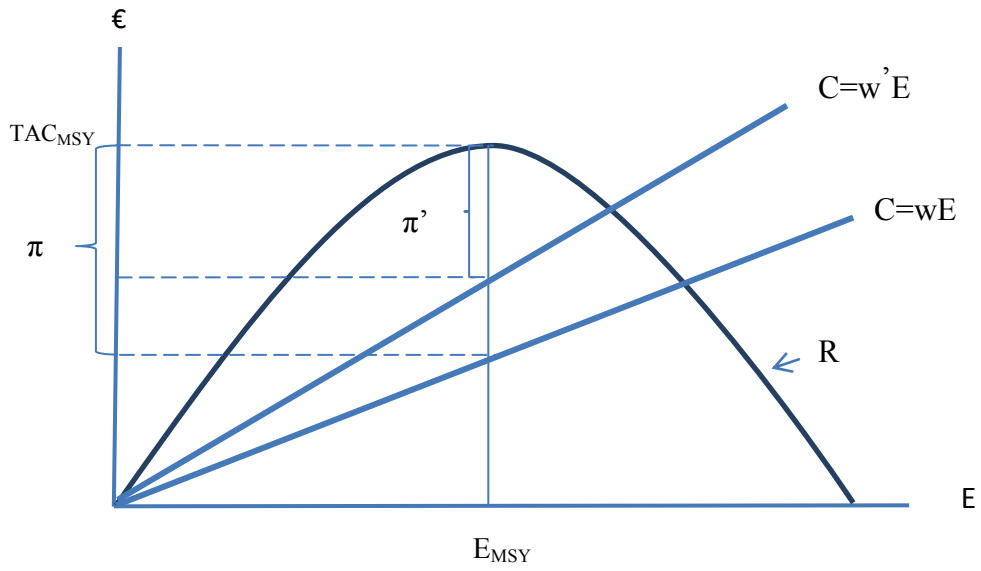
125. In both cases we assume that the TAC is binding to start with, i.e. it is set low enough to constrain the fishery, but that managers will actively change the quota based on the size of the stock. Thus, when stocks are rebuilt in a successful TAC-system, the managers will increase the quotas accordingly and set the quota equal to the growth in the stock. This ensures a stable harvest over time.

Individual Transferable Quotas

126. In the model, ITQs will ensure that for any given TAC set by the management body the fishery will generate the maximum possible profit. To maximise the total economic outcome from the fishery the manager will aim at the MEY level of catches, but alternative management measures such as the MSY level are available. The MEY level of the TAC (harvest) will change if w changes as is shown for the MEY

case in Table A2. In this sense, the solution will be identical to the MEY analysis. The mechanism behind the changes includes a management body setting the TAC. This is of course under the assumption that fisheries managers will change the TAC according to the new conditions, which will not be the case if setting the TAC at MSY level. In this case catch, effort and stock will be unaffected by reducing fuel tax concessions, but the profitability in the fishery will decrease. The situation is shown in Figure A4, and the reduction in the tax concession results in a decrease in the sector's profit from π to π'. The reduction in profit for the fishery is collected as tax revenues by the government.

Figure A4. ITQ with a fixed TAC at MSY level



Free access under quota

127. If access to the quota is free there will be competition for the fish in a similar way as for the Open Access fishery, although the TAC has the potential to ensure the biological sustainability of the stock. Assume a successful TAC-system that allows the fish stock and the long run TAC to stabilise at MSY level. The corresponding effort level is E_{MSY}, but due to the competition for quota the capacity in the fishery will increase as new vessels enter the fishery. More vessels fishing for the TAC will shorten the fishing season and increase the cost of performing E_{MSY} due to excess capacity. In the long run, the resource rent will be zero (see e.g. OECD, 1997). In Figure A4 this would correspond to an intersection of the cost and revenue curves at the MSY level. By abolishing fuel tax concessions the fishery will pay higher costs for using fuel. This will increase costs and the fishery will be unprofitable in the short run. The least efficient vessels will leave the fishery, thus reducing excess capacity, until a new free access equilibrium with zero profits is established. Catch, effort and stock will be unchanged in equilibrium since the management body determines the long run level by setting the TAC at MSY level. However, since some fishermen will leave the fishery part of the cost for the fishery will be paid as taxes instead of costs for excess capacity.

Effort controls

128. OECD (1997, p93) defines an effort unit as an amount of time a unit of gear spends fishing. However, as pointed out by OECD (2006) effort of various kinds of vessels needs to be standardised, and this is a difficult topic in practical management. OECD views the possibility to successfully manage a fishery with effort controls as dependent on the fishery's flexibility, i.e. the possibility to increase production per effort being controlled. A flexible fishery can increase harvest per effort and thus the effort control will be inefficient for controlling harvest rates. In an inflexible fishery it is not possible to increase harvest per effort. The OECD (2006) views this as unlikely to happen since managers are seldom able to control all aspects of production. We continue the analysis with two cases based on individual effort quota. With individual effort quotas, both total effort and the number of vessels are restricted since effort quotas are allocated to the participating vessels.

Inflexible fishery

129. If the fishery is inflexible and thus cannot increase the catch per unit of (controlled) effort the individual effort quotas will be similar to a catch quota system (OECD, 1997). Thus, a reduced tax concession would not affect effort, stock and harvest as long as managers do not change the total effort in the fishery, see Figure A4 with effort fixed at E_{MSY}. However, the role of the management is to set the effort in a way that corresponds to the management objectives. This could be to maximise the economic profits, and in this case the effort will be set at E_{MEY} in Figure 2. Abolishing fuel tax concessions will change the optimal effort to E'_{MEY}.

Flexible fishery

130. If the fishery is flexible the effort is not fully controlled and it is possible to increase effort. In this case the fishery will be similar to an Open Access fishery as will the effects of a change in fuel tax concessions. However, if the number of vessels and their time spent fishing is effectively controlled the expansion will not be due to additional vessels, but to investments increasing the catch per unit of effort (capital stuffing). OECD (2006) elaborates on this topic.

Two fleets sharing the same resource

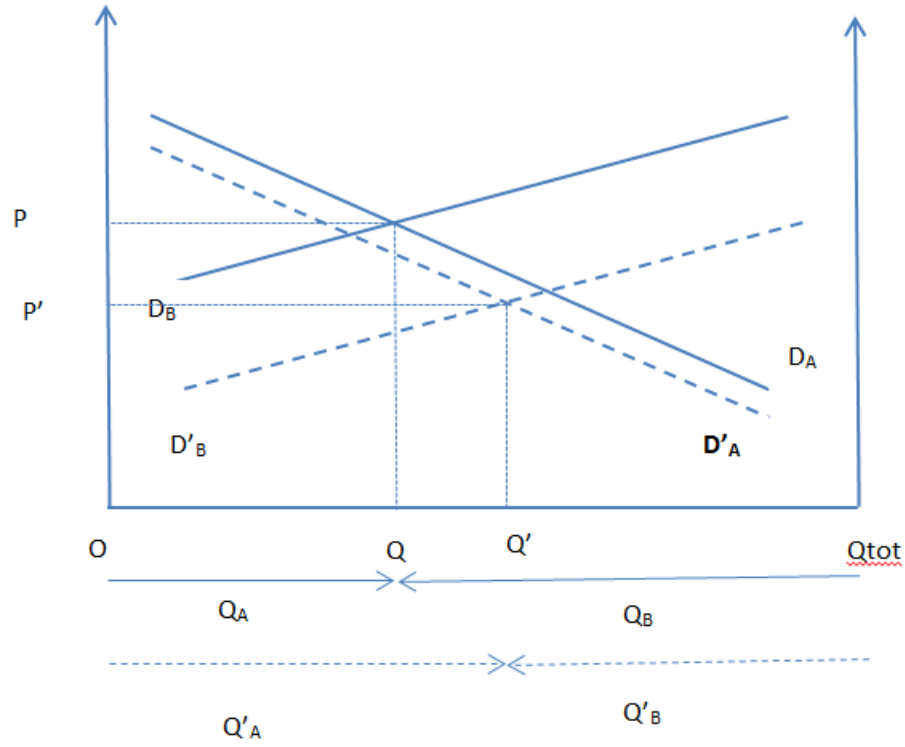
131. The bio-economic model outlined above is based on a single fleet utilising a single stock. For fuel tax concessions it is also of interest to analyse the impact in a case with multiple fleets utilising the same stocks but using technologies that differ in fuel intensity. Below, the change in fleet composition in a fishery with two fleets is illustrated in a simplified example.

132. The example shows an ITQ system with two firms, A and B, trading quotas. The total quota is set by a management body, and is represented by the distance O-Qtot on the horizontal axis in Figure A5. Firm A's quotas are measured from O and to the right, while firm B's quotas are measured from Qtot and to the left. The total amount of quota for A and B thus equals the total quota in the fishery. The demand for quota for firm A is D_A and the demand for firm B is D_B as represented by the solid lines in the Figure. The demand is determined by the price of fish and the cost for fishing. The more profit the firm can make by fishing an additional unit of fish, the higher is the firm's willingness to pay for quota. It is assumed that the marginal cost of fishing is increasing for both firms, and thus the demand for quota is downward sloping. The firms trade quota until the willingness to pay for an additional unit is equal for both firms. This is where the demand curves intersect. Before abolishing fuel tax concessions, the quota was traded such that firm A had O-Q units of quota and firm B had Qtot-Q units. The price of quota in the market was P.

133. Assume that firm B uses a more fuel intense fishing technology than firm A. Thus, if abolishing fuel tax concessions firm B's cost for fishing will increase more than firm A's. Higher costs imply that the

demand for quota is shifted downwards for both firms, but proportionally more for firm B. The demand curves after fuel tax concessions are abolished are shown as D'_A and D'_B in the Figure. The new market equilibrium is at Q' with the corresponding price P'. In this market equilibrium firm B has decreased its share of the total quota, which is due to the high fuel consumption relative to firm A.

Figure A5. Two firms trading quota



134. The analysis shows how the relative distribution of quotas between fishing techniques with high and low fuel usage is expected to change when abolishing fuel tax concessions. Techniques with low fuel usage will increase their fishing. In the illustrated example the total quota is fished after fuel tax concessions are abolished. This will of course not be the case if it is not profitable to utilise the entire quota. Further, a fishery with low fuel use but also low economic performance might not be able to sustain a fishery with fuel taxes even if the additional cost is low.

Discussion

135. The implications of abolishing fuel tax concessions will depend on the management regime at hand. In this analysis we use a bio-economic model to illustrate the Open Access and Maximum Economic Yield situations. These cases can be viewed as two extremes and few fisheries can be characterised purely as one of these cases. Most marine fisheries are managed in some way, thus not being a pure Open Access system, but at the same time few management systems allow the fishery to reach the full MEY profit. This could be due to management objectives such as employment or coastal development.

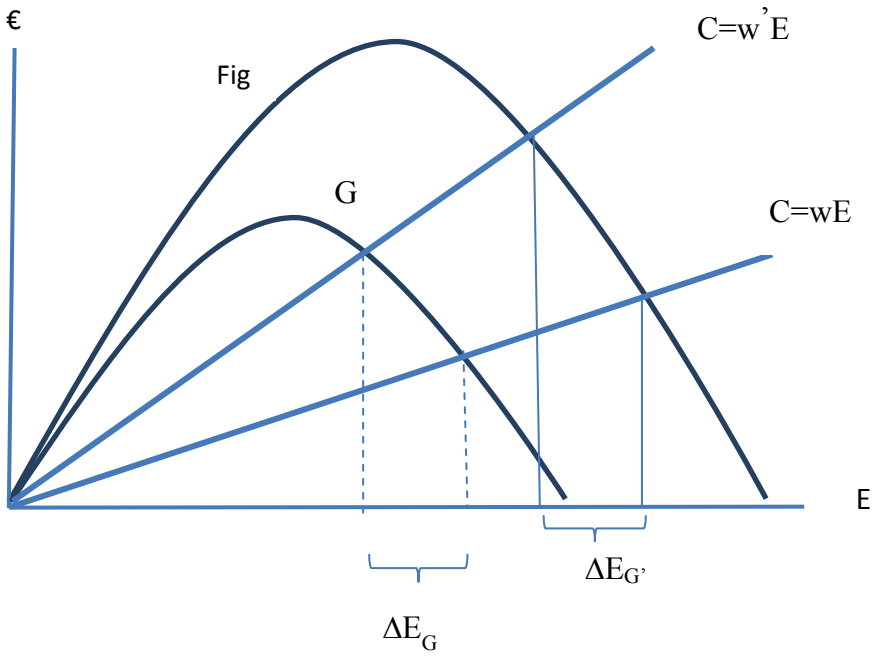
136. The analysis is for long run effects, i.e. when both the stock and the fleet have adjusted to long run equilibrium after the change in fuel tax concessions. From the analysis it is possible to determine that for both MEY and Open Access an increase in fuel taxes will cause effort to decrease and stocks to increase. The harvest level in MEY will decrease while the effect on the harvest in Open Access will depend on if the equilibrium is above or below the MSY level. The magnitude of the changes is dependent

on biological characteristics such as the intrinsic growth of the fish stock, on economic factors such as costs for inputs and the price for fish, and on how easy the fish is to catch (catchability coefficient). Further, if more than one fleet utilises the stock, the total effect on the fleets will be dependent on their relative fuel intensity. In summary, even in simplifying bio-economic models the total effects of reforming fuel tax concessions will be a complex topic with multiple factors influencing the outcome.

Highly productive stocks

137. A highly productive stock, i.e. where the *g* parameter is large, is able to sustain a larger harvest for any given stock size and fishing effort, and the MSY is higher than for a low productive stock. Further, higher fishing pressure is possible without depleting the stock. This is shown in Figure A6, where *G* is the growth in the low productive stock and *G'* is the growth in the high productive stock. At the level of effort that will deplete the low productive stock, it is still possible to maintain a biologically sustainable fishery in the high productive case.

Figure A6. Effort and harvest for stocks with different intrinsic rates of growth



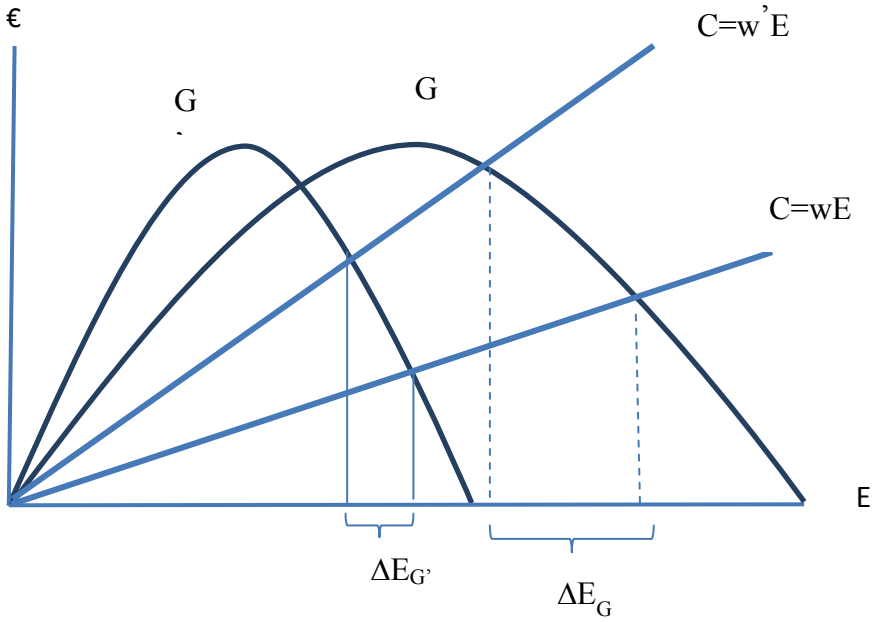
The effect of a fuel tax is, as shown in Table A2, larger when *g* is large. In Figure A1 this is implies that $\Delta E_{G'} > \Delta E_G$.

Catchability

138. The catchability of a species depends both on the behavioral conditions of the species (e.g. if it is schooling or not) and on the technical development of the fishery. With high technological development harvesting a fixed amount of fish will be possible using less effort. It is also possible to deplete the fish stock using less effort. However, we observe that the growth in the stock does not change so the harvest at

MSY is equal but harvested at a lower E. This is shown in Figure A7 where *G* is the stock growth when fishing with low *e*, and *G'* is the stock growth when fishing with high *e*.

Figure A7. Effort and harvest with stocks with different levels of catchability



From Table A2 we know that the impact of a fuel subsidy is smaller when e is large. In Figure A2 this is shown as $\Delta E_{G'} < \Delta E_G$.

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GREEN GROWTH: GOVERNANCE ISSUES FOR MARINE CAPTURE FISHERIES

23-25 October 2013

This document provides a report on "Green Growth and Governance in Fisheries and Aquaculture", a consultant's report by Professor David Symes. It is presented to the 112th Session of the Committee for Fisheries under item 3 iv) of the draft agenda and is distributed for DISCUSSION.

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GREEN GROWTH: GOVERNANCE ISSUES FOR MARINE CAPTURE FISHERIES

Introduction

1. According to the OECD (2011) "(G)reen growth means fostering economic growth and development, while ensuring natural assets continue to provide the resources and environmental services on which our well-being relies". It is an essential component of the broader concept of sustainable development, focusing on the need to maintain the diversity, productivity and integrity of local, regional and global ecosystems. In the context of marine fisheries there is a prior need for remedial action to repair damage to the marine ecosystem and rebuild stocks of commercially valuable species before the full potential of the ocean's environmental services can be realised. Overfishing not only reduces the overall size of the targeted fish stock – leading to lower output and rising costs per unit of catch – but it will also distort its age and size structures with implications for future reproductive capabilities and can eventually lead to the removal of the top predators, fishing down the food chain and the consequent weakening of ecosystem structures and functions. As a result, green growth is more likely to result from improvements to the efficiency of harvesting and the quality of the product within the supply chain, together with the minimisation of waste , than through increases in the volume of fish harvested. Indeed, in some parts of the world – notably in the north east Atlantic – it may be necessary to reduce levels of fishing activity to allow some of the more heavily exploited seas to achieve"good environmental status'.

2. Green growth will provide a further challenge for the multi-level systems of governance by which policies are formulated, implemented and monitored. Management of the "ocean commons" faces particular difficulties arising from the nature of the sea as an undivided multi-functional space, the mobility of its living resources and the absence of clearly defined rights of ownership. In the case of fisheries governance, systems are already highly stressed and undergoing major demands as they struggle to cope with problems of overfishing, resource depletion, allocation of resources and increasing market demand, *inter alia*. Different responses to such issues have meant an increasing variety of institutional arrangements for fisheries governance throughout the world. Adoption of a green growth agenda may do more than simply add to the burden of fisheries governance. Depending on the extent to which green growth is pursued, it may call into question the principles – and the science – on which policy is based and necessitate certain changes to the institutional structures that make up the governance system itself.

3. Much will depend on the characteristics of the affected fisheries and the time frames set for green growth and the recovery of depleted fish stocks and damaged ecosystems. Some remedial measures can take immediate effect with little or no risk to the viability of current fishing activities. Others will require long term treatment perhaps involving more draconian action now – and threatening to dispossess some fishers of their entitlements to fish – in order to attain higher levels of production and productivity in the future. However, because of the innate uncertainties of marine ecosystems and the effects of long term climate change, the outcomes of recovery strategies can rarely be guaranteed.

4. The purpose of this paper is to examine current systems of fisheries governance – local, national and global – from a green growth perspective. Its aim will be to assess whether (and how far) green growth objectives can be achieved, alongside those of economic efficiency and social justice, within existing structures or whether the delivery of the green growth agenda will require a fundamental reform of the governance system. Central to this analysis will be the need to ensure a high degree of coherence between the essential elements of environmental and fisheries policies and between the different scales of governance – global, national and local. At the same time policy makers must always be alert to the fact that what may appear a sensible course of action at the regional or national scale may have strong negative impacts at the local or community level (and *vice versa*). The scaling up or scaling down of solutions

deemed appropriate at one level rarely works. Indeed, managing the global and local perspectives of a problem is likely to lead to hard choices.

5. Chapter 2 outlines the basic characteristics of modern governance systems for fisheries while Chapter 3 explores the significance of scale and the need for coherence. In Chapter 4 the nature of green growth is examined and the demands it will place on governance systems, along with an assessment of the opportunities for its implementation through immediate short term action, the adoption of an ecosystem based approach and the development of integrated marine management. An overall assessment of the opportunities for and barriers to transformational changes to the governance systems is assessed in Chapter 5.

Understanding fisheries governance

What do we mean by governance?

6. Although the history of fisheries regulation may stretch back more than two thousand years, the idea of a comprehensive system of fisheries management is much more recent. The theoretical underpinnings of fish stock management were developed in the 1950s and 1960s and the current geopolitical framework established even later following the contagious spread of *de facto* 200 mile exclusive economic zones (EEZs) in the second half of the 1970s and the subsequent incorporation of the principle in the United Nations' Law of the Sea in 1982. Previously national jurisdictions were limited to the 12 nm "territorial seas". Beyond 12 nm management of the fisheries had to rely on the willingness of nation states to abide by recommendations framed by regional management organisations such as the North Atlantic Fisheries Organisation (NAFO) and the North East Atlantic Fisheries Commission (NEAFC).

7. Use of the term "governance" ("the action, manner and system of governing": Collins English Dictionary, 2nd Edition, 1986) in preference to "management" has grown significantly in recent years. It reflects the increasing diversity and complexity of decision making in relation to public policy as governments have opened up new channels of consultation to a growing range of actors and at the same time begun to "hollow out" the role of the state by devolving certain responsibilities to regional and local levels of administration and to non-governmental agencies engaged in policy making and implementation. As a result, the act of governing has become a task shared among very many public and private actors and the boundaries between the public and private domains are becoming increasingly blurred.

8. In essence, fisheries governance is concerned with a range of decision making from the development of scientific advice through the formulation, implementation and monitoring of policy, the underlying principles that guide decision making and the alignment with macro-economic and environmental policies. It is particularly concerned with how the policy is formulated and implemented (*policy process*) and the ways in which different stakeholder interests are incorporated within the process in an advisory, executive or implementation capacity (*policy community*).

9. The decisions to reduce the role of the state and devolve responsibilities to other areas of society have added greatly to the complexity of the governing system and to the process of decision making. It has inevitably led to a significant increase in the numbers of actors involved and to the complex relationships that exist between them. This growing complexity raises the question as to how far the different actors involved understand the overall system of which they are a part and the roles that each actor is expected to contribute. Despite greater inclusivity, problems of compartmentalisation still persist (especially within state institutions) and there is a need for interactive learning to improve the level of understanding of the system and appreciation of the different roles, contributions and viewpoints involved. Even where fisheries administrations have been brought under a broader departmental umbrella (food, environment, marine),

they have tended to retain their independent identities, partly because of the uniqueness of the science that underpins the policy decisions.

10. Increasing complexity of structures, relationships and procedures occurs at all levels of governance. With the emergence of new interest groups, including the market and particular elements of civil society, and changing modes of operation, it becomes increasingly difficult to discern where the sources of greatest influence over governance actions now lie and what forms it takes, both within the fisheries sector and among contingent areas of interest. Just how far these changes have contributed to the achievement of good governance and to the attributes of transparency, accountability, inclusivity and proportionality is unclear.

11. According to Kooiman (2003) three distinct but interrelated orders of governance can be recognised. *First order governance* deals with day-to-day problems relating to a range of activities including quota uptake, market supplies, prices and employment *inter alia*. It involves the identification of problems, consideration of risks, choice of tools and creation of incentives as part of the opportunities for their solutions. These problems are most likely to occur in relation to the implementation of policy and occur at the local level, with responsibility for their solution being discharged at the national and/or local levels.

12. *Second order governance* relates to the wide range of institutional arrangements within which first order governance activities are conducted. They comprise agreements, rules, rights, laws, norms, beliefs, roles, procedures and organisations which set the criteria by which governance action is measured in terms of its legitimacy and performance (Kooiman *et al*., 2005). A principal test of the governance system is whether these arrangements combine in a coherent framework for problem solving and allow an effective division of risk, responsibility and authority between the public and private actors involved.

13. *Third order, or meta-governance* concerns the development of overarching values and principles that will guide the governance process through the inevitable "hard choices" that will have to be made in relation to the central concerns of food security, livelihoods, social justice and ecosystem health, as well as defining the basic strategy and setting broad targets for its achievement.

14. These three orders of governance are interdependent and interactive. They clearly cannot function in isolation but they do not equate directly to the different levels of governance (global, national, local). It is, however, highly unlikely that local governance systems will be involved in carrying out meta-governance functions or, conversely, that global governance institutions like the United Nations will be concerned with solving day-to-day problems associated with first order governance. The governance system, as a whole, and the three orders of governance will need to be continually renewed, revised and adapted to the constantly changing conditions that surround fisheries. This is a task to be shared between all parties in the governing system, but with the elected governments assuming overall responsibility. Failure to adapt will render them incapable of responding effectively to the challenges of a changing world.

Modern governance systems

15. Today there is a wide variety of governance systems across the world with each system reflecting the particular values, laws, beliefs and history of the country in which it is set. No two countries' governance systems are identical and though several generic models can be identified – hierarchical, participative, co-governing and self-governing (see 2.3 below) – in practice most systems are hybrid in form with each combining to a greater or lesser extent elements of all four model systems.

16. Despite concessions to "hollowing out the state" and the inclusion of the market and civil society among the active partners, most modern governing systems still cling to the basic elements of a traditional

model of hierarchical governance – centralised, bureaucratic, top-down mode of policy delivery – in which central government remains solely accountable for policy outcomes. The state intervenes on behalf of the public interest usually through systems of parliamentary democracy and the rule of law, focusing on the need to ensure resource sustainability (management of the fish stocks) and an efficient and equitable allocation of access to fishing opportunities (licensing, quota entitlements). It relies heavily on expert scientific opinion (stock assessments) provided by government funded fisheries laboratories while hierarchical systems may seek the opinions of stakeholders through both regular and *ad hoc* consultations with recognised fishermen's organisations, rarely will they be bound to accept and act upon such advice.

17. The rule of law is both an enabling and constraining feature of hierarchical governance. Although in the more developed, western world the state is increasingly unlikely to "command and control" fishing activity through ownership of the means of production, it will still seek to influence the behaviour of the fishing industry (and the outcomes of policy) by setting limits to its activity in the form of restrictive regulations. At the same time, the powers of the state to intervene will be limited by constitutional law and human rights legislation *inter alia*. Operating within a framework of democratic procedures, the legitimacy of its interventions and the ensuing regulation is ensured and ultimately subject to independent judicial review.

18. Formalised systems of hierarchical governance will need to retain sufficient flexibility and be able to respond in timely fashion to the dynamic and often unpredictable conditions of marine ecosystems and the global market system within which fisheries operate. The necessary adaptability may be constrained by a built-in tendency to path dependent change whereby previous policy decisions may seriously limit the scope for future decisions making it much more difficult to embark on radical reforms of policy (Gezelius, 2008). In general, decision making remains conservative, focused more on short term issues and largely concerned with remedying faults within the existing policy approach. In some instances constitutional rules may also proscribe much needed institutional changes, as in the case of the European Union's Common Fisheries Policy (see Box 1).

Box 1. The Common Fisheries Policy

The Common Fisheries Policy is a unique experiment in fisheries governance. One of the world's largest and most diverse territories, the EU's fishing zone extends through 40º of latitude and 60º of longitude and is formed by the amalgamation of the EEZs of 23 coastal states. Its geopolitical structure is complicated by the presence of non-member coastal states in each of the major enclosed or semi-enclosed seas that form part of the EU's fishing zone.

The underlying principle of EU governance is non-discrimination, translating in fishing terms into equal access. At the time of establishing a comprehensive common policy the principle of equal access was greatly weakened by a derogation granting member states (MS) responsibility for managing inshore waters (0-12m) and the adoption of permanent keys for the allocation of quota that became known as “relative stability”, a countervailing principle respecting national fishing rights.

The EU's governing system involves a two-tier structure where responsibility is normally shared between EU institutions (Commission, Council of Ministers and Parliament) and the MS. However, for the purposes of biological conservation of the fish stocks, sole competence is vested in the European institutions with the Commission initiating and developing policy and the Council and Parliament jointly tasked with approving policy proposals. Guidance is provided by external and internal bodies, including ICES on TACs, the Scientific, Technical and Economic Fisheries Committee on technical matters and the Advisory Committee on Fisheries on a broad range of policy issues, together with Regional Advisory Councils representing fishing and other interests at the regional sea level. Policy decisions take the form of regulations to be translated directly into MS law rather than the “softer” directives that allow MS more discretion in the form of implementation.

Important areas of fisheries policy – fleet management and quota management – are shared responsibilities, with the Commission setting out guidelines and targets but MS deciding how these are to be implemented. Inshore fisheries are managed by the MS.

The CFP is subject to decennial review resulting in new framework regulations governing both fisheries policy and the less controversial “common organisation of the market”. The latter includes the role of producer organisations with potential to develop self- or co-governance in relation to quota management. Much needed reform of the policy process, including delegation of responsibilities for detailed “micro-management” of fisheries to MS (or, preferably, to new regional management organisations), has proved difficult to achieve. Reasons include the need for agreement between all MS and between Council and Parliament, institutional inertia, and legal constraints embedded in the European Treaties (see Chapter 5).

Interestingly, in the context of this report, the scope of DG Mare – the Directorate General of the Commission responsible for preparing fisheries policy – has recently been extended to include integrated maritime policy. Paradoxically, this extended brief does not include marine environmental policy; that remains in the hands of DG Environment.

19. Hierarchical governing systems have attracted a good deal of recent criticism as being outdated, irrelevant and inadequate for the complex task of managing the diverse living resources of the sea. One of the most trenchant and comprehensive recent critiques has come from the social scientist Fikret Berkes (2010) in which he attacks modern governance systems for their commodification of nature[1] and their domination by a management élite using positivist and reductionist science in pursuit of false certainties and spuriously simple technical solutions and the consequent disempowerment of local communities and erosion of local control over resource use.

1. According to Berkes (2010) the commodification of nature refers to the utilitarian view that natural resources are of value only to the extent that they can be extracted to create goods for human use without due concern for the impact on the wider environment. In fisheries, commodification was typified by the industry's focus on quantity rather than quality or composition of the catch and *in extremis* it led to the practice of pulse fishing' by highly mobile distant water fleets prepared to fish out a stock before moving on to exploit another stock or fishery in similar fashion. Today natural resources are increasingly being revalued within the context of the sustainability of environmental goods and services.

20. More specifically, modern governing systems reliant on a hierarchical approach have been criticised for their lack of attention to the diversity, complexity and dynamics of fisheries systems *per se* (see Box 2) and the need to factor these essential characteristics into the development of fisheries policy (Kooiman *et al*., 1999). Jentoft and Chuenpagdee (2009) have drawn attention to the failure of policy makers to recognise fisheries and marine conservation issues as so-called "wicked problems" that are difficult both to define and delimit and are frequently incapable of permanent solutions. Such issues are inimical to the reliance on an instrumental, "tool kit" based approach in which policy is often closely identified with increasingly restrictive regulation. Few management issues in fisheries can be resolved by simple, technical fixes; most will require a more nuanced, negotiated and adaptive approach, together with continuous monitoring to guard against unintended consequences.

Box 2. Diversity, complexity and dynamics of fisheries systems

The *diversity* of the world's fisheries systems is legendary. It derives in the first instance from the huge range of ecosystems, habitats and fish species and from the cultural choices as to which species are harvested for food (or other uses) and extends to include sources of knowledge, fishing methods (métiers), design of fishing vessels, locus and scales of production (small scale inshore fisheries *v* offshore, industrial fisheries), level of engagement (full time, part time, seasonal, recreational)' ownership of the means of production (individual, family, community, company) and methods of remuneration. Diversity is added to through the fish (or value) chain extending from harvesting through processing and distribution to retailing activities. Most individual fisheries incorporate a mix of production, processing and marketing characteristics.

Complexity refers to the interactions or relationships between different elements of the fisheries system and with its wider socio-economic and physical environments. Systems become more complex with lengthening chains of interaction as more actors become involved and when the geographical distance between actors is extended. Globalisation has therefore added greatly to the complexity of relationships – extending the range of fishing operations (globalisation of production), connecting fishers to larger and more distant markets (globalisation of trade) and the growth in regulatory controls at all levels of governance which have sometimes resulted in confusing regulatory patterns.

Dynamics are related to the tensions with and between systems and are associated with the incidence of and propensity for change. Fisheries are inherently unstable systems, prone to fluctuation or occasionally more fundamental shocks originating in the physical environment, local and global markets, or the social, cultural and political environments. The resulting perturbations may be magnified by the lengthening chains of interaction.

Source: Based on Kooiman *et al.* 2005 pp 13-14.

21. Berkes (2010) also draws attention to the need to recognise fisheries and their host ecosystems as inherently unstable and requiring adaptive management ('learning by doing') as opposed to prescriptive, "one size fits all" solutions. Meanwhile the importance of a precautionary approach to fisheries management in face of uncertainties – both known and unknown – is stressed by fisheries scientists.

22. Finally, in their submission to the European Commission on the reform of the Common Fisheries Policy (CFP) Sissenwine and Symes (2007) point to the remoteness of hierarchical governance and the overall loss of trust in, and respect for, the governing system and regulatory regimes on the part of stakeholders, leading to weak levels of commitment to and compliance with the regulatory system. The need to bring decision making much closer to those most directly affected and to give stakeholders a more active role in the policy process lies at the heart of effective governance.

Alternative governing systems

23. Growing awareness of the deficiencies of hierarchical governance has led to several important changes being made to the structures and procedures of fisheries governance, especially in the more

developed countries where hierarchical systems had taken a firmer hold. These changes are focused largely on the need to broaden the policy community so as to strengthen the damaged relations between government and industry, improve the technical content of policy measures and redeem the trust, commitment and compliance of fishers. This kind of transition is not unique to fisheries but a natural outcome of "hollowing out the state" and the inclusion of civil society within the governance system. In the context of fisheries it is a response to the stark realities of a failing policy and the need for further democratisation of the policy process.

24. Here three different modes are identified – participative governance, co-governance and self-governance – which when set alongside hierarchical governance form a continuum of changing styles of governing found within fisheries. Strictly speaking they are not alternatives, for elements of all three approaches can be combined within a single governance system. The common denominator of the three modes is the greater involvement of the principal stakeholder (the fishing industry) in the governing process. The distinctions between the three modes are based on the specific form and extent of stakeholder involvement. That involvement may come about either through the incorporation of recognised stakeholder organisations within the policy process (*participative governance*) or the delegation or devolvement of specific responsibilities and authority to the local state and/or to non-governmental organisations (*co-governance; self-governance*).

Participative governance

25. Participative governance implies the engagement of stakeholder interests at all stages of the policy process from the generation of stakeholder advice (*fisheries-science partnerships*) through the formulation of policy proposals to their formal implementation. In theory, it would mean opening up the largely non-transparent deliberations of the bureaucracy to the repeated scrutiny of the fishing industry and thereby investing the industry with considerable influence over the policy outcome. In practice, however, this rarely happens as involvement of stakeholders is usually limited to advisory or consultative roles. The EU's Common Fisheries Policy is, for example, serviced by the Advisory Committee on Fisheries drawn largely from a range of commercial fishing interests but also including a wide range of non-fishing interests and meeting regularly in Brussels and by Regional Advisory Councils operating principally at the level of the regional seas.

26. The significance of the moves towards participative governance are threefold. First, it involves the formal recognition of stakeholders as partners – though not equal partners – in the policy process. Secondly, it implies an obligation on the part of government to consult with the industry at relevant stages of the policy process rather than presenting them with policy decisions as a *fait accompli*. And thirdly, where the consultation process works effectively it can provide an insightful and constructive interaction between the governing system and the system to be governed (see 2.4 below).

Co-governance

27. Whereas participative governance is concerned with the *integration* of stakeholder interests throughout the policy process and operates mainly at the national and regional scales, the more common forms of co-governance are principally concerned with the sharing of responsibility between the state and civil society based on a clear *division* of functions and are more usually associated with the detailed implementation of policy at the local scale. As Sen and Raakjaer Nielson (1996) make clear, co-governance can take a variety of structural forms and embrace a range of functions (including access arrangements, quota management, effort management *inter alia*). Although it is often thought of as a relatively new form of governance, a number of co-governance systems have deep historical roots with their origins in medieval guilds (the Spanish *cofradia*), feudal tenure systems (as in the Japanese inshore

cooperatives) or early forms of public administration (including the Sea Fisheries Committees in England and Wales established towards the end of the 19th century – see Box 3).

Box 3. Inshore fisheries governance in Great Britian

Responsibility for managing inshore fisheries in Great Britain is devolved to the three "national" administrations (England, Scotland and Wales). Each has elected to take a different path so that today Great Britain provides a microcosm of inshore governance systems found throughout the developed world with three distinctive modes: centralised (Wales), local advisory (Scotland) and local co-governance (England).

In *Scotland*, responsibility for managing inshore waters (0-12 nm) has remained in the hands of the central administration. A partially devolved system of management was introduced in 2009 with an initial tranche of of six pilot Inshore Fishing Groups (IFGs) tasked with developing management plans for their districts. Membership of the main committee is confined to representatives of national and local commercial fishing interests, with access to scientific and nature conservation expertise available through supporting advisory committees. IFGs have no executive powers of their own and responsibility for implementing their recommendations rests with Marine Scotland.

In *England and Wales* a system of fully devolved local management for inshore fisheries has been in place for well over a century. A network of local Sea Fisheries Committees (SFCs) began to emerge after 1888: the resulting 12 Sea Fisheries Districts varied greatly in size, complexity and budgetary strength. Membership of the committees was divided between elected representatives of the local authorities (the funding bodies) and stakeholders drawn largely from local commercial fishing interests. SFCs were equipped with statutory bylaw powers for managing the fisheries, including limiting the size of vessels, regulating the size and number of towed gears, effecting local closures and varying national regulations on minimum landing sizes to suit local conditions. Under the Sea Fisheries (Shellfish) Act 1967, new powers to manage shellfish beds were introduced. SFCs developed their own seagoing and land based enforcement capabilities and some of the larger SFCs have appointed their own scientific officers to support the Committees' work.

Weaknesses in the structures, regulatory powers and funding of the system were becoming increasingly apparent. A new suite of Inshore Fisheries and Conservation Authorities (IFCAs) was introduced in England in 2011 with changes to their remit in respect of fishing and wildlife conservation, extension of powers to include emergency bylaws and effort limitation, improved funding and a shift in the composition of the new authorities. This last modification provoked alarm among fishing interests. Representation of the local authorities was reduced; and seats allocated to national and local conservation bodies were increased at the expense of commercial fishing interests. To a degree, therefore, IFCAs could be seen to anticipate a much stronger integration of fisheries and marine wildlife conservation.

Meanwhile, the government in *Wales* decided to bring inshore fisheries management in house – a move that ran counter to the majority view expressed by fisheries and conservation interests alike during the public consultation.

Source: Symes and Phillipson, 2010.

28. The basic principle underlying the concept of co-governance is subsidiarity, by which decision making is devolved to the most appropriate level of competence. It is not simply a question of relieving central administration of the onerous tasks associated with the implementation of policy at local level; nor is it driven by a need to reduce the public costs of fisheries management – though both benefits may well

accrue as the result of effective co-governance. Co-governance promotes a more open and inclusive form of governance, facilitating bottom-up delivery of community level initiatives. It is concerned with the positive advantages for management to be gained from bringing local knowledge, experience and expertise of the fisheries to bear on the managing the resources, creating distributional justice and resolving conflicts, recognising the rights of local communities to be involved in managing "their" resources and cultivating a sense of local stewardship.

29. Ideally, co-governance is about partnership, allowing all parties to communicate, cooperate and coordinate their activities through networks of public and private actors. Such networks should help to facilitate spontaneous opportunities for interactive learning that will assist the development of mutual understanding of the problems and generate the synergies for their solution. Where successful, co-governance can secure the necessary basis for adaptive management and sustainable development at the local scale.

30. Several important advantages over hierarchical systems of governance can be posited. They include greater openness and transparency of decision making; a broader basis of information and knowledge combining the product of formal fisheries science and local ecological knowledge; greater proportionality in terms of matching solutions to problems; increased rationality and legitimacy for the regulatory system; a sense of "ownership" of the management process; enhanced levels of commitment and compliance on the part of the user groups; and lower transaction costs with user groups internalising some of the costs associated with data collection, surveillance and control (Symes and Phillipson, 1999).

31. Both participative and co-governance systems face a number of potential disadvantages. Gray (2005) suggests that the system may become unwieldy, time consuming and costly, adding considerably to the time taken to reach decisions and so limiting the systems' ability to act swiftly and decisively. Under pressure from stakeholders they may shift their focus from long term sustainability goals to issues of more local, short term self-interest. But the greatest challenge for these forms of governance probably relates to stakeholder representation and issues of reasonable balance. It is by no means certain that representation of the fishing industry will affect access to all shades of opinion within the industry; the likelihood is that industry representatives serving on advisory bodies will reflect the views of their own sectoral interests. Part of the problem is a reflection of the (dis-)organisation of the fisheries sector that comprises very large numbers of highly diverse small scale enterprises dispersed around the coastline and where significant numbers of enterprises remain outside the formal networks of association.

32. In Norway – often considered as one of the most comprehensive and successful examples of participative governance – the National Fishermen's Association (NFA) exercises a virtual monopoly when it comes to representing the harvesting sector's interests. It occupies a dominant and privileged position in negotiations with government over the direction of fisheries policy. According to Gezelius (2008: 46) the NFA – despite representing less than 60% of those involved in the harvesting sector – displays "a remarkable capacity to arbitrate between conflicting industry interests and, by doing so, present uniform advice to the government". Other countries tend to be less fortunate. In circumstances where conflicting sources of advice reflecting different segments of the industry are articulated, the participatory process can be confusing, fractious and sometimes inconclusive. The problems of fair and balanced representation are likely to become more acute where issues relating to environmental conservation and green growth become central to the governance system.

Self-governance

33. Although self-governance may be seen as the "ideal state" in the final stages of "hollowing out the state" characterised by the withdrawal of public sector involvement, deregulation and privatisation of fishing rights, it is in fact a very rare feature of modern governing systems. Paradoxically, the term best

describes the customary forms of fisheries management that predate the widescale intervention of central governments in the management of the living resources of the sea that were progressively extinguished by the development of state led modern governing systems in the second half of the 20th century.

34. Self-governance implies a situation where stakeholder (or other independent) organisations exercise a high degree of autonomy over particular aspects of management – in other words whose actors take care of themselves rather than acting at the behest of government. It is more commonly associated with post-harvest elements of the fish chain than with managing the resources (fish stocks). Usually the limits of independent action are framed by government regulation, as in the case of quota management systems developed by producer organisations or community interest groups, for example.

35. Elements of self-governance are implicit in the concept of objectives led (or results based) management where basic principles, objectives and targets for fisheries are set by the overall governing system while stakeholder groups are given the responsibility of developing the detailed fishing plans and designing the instruments by which the objectives and targets will be realised (see Lassen *et al.* 2008). At the other end of the spectrum the term "self-governance" may be applied to voluntary agreements over the zoning of potentially conflicting gears or codes of conduct agreed between local wildlife conservation groups and fishermen for fishing in environmentally sensitive areas.

Interactive governance

36. A recent and ongoing development in the theory of governance – and one that is being worked out primarily in the context of marine fisheries – is the concept of interactive governance (Kooiman *et al*., 2005). It offers a useful deconstruction of governance into three sub-systems. The first is the "*system-to-be-governed*", represented by the fish chain extending from harvesting, through the processing, marketing and distributive links, to the final point of consumption ("from sea to plate"). This sub-system is normally characterised by considerable diversity, complexity, dynamism and issues of scale and by four critical areas of concern for policymakers, namely ecosystem health, food security, livelihoods and social justice. The second sub-system is the *governing system* focusing on the roles of the state, markets and civil society, operating on different geographical scales – global, macro-regional, national and local (see chapter 3 below) and through different forms (see 2.3 above).

37. The third sub-system is created by the *governing interactions* between the system-to-be-governed and the governing system that will reveal the goodness of fit between different modes of governing (hierarchical, co- and self-governance) and the diversity of circumstances contained within the system-to-be-governed. Interactive governance, focusing on this third sub-system, provides a set of lenses through which we are able to analyse and evaluate governance systems and identify the factors that may promote or hinder effective governance (ie *governability*). It does not point us in the direction of model systems but instead stresses the need to pay much greater attention to the four cardinal factors of diversity, complexity, dynamics and scale that characterise the systems-to-be-governed when considering the design of the governing system. Most persistent problems in fisheries governance occur as a result of mismatches between the two basic sub-systems. Generally speaking, the simpler and more local of the system-to-be-governed the better the chances of achieving a good match (see Bavinck *et al.*, 2013).

Overview: governance systems and fisheries policy

38. Evaluating recent changes in the structures and styles of governance outlined above – with an emphasis on the inclusion of stakeholders in the policy community and a greater transparency of the policy process – is not easy. Changes were made not with a view to doing different things but rather to doing things differently and improving the overall quality of decision making. Their introduction was not about "political correctness" but about broadening the basis of knowledge and experience, opening up

opportunities for new initiatives and achieving further collaboration with those at the centre of fishing related activity – the practitioners – though not necessarily with their unanimous approval. The outcomes cannot be judged in terms of particular successes or failures but through a sense of greater understanding and respect between the governors and the governed and greater likelihood that the right decisions will be made in the right places and at the right times.

39. The systems of fisheries governance that have evolved over the past 60 years or so have become increasingly complex as they have sought to cope with changing conditions within the fish chain and accommodate new modes (or fashions) of governance. Development of the systems have occurred through incremental change and accretion rather than by the replacement of outmoded institutions. The systems have evolved continuously; rarely have they been subjected to comprehensive review. The EU's Common Fisheries Policy is an exception; but even here the decennial review – itself a massive exercise in participation – and the resulting new framework regulation are more about signalling a change of direction or emphasis than about direct policy action. Translating the intentions set out in the new framework regulation into action usually requires secondary legislation that can reignite debate over contentious detail. As most policy changes involve amendments to existing regulations, as part of a process of fine tuning to account for changing circumstances or to remedy past mistakes that is consonant with the idea of path dependent change, there is little opportunity for a bonfire of redundant regulations.

40. In marked contrast to the rapidly changing styles of governance, there has been little change in the basic content of fisheries policy over the years. The tasks allotted to governing systems have remained remarkably constant. They are concerned primarily with food security and the conservation of commercially important fish stocks as the central issue for the state, and, secondarily, with social justice in terms of equitable and efficient allocations of fishing opportunities – a task which is being increasingly transferred to the role of the market. The other critical areas of concern for fisheries governance – ecosystem health and livelihoods – have tended to claim rather less attention, certainly in the more developed countries. Livelihoods are a more pressing concern in developing countries where fisheries may provide the only reliable source of employment, income and food supply in some coastal regions. Lip service has been paid to ecosystem health as the *sine qua non* of sustainable fisheries, but the focus continues to be on the health of the fish stocks *per se* rather than on the marine ecosystems that sustain them. Attention has in fact focused almost exclusively on the early stages of the fish chain – the harvesting of the fish – and on the regulation of fishing activity; much less attention has been paid to the end stages linking marketing with the consumer.

41. This rather narrow focus has left fisheries governance somewhat isolated from other cognate areas of policy making, most notably marine environmental policy and maritime economic development. The situation is likely to change as issues relating to environmental change, ecosystem health and competition for marine space seem about to move up the political agenda. How well fisheries governance systems will cope with these challenges is a matter for some concern (see Chapters 4 and 5 below).

Coherent design: the issue of scale in ocean governance

Introduction

42. The oceans are a difficult space to govern whether for purposes of fisheries, marine environmental management, shipping or exploitation of the mineral resources of the sea bed. They form a virtually continuous, three dimensional space lacking clearly discernible boundaries; they comprise a highly fluid medium; and they are subject to contrasting legal regimes (*res nullius; res communis*) with basic rights of access for the purpose of navigation. Even with satellite surveillance technology they are difficult to police. The natural determinants of the oceans' living resources (marine ecosystems), together with the distributions of populations of commercially important species, bear little or no relation to the

highly complex geopolitical jurisdictions that define the basic structures of marine governance. And in many instances, whether it be in the partially enclosed sea basins like the North and Baltic seas in Europe or on the high seas beyond the 200 mile EEZs, exploitation of the fish stocks is shared among several different national fishing fleets.

43. Such discontinuities and patterns of exploitation pose a particular challenge for ocean governance in attempting to achieve a sufficient measure of congruence between contiguous governing systems that will ensure coherence of the overall approach. Coherence is required vertically between different geographical levels of governance, horizontally between adjacent jurisdictions operating at the same level, and diagonally between cognate areas of policy making, most notably between fisheries and marine environmental management where integrated coastal zone management and marine spatial planning seek to address issues of multiple use. Interactive governance teaches the importance of matching, as far as possible, governing systems to the scale characteristics of both the biological resource system and the social organisation of fishing activity. The spatial dimensions of the fish chain have greatly expanded with the globalisation of trade in fish and fish products. Fish have become an international commodity, sensitive to trends in global markets. Yet, at the same time, fishing remains a concern for local communities where the consequences of governance failure are most keenly felt. Bridging these polar extremes through the governance system is a tough call.

44. As Mahon *et al*. (2005) point out, governance at multiple scales may be essential for a single management strategy. For example, marine protected areas will certainly need some form of co-governance but to be fully effective they will need to be consistent with national level strategies and implemented as part of a regional network. Action at only one level is likely to see the rewards falling somewhat below their full potential.

Inshore, offshore and high seas fisheries

45. In attempting to understand the significance of scale in fisheries governance, a useful starting point is the simple division of marine space into three distinctive realms of fishing activity, each characterised by very different geographical, legal and organisational features *viz* inshore waters, offshore waters and the high seas.

46. *Inshore or territorial waters* usually extend to the 12 nm limits within which the coastal state has territorial rights in respect of fisheries and other uses of the sea and seabed. This zone is commonly reserved for exclusive use by the coastal state's own fishing boats and the fisheries are prosecuted primarily by individually (or family) owned, small scale, artisanal enterprises with a limited operational range. Such vessels use static and, less commonly, mobile gear for the exploitation of molluscan and crustacean shellfish, demersal and some pelagic (eg tuna) fish. The inshore zone also contains the nursery grounds for many of the demersal species that form an important focus for offshore fishing activity. Non-transferable fishing rights are usually allocated to individual vessel owners, fishing groups or community interest groups. The fisheries may be managed through customary practice, local or national statutory regulation (or a combination of those elements possibly leading to a situation of “legal pluralism” where statutory law may conflict with local customary practice leaving the individual with a difficult choice of which rules to follow).

47. Inshore waters are increasingly subject to intensive interactions with other sea uses, including wildlife conservation, recreation, dredging for aggregates, renewable energy and navigation. They also contain some of the most highly valued and sensitive local ecosystems at risk from certain types of fishing, dredging and the effects of pollution from both land based and marine activities.

48. Since the contagious "annexation" of the contiguous seas out to 200 nm – roughly coinciding with other outer edge of the continental shelf – in the late 1970s, the *offshore waters* have also come under the direct control of the coastal state, with powers to exclude third country vessels from all or parts of the acquired Exclusive Economic Zone. In a number of instances, especially in the case of developing countries, bilateral agreements were negotiated to allow the operation of a particular third country's fishing vessels within the coastal state's EEZ under strictly regulated conditions. For the host nation, the financial arrangements secured for the government an important source of foreign currency but at the cost of inhibiting the development of the national fisheries sector and the possible overexploitation of the natural resource base. In some cases the bilateral agreements could contain clauses requiring the participating vessels to land part of their catches into the coastal state's ports and/or provide employment on board the vessels for the coastal state's nationals.

49. Harvesting of the offshore waters has been associated with medium and large scale enterprises (15-35 m vessels) owned either individually or by fishing companies sometimes as part of an integrated concern engaged in the harvesting, processing and marketing of the fish. Increasingly, rights based quota management systems based on the use of individual transferable quota (ITQ) are being deployed as the mechanism for allocating fishing opportunities in the offshore sector.

50. Aided by advances in vessel design (stern trawling, onboard freezing etc) and improvements in gear technology, the offshore sector witnessed the greatest increases in catching capacity in the final 40 years of the 20th century, thus contributing to the decline in demersal fish stocks especially in the northern hemisphere. Offshore waters account for substantial shares of the global demersal catch (probably around 80%) and for somewhat smaller but still significant shares of pelagic landings. The bulk of these catches is destined to enter the channels of international trade.

51. Within the much reduced *high seas* extending beyond the 200 mile EEZs – an area of open access for fishing – there is no recognised authority, comparable to that of the coastal state, with responsibility for managing the fisheries. Management is possible only through what are in effect voluntary agreements. It is an area of relatively low levels of fishing activity directed towards the exploitation of conventional demersal stocks on the outliers of the continental shelf, slow maturing, highly vulnerable deep water demersal species on the continental slopes and highly mobile pelagic species (tuna, herring). Problems of management are complicated by the practice adopted by significant numbers of vessels fishing the high seas of registering under "flags of convenience", that is with states that have opted out of membership of the relevant international and regional management organisations (see below) and are therefore not bound by their rules.

Scales of governance

52. The defining characteristics of these different scales of fishing activity – whether from the point of view of the operational scale, *métiers*, socio-economic structures, market relations, allocation of fishing opportunities or the sensitivity of their supporting ecosystems - all point to their distinctive governance needs. Matching the system-to-be-governed with appropriate governing systems is key to their sustainable management and arguably overrides the concerns for a coherent system of oceans governance at all scales. Nonetheless, common threads of concern for sustainability of the resource, social justice and livelihoods can be found running through all four scales of governance (global, regional, national and local).

53. At the *global scale*, although a fully comprehensive system of oceans governance remains a futuristic dream, the United Nations and its agencies have played a major role in creating a basic framework and clear sense of direction for fisheries management. Among the key developments are the current legal framework for fisheries governance (UNCLOS III, 1982), the Agreement on the Conservation and Management of Straddling Fish Stocks and Highly Migratory Species (1995) and outlining the basis

for sustainable fishing via UNCED's (1982) Agenda 21 in which Chapter 17 is devoted to "the protection, rational use and development of the living resources" of the living seas.

54. These actions, together with the Reykjavik Declaration on Responsible Fisheries in the Marine Environment (2001) looking to strengthen cooperation and coordination among various regional organisations and between scientific bodies and UNEP's Regional Seas Programme, have set the frameworks for sustainable fishstock management. The FAO's Code of Conduct for Responsible Fisheries on the other hand, while focusing on environmental responsibility, sets out basic principles for handling the economic, social and cultural dimensions of fisheries management at regional, national and local scales. More recently the FAO has been developing guidelines for the governance of small scale fisheries.

55. Other actors operating at the global scale include the World Trade Organisation, the World Bank and the international NGOs with a global reach including WWF, Greenpeace and the Marine Stewardship Council.

56. The *regional scale* of governance in effect embraces two quite separate situations: the "no man's land" (*res nullius*) of the high seas and the regional seas where the interests of several coastal states may overlap in the exploitation of particular fisheries.

57. Management of the high seas remains an area of potential or actual weakness. Suarez de Vivero *et al.* (2005) list over 20 international or regional organisations that have taken on responsibilities for either collating or mediating scientific advice at the regional level (eg the International Council for the Exploration of the Sea in the north east Atlantic; the North Pacific Marine Science Organisation) or for managing fisheries. Among the latter a distinction can be drawn between those concerned with a single species (eg the International Commission for the Conservation of Atlantic Tuna; the North Atlantic Salmon Conservation Organisation; the International Pacific Halibut Commission) and those brokering regional management agreements for a wider range of species (eg North West Atlantic Fisheries Organisation; North East Atlantic Fisheries Commission; Commission for the Conservation of Antarctic Marine Living Resources). Their effectiveness will depend in part on their conditions of membership[2] and the extent to which that membership provides a comprehensive coverage of the major fishing industries operating within the region. Where membership is "voluntary", incomplete coverage, opt out clauses and the absence of any international enforcement capability is likely to render agreements somewhat insecure. The potential fragility of such arrangements is well exemplified by the recent breakdown of the agreement between the EU, Norway, Iceland and the Faeroes over quota allocations for the north east Atlantic mackerel fishery. The EU is the only example of a permanent international institution with authority over the management of activities of a large number of coastal states at the level of the regional seas. Paradoxically, however, it is proving difficult to persuade the EU to adopt a more regionalised approach to the management of its fisheries (Symes, 2011).

58. The concept of "regional governance" also extends to circumstances where the interests of several coastal states overlap in the exploitation of shared stocks within a *regional sea*. This situation is likely to arise in the smaller, semi-enclosed seas like the Baltic and Mediterranean Seas. Here regional commissions have had oversight of the allocation of quota and/or common technical conservation measures. In other instances it is left to bi-lateral or multi-lateral agreements to secure an equitable

2. According to Suarez de Vivero *et al.* (2005), although the FAO's *Code of Conduct* recommends that membership of Regional Management Organisations (RMOs) should be open to any state wishing to join and engage in the management of the fisheries in question, a majority of the 22 RMOs either impose entry conditions or are closed to new members. In some instances, decisions taken by the RMO may only be binding on those member states where prior consent has been given.

arrangement between participating states eg between Norway and Russia for the management of the cod in the Barents Sea.

59. With the creation of the EEZs in the 1970s and early 1980s, the *nation state* became without doubt the basic unit of fisheries governance. In contrast to the regional management authorities, the nation state possessed all the powers necessary to build a comprehensive management regime. Its authority extended throughout the richest zone of marine living resources (the continental shelf), was backed by the force of law and had the ability to police the regulatory system through its own seagoing and land based enforcement agency.

60. The national governing system was responsible for all three orders of governance: the meta-governance functions related to defining the principles, goals, norms and targets of governance; the second order institutional framework; and first order functions covering the formulation and implementation of the detailed regulatory instruments. Thus the governing system tends to be characterised by the hallmarks of the national, constitutional, legal and political systems but it will also reflect the nature of the fisheries, the structure of the fishing industry and the conventions of the food distribution system.

61. Most commonly the governing system will be a modified version of the hierarchical mode with varying, but usually increasing, degrees of stakeholder participation conducted mainly through the national fishermen's organisations but also involving downstream elements of the fish chain. In the more industrialised countries, it is increasingly likely to find representatives of major food manufacturing companies and supermarkets sitting alongside NGOs (representing civil society) and fishermen's representatives in broadly based advisory councils.

62. Mention should be made of the particular issues of *federal forms* of national government and the division of responsibilities between the federal and state institutions. Considerable variations are to be found: in the USA responsibility for managing the fisheries within the 200 mile zone is largely devolved to 8 Regional Management Councils whose membership is made up mainly of commercial fishing interests and whose recommendations are subject to the approval of the federal government. By contrast, in Australia the federal government assumes full responsibility for managing the various fishing resources except for a narrow 3 mile inshore zone where the state government is the responsible authority.

63. Coastal states may choose to delegate responsibility for managing certain geographical situations (eg the inshore zone) or particular organisational aspects of fisheries (eg quota management) to *local scale* institutions. The basic guiding principles for such delegated responsibilities are subsidiarity – devolving management to the most appropriate level of competence – and stakeholder participation making use of their extensive local ecological knowledge and understanding of how the local fisheries are conducted. The activities involved are likely to be restricted to first order governance functions, principally the framing of local regulations.

64. The local governing bodies are most likely to involve either groups of fishers with broadly similar interests but not necessarily from the same geographical community (eg producer organisations formed for the purpose of organising the sale of member vessel catches and/or quota management) or community based enterprises. They may take the form of self-governance, that is without the direct involvement of state institutions or co-governance, a partnership involving both the state and local stakeholders (see Box 2).

65. In situations where the local community is heavily dependent on the fortunes of its fishing industry it may be in the interests of the whole community and not just the fishers to take on some of the responsibility for the industry's future. Community based management systems can vary in scale from the involvement of the local authority, fishermen's associations and other fishing related business and covering

a potentially extensive area (as in the Shetland Islands in Scotland) to very much smaller single community ventures in Denmark (see Højrup, 2011).

66. There are countless examples of local governance systems throughout the world and an almost infinite variety of forms.

Overview

67. Garcia and Charles (2007) point to several systemic weaknesses in fisheries governance. They identify the oversimplified paradigms that evolve too slowly to resolve emerging problems; the institutionalised arrangements with chronically insufficient capacity to deliver the expanding management functions; and a disconnection between long term strategic planning and short term tactical measures. To this brief catalogue of reasons for the mismatch between the dynamics of the fisheries system and the constrained nature of the governing systems can be added the risks of incoherence between different scales of governance and between neighbouring governing systems.

68. Most governing agencies are restricted in their spatial jurisdiction, often to quite narrow areas, whereas the economic and ecological systems they are tasked with managing may extend well beyond their boundaries. This fundamental unconformity between geopolitical boundaries and the system-to-be-governed threatens the coherence of oceans governance and will remain a challenge for years to come.

69. Governance systems are at their most efficacious when operating at national and local scales where they are guided by clear sets of objectives defined, at least in part, by national or local interests that help to give a stronger sense of coherence of purpose to the regulatory systems. They are least effective at the regional scale, not only in the context of the "ungovernable" high seas but also at the level of the regional seas divided among the EEZs of several coastal states often with markedly different interests in the region's fisheries. Here there is an argument to be made for greater collaboration between neighbouring coastal states in formulating an overarching strategy for managing the regional seas. Pressure for such action will become greater as the emphasis of oceans governance switches from a sectoral to a more holistic ecosystem based approach.

Meeting the challenge of green growth

Introduction

70. According to Gray and Hatchard (2007) the argument regarding future "greening" of fisheries policy has already been won. Citing examples of global agreements including the UN Convention on Biological Diversity ratified in 1993 and declarations of intent by governing institutions such as the EU's setting of targets "to implement an ecosystem based approach" to 2010, "halt the decline in biodiversity" also by 2010 and "to establish an effective system of networks of marine and coastal protected areas covering also the high seas" by 2012 (CEC, 2004), they suggest that "environmental stewardship is becoming the newly dominant mode of fisheries governance" and an integral part of the sustainable development agenda. Other commentators, however, point to the lack of evidence of declarations of intent being translated into specific management measures and to the lack of robustness for deadlines set for certain targets.

71. Implementation has been slow partly because of the institutional separation between governing systems for fisheries and marine environmental policies and the prioritisation of actions either to encourage the economic development of fisheries sectors in the South or to end overexploitation and begin the rebuilding of commercially important fish stocks in the North. Over the next decade or so we can expect accelerating action to implement "green growth" in fisheries – growth that does not diminish the diversity, productivity and integrity of global, regional or local ecosystems – through initiatives at different

geographical scales, in widely differing forms and affecting different links in the fish chain. These initiatives may be introduced through official policy or through voluntary actions undertaken by private actors. Green growth, especially where it affects the harvesting sector, is likely to encounter initial resistance from the fishing industry but garner support from the end stages of the fish chain (retailers and consumers). Eventually it may face limits imposed by social and/or economic factors rather than by what is technically feasible. Depending on the level of ambition that lies behind "green growth", its implementation may necessitate more or less radical changes to the systems of fisheries governance outlined in Chapters 2 and 3 above. Here it will have to contend with issues of institutional inertia.

72. Chapter 4 therefore begins with an assessment of the limits to green growth, focusing on the constraints imposed by the current state of the fisheries, the competing claims for attention within fisheries policy and the costs involved (4.2). It then reviews the kinds of green growth initiatives that can be implemented without disrupting the existing conventions of fisheries governance (4.3) before moving on in 4.4 to consider the implication of more fundamental changes to the nature of fisheries management through the adoption of a genuine ecosystem based approach (EBA). It concludes with a brief assessment of integrated marine management (IMM) implying a more holistic approach to oceans governance.

Understanding the limits to green growth

73. The FAO's latest assessment of the status of global fish stocks provide a stark indication of what still remains to be done to establish the basis for maximising the sustainable yield of the oceans' living resources that continues to be the prior objective for many of the world's fishing regimes. Currently, some 30% of global fish stocks are overexploited and a further 50% fully exploited (FAO, 2010). Progress towards restoring depleted fish stocks is being made, albeit slowly. It could still be threatened were governments to yield to the demands of industry for instant reward for their efforts in reducing fishing capacity and fishing effort through an immediate increase in fishing opportunities. Continuing to restrain fishing efforts remains the best guarantee for the full recovery of stocks. Moreover, repairing, as far as possible, food chains within those ecosystems that have been "fished down" through overexploitation would itself be a major contribution to ensuring the diversity, productivity and integrity of marine ecosystems.

74. Even under a strictly observed moratorium on fishing, the recovery of stocks is not guaranteed as the recent history of the northern cod stock off the east coast of Canada clearly demonstrates[3]. With niches in the damaged ecosystems already filled and with marine ecosystems also undergoing structural changes under the effects of climate change the *status quo ante* may prove difficult to achieve. The task of recovery is much more complicated than restoring commercial fish stocks to MSY. There is a need to ensure that future fishing activity does not damage the habitats, species interactions and basic ecosystems that not only nurture commercial fish stocks but also underpin other essential services. This challenge is more difficult to model, measure and monitor because our detailed understanding of marine ecosystems remains relatively undeveloped.

75. As most of the world's commercial fisheries are, at best, fully exploited with scant expectations for the discovery of new stocks or species, maintaining overall levels of production from marine capture fisheries will have to rely on strategies for recovering sustainable levels of production from existing

3. Following a huge hike in fishing effort in the 1960s, mainly attributable to foreign distant water trawling fleets, landings of the hitherto prolific northern cod slumped in the following decades and, despite a mini-revival in the 1980s, finally collapsed in 1992. Notwithstanding a moratorium on cod fishing, the cod stocks have failed to recover. In practice a new fisheries regime has been established, characterised by enhanced stocks of crab, shrimps and lobster that benefited from the reduction in predation by cod and other groundfish.

fisheries. Expansion of market supplies is therefore likely to come from increasing the capacity of marine aquaculture (fish farming, sea ranching). Otherwise, satisfying the growing consumer demand from an increasing world population will have to depend on improvements to efficiency of capture, reduction in waste, improving the quality of fish handling throughout the fish chain and value adding activity.

76. Two other factors have the potential to limit green growth in fisheries: "competition" from other key concerns of fisheries governance and economic costs. Ecosystem health is one of a number of concerns that fisheries governance must address. Arguably, it is preeminent for without healthy ecosystems fishing activity on a commercial scale is put at risk. But competing for primacy among the goals of governance are food security, both globally but more particularly on a regional scale, and livelihood. Whether at some future date we may face a trade off between ecosystem health and food security or whether these two concerns are so closely linked as to be considered conjoined issues is a matter for speculation.

77. Green growth is not a free good. The costs are likely to be borne by the *fishing industry* in the shape of lost income (exclusion from certain fisheries) and/or increased production costs that cannot readily be passed on to the consumer. Where governments choose to subsidise the costs of green technology or to offset the added production costs it is the *taxpayer* who eventually absorbs some of the costs of green growth. Ultimately the *consumer* will absorb the costs in the form of premium prices for sustainably sourced fish (ecolabelling) or through price increases caused by scarcity of supplies. Of the three, it is the fisher who is most likely to bear the immediate burden of green growth and in some instances he/she may find their livelihood under threat.

78. The greening of fisheries management will be gradual, incremental and vigorously contested. It calls for changes that may appear inimical to the interests of those involved in the harvesting sector and it will challenge decades of received scientific wisdom and practice. It will require the development of a new, more broadly based science, merging the rather narrowly constructed fisheries science that deals mainly in single stock assessments with a more widely construed marine ecology. Limited, but nonetheless important, gains can be achieved within existing governance frameworks (see 4.3 below). But further progress is likely to demand significant changes to those frameworks so as to admit new expertise, realign the roles played by different actors and to bridge the often deep divisions between fisheries and marine environmental governance. But one of the hardest tasks will be to convince those most likely to suffer initial hardship in terms of employment and income of the need for yet more restraint, especially when many of those asked to bear the costs may not be around to reap the benefits.

Implementing green growth: short term opportunities

79. There are plenty of ways in which green growth can be introduced without recourse to major changes in the governance system for fisheries and marine environmental management, though their successful implementation may depend on closer collaboration between the two systems. Green growth is rooted in the sustainable use of natural resources throughout all stages of the fish chain from harvest to consumption by wherever possible eliminating or minimising collateral damage to habitats and ecosystems, waste, the "carbon footprint" and pollution.

The harvesting sector

80. The main focus for fisheries governance has been on the harvesting sector and attempts to create an appropriate balance between available resources (fish stocks) and the capacity for their exploitation (fishing fleets). Among developed countries much of the effort has been concentrated on reducing output through TACs and quota – comparatively blunt instruments lacking sensitivity for environmental concerns – in contrast to more environmentally sensitive technical conservation measures (gear selectivity, closed areas, etc).

81. Although the target for management may have been given a new focus with the adoption of maximum sustainable yield (MSY), there is little to suggest a major change in the means of achieving MSY. The basic call seems to be "do what we have already set out to do, only do it more effectively" by moving towards multi-annual or long term management based on MSY target levels. *Long term management plans* have a number of theoretical advantages and may provide scope for the inclusion of green growth initiatives. Essentially they aim to remove some of the uncertainties of annual renegotiation of TACs and quota (and some of the opportunities for political intervention) and so provide a more secure basis for business planning and investment in sustainable practices. The inclusion of harvest control rules is intended to take account of any unexpected changes to the stocks through automatic adjustments to fishing opportunities. The plans can also include stipulations on the use of certain types of gear and the earmarking of sensitive biological areas (nursery grounds, juvenile feeding areas etc) for special consideration.

82. Long term plans should also include provisions for moderating levels of fishing opportunities where action is taken to reduce the environmental impacts of fishing (real time closures, reductions in by-catch and discards, etc). One of the problems that haunts the fishing industry in its relations with environmental interest groups and the wider public is the issue of *discards*. Statements of interest and even legal action to ban discarding are of little consequence unless there are detailed provisions within the relevant long term plans to eliminate the capture of unmarketable fish in the first place, organise onshore, not-for-profit disposal of "illegal" catch, create roll-over arrangements to allow some proportion of excess landings to be carried over to the following quota year and, above all, indicate how TACs will be adjusted as discarding is reduced. An immediate challenge for scientists and administrators is to bring about a shift from single species to multi-species management in cases where the fishery includes several target species, each with different levels of tolerance for a given level of fishing effort. Some of the problems of overfishing and discarding are attributable in part to the failure to manage mixed fisheries in an integrated way.

83. A more direct contribution to the greening of fisheries management – though not necessarily to green growth – can be achieved through reductions in collateral damage to habitats and ecosystems. The potential damage varies greatly between different types of fishing gear from relatively low risks with static gears (lines, creels) to much higher risks from heavy towed gears, especially those in contact with the seabed (bottom trawls, dredges). To minimise the risks, the use of environmental impact assessments (EIAs) could be increased, particularly where new fisheries are proposed, and regulations concerning the use of environmentally friendly gears strengthened. Technical conservation measures can be more widely used to fine tune the management of specific fisheries especially in inshore waters.

84. The particular instrument for the protection of vulnerable habitats and endangered ecosystems, increasingly deployed in marine environment management is the *marine protected area* (MPA). MPAs assume a variety of forms from large scale national parks, such as the Great Barrier Reef Marine Park in Australia where a third of the Park area is closed to fishing, to very much smaller and less protective designations mainly in inshore waters. Intended for the conservation of particular habitats and species, the diffusion of these smaller designations has been rapid but their impact is often constrained by an absence of clear governance structures, clear guidelines for fishing activities and an overall networking strategy to enhance their efficacy.

85. MPAs are a contentious issue for fisheries. Their growing number, size and location can impact severely on inshore fishing activity and on the viability of small scale fisheries that are restricted to exploiting local grounds. The occasionally dubious scientific basis for the selection of sites, the lack of clear objectives and criteria for the restriction on fishing activity and poor consultation arrangements have hardened the resistance of fishing interests to what should be a win-win situation for both parties, though with deferred benefits to fishing interests. This is clearly a case for closer collaboration between fisheries

and marine environmental governance systems; it is an issue likely to grow in significance were a more robust ecosystem based approach to become operational (see 4.4 below).

86. Pollution risks from fishing are not a major issue. Indeed, fishing has to gain from alleviation of pollution risks from land and sea based sources. However, fishing related litter in the form of abandoned fishing gear, storage boxes and refuse from fishing trips is an area of growing concern.

87. On a more general level, benefits could accrue from a shift in the ethos of fisheries governance from one based heavily on regulation of fishing activity (and deeply resented by the industry) to an approach based on the incentivisation of good practice, coupled with a reduction (or simplification) of the burden of regulation.

Marketing and distribution

88. Other elements of the sustainable use of fishery resources, including avoidance of waste and minimising the "carbon footprint" are mainly the concern of downstream links in the fish chain. *Wastage* is endemic throughout the chain from discards and poor onboard handling of the catch through to the uneaten food left on the table. A key requirement is for much closer coordination between catching (supply) and marketing (demand). At present each segment acts in partial ignorance of the other's needs. Fishers have little knowledge of the markets in which their catches will be sold, while the market has only minimal notice of the type, size and quality of the fish to be landed. There is still a tendency in parts of the catching industry to concentrate on volume rather than quality despite pressure from the retail sector (and especially the supermarkets) for improvement in the quality of fish landed.

89. The disconnect between catching and marketing is sometimes institutionalised in two quite separate sub-systems of governance. In the EU for example, the Common Fisheries Policy and the Common Organisation of the Market are set out in separate framework regulations. Producer organisations are now tasked with bridging the gap between catching and marketing through integrated management plans for their members' catching and marketing activities.

90. Overall, the *carbon footprint* of the global fishing industry is probably quite small. Fuel consumption will be low in the small scale, static gear inshore fisheries in comparison with offshore fishing in general and high seas pelagic fishing for herring in the north Atlantic in particular. Processing and packaging of fish products can add quite significantly to the footprint especially in the relatively rare outsourcing by processing firms around the north Atlantic rim of labour intensive activities (eg filleting) to low labour cost areas in the Far East, before the processing is finished back in the north Atlantic rim. But the greatest contribution to the carbon footprint is the result of the globalisation of the market in fish and fish products. Huge volumes of fish - probably around 40% of the global catch – are moved around the world largely to satisfy demand in the northern hemisphere, adding significantly to the notion of food miles.

91. Little can be done to alter this situation. Actions to increase value adding activity where the fish is landed would reduce the volume of fish involved. Improved local marketing opportunities for fresh, locally caught fish – the "greenest" form of fish available – often involving irregular, small unit landings of a diverse range of species, that tend to be ignored by conventional marketing channels, would enhance the viability of the small scale sector. "Community supported fisheries", pioneered in the USA, can provide a solution. Here networks of customers in the local and neighbouring communities are supplied directly with regular, pre-paid boxes of fish (based on "the catch of the day"). This provides a regular return to the fishers, reduces food miles and eliminates potential wastage through unsold fish, while educating and broadening the consumers' fish eating habits.

Consumers

92. Public opinion is potentially one of the most powerful agencies for green growth. As consumers the public express their preferences for the fish they wish to eat, in terms of species and the type of product (fresh, frozen, canned, ready-to-cook portions etc). In the past choice has been guided by availability and price. Today, especially in developed countries, there is growing evidence that choice can also be influenced by information concerning the exploitation status of the fish, its geographical origin and the method of capture as provided by responsible NGOs like the Marine Stewardship Council. Such accreditation schemes are increasingly being recognised by food manufacturers, multiple retailers and gradually throughout the fishing industry. Ecolabelling has become an established instrument for green growth.

93. The influence of public opinion extends beyond consumer choice. It can be mobilised at the local level in support of green growth initiatives or, taking its lead from responsible environmental NGOs operating within the framework of civil society and with the aid of an eco-friendly media, it can be used to pressure national governments to enact new legislation. For public opinion to be fairly used in this way, however, it must be given access to more objective information that will help to form a balanced picture of fisheries and the marine environment and counter the popular but often erroneous media images.

Overview

94. Many of the issues and some of the solutions outlined above can be (and in some instances are being) implemented through action by existing governing systems. However, to do so effectively calls for a shift in the balance of policy making towards greater respect for the sustainability of the ecosystems that nurture the natural resources of the fishing industry. Such a reorientation necessitates further partnership building between private and public actors both within the fish chain and the governing system. It will require the (re-)education of all the actors concerned in order for them to make sense of diverse information streams, find common ground between scientific and local ecological knowledge and dissipate the prejudices that inaccurate or incomplete understanding creates.

95. This re-education takes the form of interactive learning. Garrett *et al* (2012) have demonstrated the value of stakeholder forums in the UK with representatives from the harvesting and processing sectors, science, administration and marine conservation interests, each with their differing experience, knowledge, ideas and values, coming together to find solutions through discourse to issues that stem from a lack of common understanding. The outcomes have included improved information systems, new guidelines for responsible fishing and, in one case, the piloting of lighter gear that should reduce habitat damage, improve catch quality and cut fuel consumption. Such voluntary actions are an indication of the progress already being made throughout the fish chain to facilitate green growth.

96. It seems certain that the majority of green growth initiatives will come from individual enterprises and local communities looking to to extend or diversify their activities as a means of securing a sustainable future. Such initiatives require careful coordination and will benefit from additional funding, a local strategic framework to ensure an appropriate balance of new activity and a strong support network of business advice – similar to that outlined in Box 4.

Box 4. The EU's FLAG initiative supporting green growth in fisheries areas

Within the EU, the remodelled European Fisheries Fund (2007-13) and its new Axis 4 programme, with a budget of €570 million, is dedicated to assisting local communities in fisheries areas in their transition towards a more sustainable future based on green growth as "a smart, inclusive and sustainable [form of] growth that mostly capitalises on the environment for its development" (FARNET, 2013).

Central to the transition process is the voluntary establishment of FLAGs (Fisheries Local Action Groups) to act as the catalyst for creating the necessary conditions for new initiatives to flourish at the local level and become the drivers of green growth. As multi-stakeholder based local management boards, FLAGs are responsible for generating a local development strategy, helping to build synergies between fishing and other local business sectors and bringing together different sources of public and private funding (EU, national and local in origin) to support local projects.

Already there are over 300 FLAGs supporting some 3000 local projects throughout the EU's extensive coastal and inland fisheries areas. Among the criteria for approval of the projects are that they are locally owned and managed, aimed at securing a future for existing and/or additional fishing related employment and backed by sound financial planning – all designed to ensure a measurable benefit not only for the local fishing industry but also securing the wider community interest. Only a handful of the projects are directly concerned with environmental improvements *per se*. Others are intended to promote greener, more sustainable fishing activities, generate improved marketing (focusing on direct selling) and value added processing. Many rely on creating linkages with other local business sectors, most notably in tourism (pesca-tourism, recreational fishing, fish restaurants etc) and promoting the cultural heritage of the local fishing industry.

An ecosystem based approach to fisheries management

97. There are clear limits to achieving sustainable marine ecosystems and responsible fisheries through existing sectorally based governance systems that by definition are based on narrowly defined terms of reference, limited objectives, fisheries specific indicators and targets while leaving broader environmental considerations to other agencies. The perpetuation of a dual approach to oceans management through a separation of fisheries and marine environmental governance is seen by many as inhibiting the long term sustainability of both commercial fisheries and marine ecosystems.

98. Going beyond the limited agenda for action outlined in previous sections raises the bar quite considerably in terms of challenges to the governance systems' capabilities. It raises still further the likely costs to present and immediate future generations in terms of foregone production, income and employment within the fish chain against the promise of greater productivity of the oceans at some unspecified future date. Above all – in the context of this report – it poses some leading questions as to how far down the road to securing sustainable ecosystems green growth is supposed to take us. There are many shades of opinion from those who see green growth as assisting the recovery of marine ecosystems without prejudicing sustainable resource use to those who promote the restoration of depleted ecosystems irrespective of the economic and social impacts on fishing. Adherents to the latter can call upon some fairly eminent scientific support (see Box 5).

Box 5. Turning the Tide: The Royal Commission's views on fishing

The 25th Report of the Royal Commission on Environmental Pollution – *Turning the Tide: Addressing the Impact of Fishing on the Marine Environment* – was published in 2004. It contained recommendations covering MPAs, marine spatial planning, effort control, technical conservation measures, co-management, fish consumption *inter alia*. A selection of the recommendations reproduced below is sufficient to indicate the tenor of the Report:

" the principle objective of UK policy in this area should be to protect the marine environment (11.16); human impacts on the marine environment should be managed in a fully precautionary manner. Fishing should only be permitted where it can be compatible with the framework of protection set out in this report; the above principle would reverse the current presumption in favour of fishing. In future applicants for fishing rights … should have to demonstrate that the effects of their activity would not harm the sea's long-term environmental sustainability (11.6);

the UK government should develop selection criteria for establishing a network of marine protected areas so that, within the next five years, a large-scale, ecologically coherent network of marine protected areas is implemented within the UK. This should lead to 30% of the UK's exclusive economic zone being established as no-take reserves closed to commercial fishing … (11.7);

the UK government should develop a comprehensive system of marine spatial planning that sets out the principles and long-term goals for protecting the marine environment and promoting the sustainable use of the sea [and] develop integrated regional management plans to guide all major users of the sea, including fishing (11.11). "

99. The ecosystem based approach was initially developed in the final decades of the 20th century as part of a strategy for realising the aspirations of the UN Declaration on Biodiversity 1992 concerning the integrity of marine ecosystems and the sustainability of a wide range of ecosystem services[4]. It focused attention on the interconnectedness of ecosystem components and the ecosystem structures and functions that help to deliver ecosystem services (Curtin and Prellezzo, 2010). The ecosystem based approach was quickly translated into a fisheries context as an ecosystem based approach to fisheries management (EBAFM), though with an immediate focus on mitigating the negative impacts of fishing activities on marine habitats and ecosystem structures.

100. Although the phrase "ecosystem based approach" reflects a deliberate choice of words, so as to avoid any notion of managing ecosystems *per se*, the various definitions of EBAFM lack precision. It describes the means but not the ends (or goals) of fisheries policy. Taken literally, it implies a shift in the approach that places greater emphasis on, respect for, and greater knowledge and understanding of, marine ecosystems and on actions to protect their integrity. As such, the concept can be used to describe existing policy approaches as with reference to the incremental adoption of an ecosystem based approach in Article 2.1 of Council Regulation No 2371/2002 governing the CFP. The aspirational aspects of EBAFM have been widely endorsed by regional conventions and national governments and acknowledged as the way forward by fisheries science and fishermen's organisations alike. Such unanimity is impressive – but also an indication of the latitude of interpretation as to its goals.

101. Problems arise when it comes to operationalising EBAFM. This involves four principal stages: defining the long term ecosystem related objectives for fisheries management; modelling ecosystem-fisheries interactions; identifying meaningful indicators of ecosystem health; and delivering appropriate data collection and analytical procedures. In order to assess the feasibility of translating theory into practice through a simple desk study, Pope and Symes (2000) selected ten possible objectives (Table 1) ranging in complexity from "understanding the consequences" to the much more challenging "restoring the

4. These services include oxygen production, nutrient recycling, carbon capture and sequestration at the global level and stabilisation of coastlines, bioremediation of waste and pollutants, aesthetic and cultural values at regional and local scales *inter alia*.

integrity of the ecosystem". These were assessed in the light of their scientific requirements, management feasibility and impact on fishing effort. Financial costs were not considered, though inevitably these will exert a significant influence over the likelihood of their being adopted. The ten objectives were grouped together in terms of the overall difficulty of implementation: A building on current practice and with little or no impact on fishing effort; B implying some protection for all species but at some cost to levels of fishing activity; C involving some optimisation of all parts of the ecosystem and a more substantial reduction in fishing activity; and D representing a fundamental switch from species based to whole ecosystem approach, involving unknown but probably very substantial impacts on the industry.

Table 1. Ecosystem objectives (after Pope and Symes 2000)

Objective		Science feasibility	Management feasibility	Reduction in fishing effort
A1	Understanding the consequences	9	10	Zero
A2	Ecological indicators [(a)]	6	6	Low
A3	Essential fish habitat	6	7	Zero
B4	Rational exploitation	8	7	Low
B5	Ecosystem limit reference points	8	7	Moderate
C6	Max. economic yield of ecosystem	4	4	High
C7	Ecosystem target reference points	6	5	High
D8	Optimum size spectra	5	6	Variable
D9	Optimum harvest of trophic levels	6	5	Variable
D10	Restoring integrity of ecosystem	3	3	Uncertain

(a) applicable only to small scale ecosystems/areas.

102. The final stage involved the selection of an overall package of objectives capable of implementation within the constraints of existing scientific knowledge and management procedures. Objectives 1-5 describe a management system in which

- scientists are required to provide ecosystem impact assessments alongside advice on management options (Objective 1);
- in the absence of precise scientific knowledge, estimates of habitats and species target levels are used as indicators of healthy ecosystems (Objective 2);
- action is required to protect essential fish habitats through closed areas and gear exclusions (Objective 3);
- action is required to ensure that damage to the ecosystem is not caused by intensities and forms of fishing beyond those required for rational and responsible exploitation of target species (Objective 4); and

- scientists are required to establish limit reference points for spawning stock sizes for both target and non-target species within the ecosystem and managers should implement best fishing practice to ensure that none of these reference points are exceeded (Objective 5).

103. The package represents an extension of the precautionary approach and concept of responsible fisheries. It places sustainable fisheries at the forefront of the governance agenda while providing significant ecosystem benefits. It is, however, unlikely to find favour with some of the environmental interest groups looking for a more rigorous and ecosystem centred set of operational objectives. In practice, little progress has been made towards systematising EBAFM and very few examples of implementing the approach exist (see Box 6).

Box 6. An ecosystem based approach to fisheries management in the Antarctic Ocean

One of the most comprehensive formulations of EBAFM is to be found in the Convention on the Conservation of Antarctic Marine Living Resources (CCAMLR) which forms the basis for one of the world's most extensive management regimes. Article II of the Convention embodies two defining principles: the precautionary and ecosystem based approaches. According to CCAMLR (1991) these recognise that:

- exploited populations must not be allowed to fall below a level close to that which ensures their greatest net annual increase;
- depleted populations must be restored to such levels;
- ecological relationships between harvested, dependent and related species must be maintained; and
- risks of changes to the marine ecosystem that are not potentially reversible over two or three decades must be minimised.

Monitoring the Antarctic marine ecosystem is conducted through indicator species sensitive to changes in food availability. The critical component of the food web is the krill (*Euphausia superba*) itself a target for industrial fisheries and the key indicator species include the fur seal, several species of seabirds and whales. These are monitored for their reproduction, growth and condition, feeding ecology and behaviour, abundance and distribution.

Source: CCAMLR, 1991.

104. Instead attention has turned to a reappraisal of MPAs as the only practical means of protecting vulnerable ecosystems – with the intention of extending the coverage to include offshore areas at risk, building more effective networks of protected areas in inshore waters, and laying out stronger guidelines for management and stricter regulation of fishing activity. The main thrust has been to identify areas at greatest risk and in need of immediate action using, in some instances, a so-called “traffic lights” system of prioritisation – red for highly vulnerable sites requiring immediate action to exclude or severely limit fishing activity ('no-take zones'); amber for areas in need of careful monitoring and reassessment to ensure that existing fishing activity does not have the potential to damage habitats/ecosystems; and green, potentially sensitive areas where existing activity is unlikely to disrupt ecosystem integrity and function.

105. The implementation of a more structured EBAFM as outlined above would have quite significant implications for the process and instrumentation of fisheries governance. It implies a move towards *adaptive management* to take account not only of risks and uncertainties associated with the instability of marine ecosystems but also the uncertainties within scientific understanding of ecosystem processes and functions and the anticipated improvement of our understanding of the interactions between marine

ecosystems and fishing activity through further scientific research. Fisheries governance thus becomes a continually evolving process compared to the rather static, reiterative procedures of the past 40 years.

106. New forms of regulation may be required, including the concept of "parametric management" based around technical conservation measures designed to complement ecosystem processes and ensure that the right precautionary measures are adopted in the right location at the right time (Wilson and Dickie, 1995). Symes and Pope (2000) argue that implementing EBAFM requires supporting measures, including the phasing out of restructuring funds; the introduction of incentives for good environmental practice (environment resource payments) and the phased introduction of resource rentals to offset additional costs in science and management, as well as institutional reforms to facilitate regional management.

107. Overall, the repercussions for fisheries governance appear considerable. The system-to-be-governed needs to be redefined in terms of marine ecosystems as the initial point of reference (as opposed to commercial fish stocks), with immediate knock-on effects in terms of the science underpinning governance decisions and the balance of representation within the governing system. The major stumbling block, however, could prove to be the increasingly evident mismatch between the system-to-be-governed and the geopolitical boundaries of governing systems based essentially on nations and their sovereign EEZs. EBAFM calls for a switch of governance away from the coastal state to the regional seas (and large scale marine ecosystems) and to the "local state" (calibrated with small scale, mainly inshore ecosystems).

Integrated marine management

108. It is doubtful whether ecosystem based approaches can be realised within the sectorally focused management that dominate oceans' governance today. The concept of integrated marine management (IMM) is the embodiment of the approaches to governance that were anticipated in the UN Convention on Biodiversity 1992. It incorporates the need for precautionarity and an ecosystem based approach to management and recognises the relevance of an holistic view that the whole is greater than the sum of its parts. In more practical terms, IMM can be described as "a coordinated, proactive and planned approach to management of multiple, overlapping uses of marine resources by optimising across different priorities" (Scottish Government, 2010).

109. In trying to move away from sectoral, single issue management, where conflicts between sectoral interests are resolved *post hoc* and *ad hoc*, IMM seeks to build on common property principles of shared ownership and access to marine resources and shared responsibility for their sustainable use. In practice, IMM faces constraints imposed by deeply entrenched conventions of sectoral governance, on the one hand, and by growth in private ownership of marine resources (fisheries, renewable energy etc) on the other. At best IMM can presently offer a framework of common principles, shared goals and broad strategies within which individual policy areas will continue to be shaped independently. Theory and practice are likely to evolve incrementally as the issues shared by different areas of marine governance become ever more closely linked.

110. Not surprisingly, formal adoption of IMM at any level is rare. Canada's Oceans Act 1996, requiring the Department of Fisheries and Oceans to facilitate integrated management of Canada's extensive coastal and marine space and to collaborate with other organisations and individuals in bringing this about, is perhaps the best known example of statutory implementation. In the EU, by contrast, the three strands of marine policy – the CFP, the Marine Strategy Framework Directive setting out the basis for achieving "good environmental status" for Europe's seas by 2020, and the integrated Maritime Management Plan dealing with the economic development of "Blue Europe" – remain essentially separate. A growing number of coastal states have drawn up marine policy statements or enacted Marine Acts setting out strategies for the coordination of policies covering their marine domains through the medium of marine spatial planning.

111. But it is at the local scale – and especially in relation to the management of inshore waters – where integrated management is likely to exert its most immediate influence, with potentially quite serious impacts on fishing activity. It is here that competition for marine space and resource use conflicts are most severe. Fisheries that have for so long enjoyed freedom of access to marine waters may find their operational spaces confined by systems of zonal management that are likely to form a key feature of marine spatial planning.

Overview

112. The requirements for green growth appear broadly commensurate with those for the recovery of commercial fish stocks and the development of responsible fisheries that are now being embedded in most fisheries management regimes throughout the world. A question that so far remains unanswered is how far governing systems are willing and able to go to ensure not only sustainable levels of fishing activity but also take the necessary precautionary steps to secure long term diversity, productivity and integrity of marine ecosystems and thereby assure the full range of ecosystem services. This is not a task to be undertaken by sectoral governing systems acting separately.

113. The theoretical constructs behind an ecosystem based approach to oceans governance and integrated marine management are well advanced. So far, however, little progress has been made in their operationalisation for reasons that will be explored in the final chapter. The implications for green growth are therefore not yet fully known though the most likely future scenario is one of further contraction of fishing activity and output in the short term and the prospect of returning to a new and lower equilibrium at some unspecified future date. Much may depend on how global climate change impacts on the productivity of the oceans and how these impacts are distributed across the oceans and the regional seas.

Conclusion: changes to fisheries governance and the implications for green growth

Making hard choices

114. Over the past 15-20 years approaches to fisheries governance have altered appreciably. Outwardly, there has been a growing awareness of, and concern for, the condition of the marine environment, together with actions to minimise negative aspects of fishing activity and secure the sustainability of commercial fish stocks, marine ecosystems and ecosystem functions. Changes to the structures of fisheries governance have been more radical with the gradual breakdown of centralised, command and control forms of government, the incorporation of the market and civil society as partners within the governing system and a growing willingness to delegate or devolve certain tasks to non-governmental organisations and/or local scales of governance – what Nielsen *et al* (2012) refer to as the "moving out and moving down" of authority for fisheries management.

115. Within this remarkable "quiet revolution", perhaps the salient development has been the growing "inclusivity" of modern governing systems in order to rebuild trust and confidence in the governing process and gain legitimacy for the actions of the governing system. The diversity of knowledge and experience associated with inclusive governance should create a richness of opportunity for solving problems that may be denied to smaller, less complex organisations. But there are questions to be asked about other implications of inclusivity – not just about the choice of who is included (and who is left out) in the attempt to broaden the range of representation within the governing system – but also whether inclusivity has, to a degree, disabled the governing system when it comes to making "hard choices" by the substitution of softer, consensual decisions.

116. There are several possible reasons why making the big, transformational decisions confronting fisheries governance is becoming more difficult – as with the problem of bridging the gap between theory

and practice in the implementation of EBAFM. There are likely to be technical obstacles in developing the science behind the new approach and arguments between experts as to how far the science must progress before the new approach becomes feasible. For most countries fisheries are a comparatively unimportant area of public policy; few governments would be willing to risk their reputations in attempting fundamental policy changes where there is little political gain. Fisheries issues are also rarely judged a high priority in public opinion except when galvanised by media enhanced environmental campaigns usually over a single issue. Much better for governments to devote their energies to less complex, short term issues that can be more easily resolved by fine tuning the existing approach – that is by accepting path dependent change.

117. There may also be a more basic problem of incompatibility between the neo-liberal approach of many governments with the environmental imperative that implies further reductions on fishing activity and threatens growth in the short term. Where a government may be emboldened to make concessions to the environmental argument in times of economic growth, they may prove less willing to translate rhetoric into reality in times of recession. Moreover, the ecosystem based approach calls for international action: where individual governments are willing to adopt it, they may find the benefits dissipated among those coastal states who abstain from the adoption.

Barriers to institutional change

118. When it comes to fundamental reform of the governing system itself the difficulties become even greater as institutional inertia and possible legal constraints take effect. Familiarity with known structures and procedures, together with uncertainties over unforeseen consequences of transformational change are surprisingly persuasive arguments favouring the *status quo*. More important is the protection of vested interests within the governing system. Governing systems have arguably become more difficult to reform following the hollowing out of the state and the incorporation of non-governmental agencies within the policy process, bestowing a degree of recognition, status and influence on a widening range of stakeholder organisations.

119. As transformational change implies a threat to the existing distribution of influence and power within the governing system the tendency among some participants is to act defensively in protecting their own interests rather than positively in pursuit of improved governance. At the core of the governing system where elected governments have the capacity for independent action in altering structures and processes through parliamentary legislation, there is often a reluctance to interfere with a working system and risk offending influential partners, especially where political gain is limited.

120. Two examples serve to illustrate why institutional change may be seen as disruptive, expensive and even unconstitutional. Implementing EBAFM implies a small but significant alteration to the system-to-be-governed with the substitution of ecosystems for commercial fish stocks as the initial link in the fish chain: small because conserving fish stocks already involves consideration of what is happening to ecosystem structures, interactions and the integrity of marine food chains; but significant in that the ecosystem becomes the focus of attention requiring changes to management objectives and the science that underpins policy. Developing a new science is a long term project, potentially involving expensive research and additional assessment procedures. Implementing EBAFM also has implications for the composition of the governing systems with questions over appropriate representation – more specifically, the balance between commercial fisheries and environmental expertise – in ensuring that policy decisions in relation to fisheries management are fully consonant with the pre-emptive environmental policy objectives.

121. The second example concerns the recent reform of the CFP and the issue of devolving management responsibilities to the level of the regional seas. The Commission's Green Paper (2009) was

committed to "wide-scale and fundamental reform" aimed, in the main, at reducing the Commission's involvement in micromanaging its extensive fishing zone by transferring some responsibilities to MS acting in collaboration at the level of the regional sea. This would build on the successful introduction of RACs in 2002, fill a crucial void in the hierarchy of scales of governance (see 3.3 above) and create a framework for introducing EBAFM.

122. The outcome of the reform process – a voluntary system for MS working together in the implementation of policy – was much less than many had hoped for, and certainly not the robust regional framework for developing EBAFM nor even a solution to the problem of micromanaging fisheries from the centre. The Commission's legal services were concerned lest any formal system of regionalisation should undermine the authority of European institutions as defined in the Treaties *viz* the threat to exclusive competence (see Box 1), the extent to which powers could be delegated to MS and the lack of recognition for regional organisations as competent authorities in formulating or implementing Community policy. The need to safeguard the EU's authority took precedence over improving the governance of EU fisheries.

Future prospects

123. In the absence of any major step change in the structure and orientation of fisheries governance and barring any external interventions through marine environmental policy, the prospects for green growth are for steady, unspectacular progress as management strategies continue to focus on the recovery of fish stocks and minimising collateral damage to marine ecosystems. Attention is likely to focus on coastal waters where fishing will struggle to maintain its position in the face of growing competition for marine space from other uses. Here, improvement seems more likely to result not from a mandate for implementing EBAFM but from a simple but urgent need to manage marine waters more effectively to avoid potentially damaging conflicts between different uses and to protect valued but vulnerable ecosystem "hotspots".

124. Partnership building between fishing and environmental interests that share a general concern for the health of local ecosystems represents an important way forward. Informal action based on voluntary agreements between local actors may well prove more effective than statutory legislation, with governing systems providing an enabling rather than initiating role. As Grieve (2009) has demonstrated there is abundant evidence of fishers and environmental interests coming together to develop local, integrated management systems that have social cohesion, sustainable fishing and environmental protection as their core objectives. Often such schemes are based on allocating access to fisheries according to the number, size and selectivity of fishing gears, a reduced impact on breeding and juvenile populations of target and non-target species and protection of essential habitats, and using carefully designed spatial and temporal frameworks to regulate fishing activity.

125. Brokering such agreements is by no means a simple straightforward task. Granting preferential access to certain types of fishing activity may require the exclusion and relocation of others. It calls for astute leadership, considerable political skill and patience, and strong community support to bring them to fruition. Local management schemes need all the hallmarks of good governance: proportionality, transparency of objectives and procedures, accountability and inclusivity. The schemes will need to be adaptive and flexible, capable of containing short term fluctuations and allowing for adjustment in face of longer term changes to the fisheries and local ecosystems.

Overview

126. Providing an appropriate framework for green growth will remain a challenge. Changes to fisheries governance over the past two decades or so have created opportunities for green growth: the

recovery of commercial fish stocks and green growth are fully compatible. But a switch towards an ecosystem based approach could present problems – the greening of fishing practice would be enhanced but the prospects of growth in output would be seriously compromised, at least in the short term. There are perhaps some parallels to be drawn between EBAFM and climate change policy. While the need for action now to avoid a dangerous tipping point in the relatively near future and avert a major disaster over the longer term is fully appreciated, there is little political will to enforce that action through immediate legislation because it will impact negatively on short term economic growth. An ecosystem based approach seems unlikely to be implemented in full in the foreseeable future, except perhaps at the local scale. Instead we can expect a gradual evolution of fisheries governance and a continuing, slow convergence of the priorities for fisheries and environmental policy.

127. There are two areas of governance that require urgent attention. The first is improving the coherence of governing actions both vertically and horizontally throughout the spatial hierarchy of global, regional, national and local scales but especially at the regional level. The second is to ensure effective devolvement of responsibilities to permit the expansion of co-governance and self-governance in appropriate circumstances. Bottom-up solutions to specific issues through voluntary agreements worked out by the principal actors involved can pave the way to integrated management. Finding an appropriate balance between the demands of commercial fishing, environmental protection and other local interests and drawing suitable boundaries based on local environmental knowledge is possibly the best way of building a workable ecosystem based approach in fisheries and assuring green growth.

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FISHERIES COMMITTEE

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OUTCOME AND FOLLOW-UP TO THE GFT EXPERTS WORKSHOP, 25 APRIL 2013

23-25 October 2013

This document is presented to the 112th Session of the Committee for Fisheries under item 4 of the draft agenda and is distributed for DISCUSSION and APPROVAL.

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NOTE BY THE SECRETARIAT

The OECD has collected and maintained data on financial transfers to the fisheries sector in the Government Financial Transfers (GFT) database going back to 1996. In April 2013 an Experts Meeting was held to examine the utility and potential use and impact of this data. That meeting concluded with a request for the Secretariat to produce a proposal for possible future work on the GFT database. This document contains a proposal and makes recommendations designed to improve the ability of the GFT database to inform participating countries on the nature and scale of financial transfers to fisheries and enhance its ability to support research into the impacts of that support.

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OUTCOME AND FOLLOW-UP TO THE GFT EXPERTS WORKSHOP, 25 APRIL 2013

1. The Government Financial Transfers (GFT) database collected and disseminated by the OECD is the only internationally available source of consistent multi-national data on policies that generate financial transfers to the fisheries sector. The GFT database is therefore a unique resource for policy makers and researchers seeking to better understand the nature and scope of policy support to fisheries. However, the impact of the GFT database is less than it could be and there is scope for improvements that will increase its value.

2. In order to evaluate the potential for improving the GFT database, an experts meeting was held concurrently with the 111th COFI meeting in April of 2013. That meeting considered several aspects of the GFT process, including the proposals contained in a discussion paper prepared by Stefan Tangermann. (Annex 2).

3. In the summary report of that meeting (Annex 1), it was generally recognised that the GFT exercise is in need of rejuvenation. This was seen as, *inter alia*, a way to help meet Rio +20 commitments for increased transparency (UN 2012, A/RES/66/288 "The Future We Want"[1]) and to improve domestic policy-making and review.

4. The OECD Secretariat and participating countries invest time and resources in collecting the GFT data, and the results of the GFT exercise should be worth that investment. Because of the sustained effort required to maintain the GFT database, a focus on delivering value and generating recognisable impact is important for the long-run sustainability of the GFT exercise. The benefits of an improved GFT database can be quite substantial in terms of media attention, public awareness, and analytical support for policy development.

5. It was observed at the experts meeting that improving the GFT exercise involves an initial higher level of effort to establish the parameters of the new database and preliminary collection of the required

[1] 173. We reaffirm our commitment in the Johannesburg Plan of Implementation to eliminate subsidies that contribute to illegal, unreported and unregulated fishing and overcapacity, taking into account the importance of this sector to developing countries, and we reiterate our commitment to conclude multilateral disciplines on fisheries subsidies that will give effect to the WTO Doha Development Agenda and the Hong Kong Ministerial Declaration mandates to strengthen disciplines on subsidies in the fisheries sector, including through the prohibition of certain forms of fisheries subsidies that contribute to overcapacity and overfishing, recognising that appropriate and effective special and differential treatment for developing and least developed countries should be an integral part of the WTO fisheries subsidies negotiation, taking into account the importance of the sector to development priorities, poverty reduction and livelihood and food-security concerns. We encourage States to further improve the transparency and reporting of existing fisheries subsidies programmes through WTO. Given the state of fisheries resources, and without prejudicing the WTO Doha and Hong Kong ministerial mandates on fisheries subsidies or the need to conclude these negotiations, we encourage States to eliminate subsidies that contribute to overcapacity and overfishing, and to refrain from introducing new such subsidies or from extending or enhancing existing ones.

data. After that early effort, annual updating of the GFT database should not take more work than is currently required. Thus, three phases for future GFT work can be identified:

1. An **establishment** phase where the new GFT method and data requirements are identified and initial versions of a modified GFT database produced. This phase would begin early in the 2015-16 PoW. It would require participation by OECD members and other participating economies to refine the GFT classification and set the scope of policies to be included. Data collection methods and approaches would be agreed upon, including definitions and reference points where required.

2. A **consolidation** phase where the new GFT is published as part of the Review of Fisheries and any necessary adjustments are made on the basis of feedback. This phase would take place in the second half of the 2015-16 PoW. This corresponds with the first full publication of the new GFT database and would comprise a stocktaking and lessons-learned exercise.

3. An **on-going** phase where the GFT is produced on an annual basis with continual review to streamline the process and find opportunities to promote and exploit the data. Means to evaluate the impact of the GFT could be established, based on media interest, downloads or inquiries on the OECD website and use by policy makers and researchers.

6. The value of the GFT exercise comes from several components, including, but not limited to:

- International comparison of policy approaches allows participating countries to **share and learn** from each other, a core OECD mission. The GFT exercise can help provide information on different policy approaches and their application to complement other sources.

- Within national administrations, the GFT exercise can help **improve understanding of the whole policy set**, in particular where different ministries or agencies are responsible for delivering different policies. For example, some policies such as fuel tax concessions are poorly measured and understood because they emanate from outside the fisheries circles. Participating in the GFT process can prompt improvements in understanding the total policy environment, a crucial element of good policy making.

- In the area of global fisheries policy, the GFT is a contribution to better understanding fisheries policy and therefore a way to increase **COFI's impact**. An improved GFT can lead to increased media enquiries and contact, as well as engagement with NGOs and other international organisations. The fuel tax concessions work has already demonstrated strong interest in this regard, and combined with an improved GFT can lift the profile and utility of COFI work considerably.

7. In the establishment phase of the project, a number of important details remain to be worked out. The discussion paper by Dr. Tangermann pointed to the necessity of a new classification system for the GFT that makes more economically-relevant distinctions between policy types. It also emphasised the necessity of a classification based on implementation criteria rather than program objectives. These points were endorsed by the expert group.

8. Another important element of the GFT database was the question of scope: what policies should be included in the GFT, which excluded, and what are the decision factors that would determine this. It was generally agreed at the Experts Meeting that the work on fuel tax concessions should be kept up to date and included in the GFT, and a process for this was discussed. On the subject of two other policy areas - market price support and provision of social benefits and concessions - there was less agreement.

9. Market Price Support (MPS), i.e. non-budgetary support that increases prices through border measures such as tariffs, forms the largest share of support to agriculture, and its inclusion in the GFT has been previously considered. Such support is quantitatively and proportionally much less important in fisheries (in 2002 it was estimated to be around one billion USD) than for agriculture (roughly USD 100 billion), but its distorting impacts on trade in particular make its inclusion attractive. Work on MPS will have to consider both issues of scope (which fish products to include) and method, where a method of calculating MPS (the simplest method would be based on tariffs and trade volumes) will have to be agreed.

10. Social benefits such as pensions, where fishers receive benefits but are not obligated to contribute to national systems can be important in many countries. Like MPS and fuel tax concessions, the accounting of these is not always precise and may involve agencies other than those responsible for delivering fisheries policies. Whether these are included in the GFT will depend on their relative importance in particular countries and the OECD overall, the accuracy of their measurement and the costs involved.

11. Careful consideration of the scope of the GFT is important for two reasons:

1. If the GFT database is to be **representative** of national policies, it should include a significant percentage of total policy support. For example, the PSE database has a target of including support covering 70% or more of agricultural commodity production in any country.

2. For purposes of **consistency**, the same types of policies should be included in each country, reaching approximately the same minimum policy coverage as a percentage of total support.

12. The need to decide on coverage rules for the scope of the GFT does not invalidate the basic principle of including in the GFT all policies that are primarily directed at fisheries or that mainly benefit fishers.

13. The importance of timely availability of data was emphasised at the experts meeting. The main factor reducing interest in and use of the GFT database, especially by the media, is not related to policy coverage or the classification system, but rather that for many countries, the data is several years out of date by the time it is published.

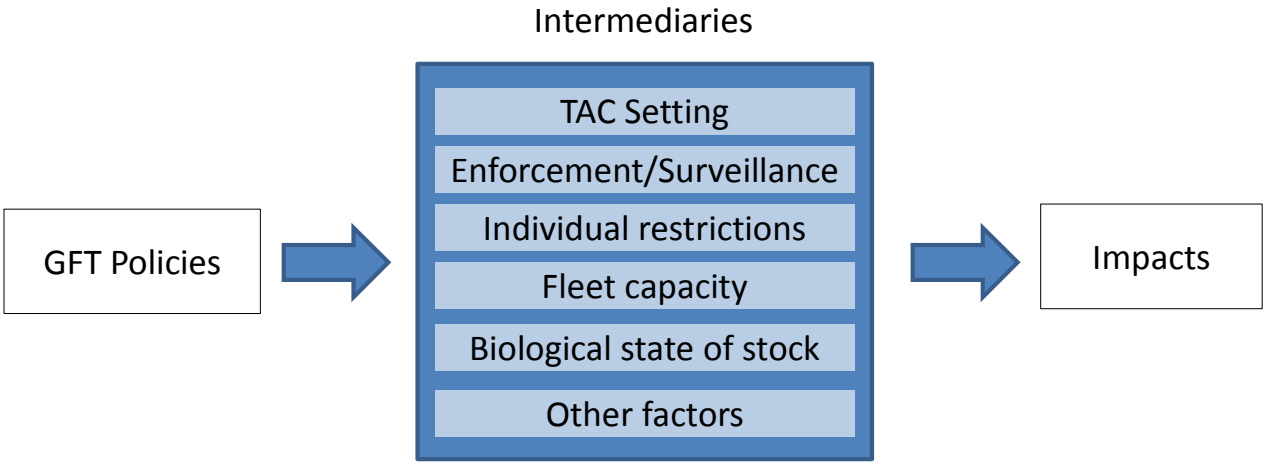
14. Improving the timely reporting of data is the most important aspect of this exercise. Members will have to commit to reporting the most recent year's data by the early spring of the following year, in time for the GFT to be prepared for the autumn COFI meeting. COFI will have to commit to reviewing and approving the results at that session for a speedy publication. That is, the process of review, revision and approval will have to take place in a single COFI session. That can only happen if there is a robust and responsive review process leading up to that meeting and that participating countries are effective in delivering required data.

15. Many countries already provide timely and accurate data, but significant reporting gaps in most recent year data remain. If countries fail to follow the agreed timeline for data reporting, there will have to be a process in place to deal with this situation. Specifically, the GFT numbers for the non-responsive member country would have to be imputed according to a formula. Simply not reporting data for certain countries, as is currently the case, is not acceptable. As a practical matter, data for the most recent year would be reported as "preliminary", and data for past years will be regularly revised and updated, but there must be a certain degree of confidence in the initial quality of the data.

16. Dr. Tangermann also noted the importance of the fisheries management system as a conditioner of the impacts of fisheries policies contained in the GFT database. That is, the response by fishers and subsequent impacts on fish stocks to policies depends strongly on the nature of the fisheries management

system, and especially the extent to which fishing effort is effectively controlled (Figure 1). This point was also agreed to be important by the participants in the experts meeting.

Figure 1. Mediators of impacts of GFT policies



17. To this effect Dr. Tangermann proposed a "label" to be included in the GFT database that seeks to measure or report on the "supply elasticity" of the management system. Specifically, he proposed this label take a value between 0 and 1 representing the proportion of landings that are deemed to be under effective control:

> *For each country, the share of the overall catch that is subject to an effective control would be identified, and in addition to the financial information on GFT, the percentage of effectively controlled catch would be reported. In that way, one single number per country would be added to the GFT information, providing aggregate but highly important information on the extent to which any potentially expansionary policy measures employed in that country, as indicated by the GFT information, is counteracted by its management regime.* (Tangermann 2013).

18. This approach is theoretically appealing, and follows an approach already used in the OECD Producer Support Estimate (PSE) database for agricultural support. However, agreement would have to be reached on a definition of "effectively controlled", based either upon observed outcomes or technical aspects of the management tools used. A way to aggregate different fisheries (including fisheries shared by different nations) to arrive at a national average would need to be determined. These questions do not at first glance seem trivial.

19. The importance of the relationship between the fisheries policies contained in the GFT and the fisheries management system is a unique feature of fisheries policy. At the experts meeting, it was observed that ultimately the GFT database could make the most sense as part of a broader policy inventory including the management system for different national fisheries. The numerical label proposed by Dr. Tangermann does this in a reduced form, but there may be some utility to creating and maintaining such a policy inventory, that would enumerate and describe the different management approaches currently in use.

Timeline for work.

20. Planning under the PoW 2013-14 is set and work underway and making significant progress on the GFT before 2015 is unlikely. For that reason, discussion of the GFT renewal project should be in the context of the 2015-16 PoW. However, it is still possible to take some early steps that will speed the process and in the course of 2014 the COFI could discuss various options for the outstanding decision as outlined above. This would be a considerable down payment and help maintain the momentum generated by the experts meeting. Participating countries can use the intervening period to review their data collection and communication processes, with an eye to identifying the bottlenecks that slow data reporting. Participants can document the implementation criteria for their policies to facilitate their classification in the new GFT system. A small steering group of interested participants could be established to assist this process.

21. Dr. Tangermann's report is an excellent first step on the road to an improved GFT. The experts meeting further advanced progress, such that the key questions have been identified. The next steps are to develop specific proposals with respect to the open issues and put in place an action plan that leads to a revised GFT database. Given the timeline for development of the 2015-16 PoW, commitment to this project is needed by April 2014. A possible timeline would then be to have a proposal made to the 115th COFI session in the spring of 2015, followed by revision and decision at the 116th session in the fall and a first revised GFT completed for the 117th Session in spring 2016.

ANNEX 1: GFT EXPERTS MEETING SUMMARY

Key points

- It was generally recognised that the GFT exercise is in need of rejuvenation. This was seen as, *inter alia*, a way to help meet Rio +20 commitments for increased transparency and to improve domestic policy-making and review.
- The limited resources of the Secretariat and Member Countries were seen as the main impediment to making progress.
- A proposal will be written by the Secretariat to the COFI for further discussion and decision.

22. Participants recognised the potential benefits of improved coverage and timing GFT reporting and related analysis. Participants were eager to hear examples of where the PSE analysis lead to real results in term of policy changes in governments. The relevance of this work to the WTO was also noted, though with an element of caution regarding trying to integrate too closely with WTO processes.

23. There was some discussion regarding how a new classification system works in practice. Using implementation criteria rather than programme objectives as the yardstick for classification was a new way to approach the classification to many participants. It was pointed out that resource sustainability and not trade distortion was the underlying motivation for the classification system, and so the classification of GFTs should speak to this. It was pointed out that the classification system proposed in Tangermann (2013) was still appropriate, as it organises the GFT in a hierarchy according to the expected effects on fishing effort.

24. The current (Tangermann 2013) proposed classification was seen as a working draft. Arriving at an agreed approach in more detail will have to be tackled early on in the process. A smaller "Friends of GFT" working group made up of a group of interested country delegations was proposed to carry out such a detailed task.

25. Two concrete ideas were discussed for expanding the scope of the GFT. These were inclusion of estimates of Market Price Support (MPS) and a new method of calculation for fuel tax concessions (FTCs). Of these, MPS was seen as posing significant practical problems due to the heterogeneous nature of fish products and the lack of reference prices and price data. A tariff-based approach was proposed, and it was suggested that this might initially be applied to a limited number of major traded fish species or products. The proposed change to reporting FTC data, based on the rates of concession identified in [TAD/FI(2010)8/FINAL] was not seen as controversial.

26. The point that the GFT exercise can help domestic policy analysis was reinforced. That is, the exercise can help motivate data collection that is important for domestic policy analysis in its own right, and not just for OECD work or work in other fora. The exercise was therefore considered to be of major value for domestic fisheries policy-makers concerned with rendering the sector more sustainable. Some participants noted that this remains a challenge in federal systems and it was not certain that a complete reporting of polices covering also local policies with a GFT element could be made.

27. Whether or not to include aquaculture was debated. The importance of the sector as a producer of fish and competitor to capture fishing was seen as a reason for its inclusion. It was noted however that policy effort in aquaculture is small and mainly limited to research and development efforts. If the total amount of support is small, it may not be cost-effective to include aquaculture despite the relative and increasing economic importance of the sector in relation to the capture fisheries sector.

28. Timeliness of data reporting was seen as a key element of success. If the member countries are unable to provide annual data within a few months of the end of the year, and if COFI is unable to declassify the resulting reports swiftly, little benefit was seen to pursuing this work. In general, a pragmatic approach to the process that is mindful of the limited resources available was encouraged. The discussion highlighted that the required resources are likely to be higher in the initial few years of development and then reduce to a level similar to that currently committed to the GFT.

ANNEX 2: SELECTED ITEMS FROM THE TANGERMANN REPORT

29. The classification regime proposed is presented in Table A2.1. It consists of two different broad targets of transfers, i.e. "I. TRANSFERS TO FISHERS", and "II. TRANSFERS TO GENERAL SERVICES". "Transfers to fishers" are broken down into six categories, from "A. Transfers based on fish sales" to "E. Transfers based on the reduction of productive capacity" and "F. Miscellaneous transfers to fishers". Among those categories, category "B. Transfers based on input use" is made up of three sub-categories, "B.1. Variable input use", "B.2. Fixed capital formation", and "B.3. Services to fishers", very much like in the PSE methodology. The reason behind that breakdown into three sub-categories is that transfers to variable inputs tend to provide stronger incentives to expand fish harvest than transfers based on fixed capital formation, which again tend to have a more pronounced impact than services to fishers.

Table A2.1: Proposed Classification of Policy Measures for the OECD's GFT Data: Marine Capture Fisheries

I. TRANSFERS TO FISHERS
A. Transfers based on fish sales
B. Transfers based on input use ***B.1. Variable input use*** ***B.2. Fixed capital formation*** ***B.3 Services to fishers***
C. Transfers based on management of resources
D. **Transfers to fishers not based on output or input**
E. Transfers based on the reduction of productive capacity
F. Miscellaneous transfers to fishers
II. TRANSFERS TO GENERAL SERVICES
III. TOTAL TRANSFERS (I. + II.)

Source: Tangermann (2013)

30. In suggesting this classification an attempt has been made to arrange the five main categories of transfers to fishers in decreasing order of their expected impact on incentives to expand harvest, with the fifth category ("E. Transfers based on the reduction of productive capacity") assumed to encompass measures that actually tend to decrease fish catches.[2] Of course the actual impact of any policy measure on catches also very much depends on the management regime in place, an issue taken up again below.

[2] The order of policy categories suggested here should be considered tentative. It would need to be discussed among fisheries experts and checked against results of specialised empirical studies.

Options for Defining Useful Indicators of GFT

31. Once GFT data have been collected and classified into different policy categories, the next step is to present indicators, i.e. parameters that summarise the policy information concerned. Indicators are essentially the results of the support estimates that are reported for use by policy analysts and a wider audience.

32. For presenting results in a summary format for all countries and the OECD total, it would appear sensible to present, as a nominal indicator, total transfers in USD million (item III. from Table A2.1 above) and, as a relative indicator, the nominal rate of assistance (assuming, for the moment, that MPS can be estimated in some way – otherwise this would remain the percentage of total transfers in total landed value). In addition, in order to provide information on the structure of policies, a number of share indicators should also be reported, defined as shares of the respective policy categories in total transfers. In this regard, the distinction between transfers to fishers (category I. in Table A2.1 above) and transfers to general services (category II.) is important. As there is particular interest in assessing the extent to which policy measures provide incentives to expand fishing effort and catches, it would make also appear to make sense to emphasise transfers based on fish sales (category A. in Table A2.1 above) which tend to provide particularly strong expansionary incentives, the relatively neutral transfers not based on output or input (category D.), and transfers based on reduction of productive capacity (category E.). Finally, as an additional item the rate of 'effective control', suggested above, should be reported. The summary table with all these indicators might then have a format like Table A2.2 shown here.

Table A2.2: Proposed Indicators of GFT – Summary Table

	Total transfers (i)	Shares in total transfers					**Total landed value minus MPS (ii)**	**Nominal rate of assistance (i/ii)**	**Effective control**
			Transfers to fishers			Transfers to general services			
			Of which						
			Based on fish sales	*Not based on output or input*	*Based on reduction of productive capacity*				
	USD million	%	%	%	%	%	USD million	%	%
Country A									
Country B									
...									
OECD total									

Source: Tangermann (2013)

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DRAFT AGENDA: JOINT SESSION COFI-DAC-FAO-WB

POLICY COHERENCE FOR DEVELOPMENT IN FISHERIES AND AQUACULTURE

23-25 October 2013

This document is presented to the 112th Session of the Committee for Fisheries under item 5. of the draft agenda and is distributed for DISCUSSION and GUIDANCE.

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JOINT SESSION COFI-DAC-FAO-WB

POLICY COHERENCE FOR DEVELOPMENT IN FISHERIES AND AQUACULTURE

Background

1. It was agreed at the 111th session of the Fisheries Committee (COFI) that the COFI will host a joint session with the Development Assistance Committee (DAC), the World Bank (WB) and the Food and Agriculture Organization of the United Nations (FAO) on policy coherence for development (PCD) in fisheries and aquaculture on 10-11 April 2014.

2. The purpose of this two day meeting is, through the lens of PCD, to have a dialogue between the fisheries and the development policy communities on areas of particular importance for both developed and developing countries with a view to identify policy coherence issues, areas for future work and, more generally, to inform the fisheries development debate.

3. It was agreed that the Joint Session would be organised around four half-day thematic panels. The themes chosen for discussion are illegal, unreported and unregulated (IUU) fishing, regional fisheries management organisations (RFMOs), rebuilding efforts of depleted fisheries, and aquaculture.

4. This document (i) describes the themes that have been chosen for discussion; (ii) highlights possible questions for discussion; (iii) describes the modalities proposed for the organisation of the meeting; and (iv) outlines the practical questions that have to be discussed during the 112th session of the COFI.

Proposed themes

IUU

5. IUU fishing and associated fisheries crime (notably corruption, document fraud, money laundering or tax evasion) threaten resource management, rebuilding efforts and environmental preservation. It also deprives governments from revenues – much needed in some countries, and contributes to social and economic destabilisation as crime in general.

6. IUU fishing continues to be a problem despite the measures taken by many countries and importing markets to ensure that traded fish are appropriately marked and their origins known and traceable. One of the reasons for this persistence is the fact that IUU needs to be combated globally to avoid it simply being displaced. The challenge of efficiently stopping IUU fishing, however, is even greater in countries where financial and human resources are scarce.

7. *Hence, how can OECD countries help developing countries in their fight against IUU? Can novel global approaches, such as that taken by Interpol, make a difference, and how can their outcomes be maximised? Has development assistance helped and how can its contribution be enhanced? How can OECD nationals and companies be incentivised to behave better in developing countries' waters? Can the private sector and consumers play a role in changing the incentives for engaging in IUU by increasingly shifting the market towards certified sustainable fish products?*

Regional Fisheries Management Organisations (RFMOs)

8. RFMOs play an important role in regulating fishing to prevent overfishing and ensure resource conservation. Historically, members of RFMOs have mostly been OECD countries. As the role of developing countries in capture and aquaculture fish production and consumption develops, and as their fishing capacity increases, developing countries seek to join RFMOs and/or should be encouraged to do so. Hence, *how well or otherwise are RFMOs placed to deal with new developing country "entrants"; how well can developing countries participate in RFMO deliberations; how can developed countries help augment the management, surveillance and enforcement capacity of developing countries so they can actively contribute to the work of the RFMO; how can quotas shares be redistributed to offer new entrants an opportunity to engage in regulated fishing while continuing to set total allowable catches sustainably?*

9. The ocean governance structure is highly fragmented and poorly co-ordinated – there are multiple bilateral and multilateral arrangements in place. *Is there room for improving coherence? Can RFMOs play a role towards better coordination and greater cooperation between OECD and non member countries?*

Rebuilding

10. In developing countries, (i) scarce human and financial resources for fisheries management; (ii) government production targets related to growth and food security objectives; and (iii) lack of livelihood alternatives for fishers, put huge pressures on inshore stocks thus making rebuilding efforts even more difficult than in OECD countries. The importance of artisanal fisheries in the context of developing countries, and their impact on the sustainably of stocks, need particular attention.

11. The COFI's body of work on rebuilding fisheries points to the importance of considering rights based management systems – individual or collective – to bring fishing effort in line with available resources, while at the same time securing profits for fisheries in the longer term. This work focused on the experiences of OECD countries. One important question relates to the applicability of these conclusions in a developing country context and/or the consideration of second-best options. *Can elements of successful rebuilding policies be transferred to DCs? What are the priorities, the basic steps, or sequencing that developing country should be looking for based on evidence of successful policies? What role for national and multilateral agencies to assist developing countries efforts?*

12. Rebuilding efforts in developing countries are sometimes made more difficult where foreign fishing vessels have access to these stocks. *Is there evidence of such impact of access agreements and how can those agreements be tailored to maximise their development potential?*

Aquaculture

13. Aquaculture has been growing very rapidly over the past two decades, particularly in developing countries. Such growth fosters important opportunities for trade, development and food security as well as potential challenges in terms of sustainability and competition for the capture fisheries sector. The development of the sector is highly impacted by trade policies and barriers as well as environmental

policies and regulations. The impact of aquaculture development on poverty and food security, on the other hand, is closely related to land and coastal area tenure.

14. *Hence, what is the potential contribution of the sector to poverty reduction and food security improvement? How can this contribution be maximised by wise policies, while restricting its negative externalities on the ecosystem?*

Practical modalities

15. Background papers to be presented by the Secretariat will be prepared for each of the thematic issues. These papers will set the scene for the discussion at the four sessions of the meeting by outlining the issues at stake, summarising possibly differing views on how to resolve them and underlining the challenges they create in terms of policy coherence for development. Franck Meere, a consultant, will be contributing notes on IUU, RFMOs and rebuilding, while the FAO will provide the note on aquaculture.

16. COFI Delegates have been cordially invited to contribute to the Agenda by submitting case-studies on experiences related to one the four themes. Proposals should be addressed by no later than 31 October 2013 to Claire Delpeuch, who will be overseeing the organisation of the meeting in the Fisheries Policies Division (TAD/FISH) (claire.delpeuch@oecd.org).

17. On 11 September, DAC Delegates were updated on preparations for the joint session. DAC Delegates expressed great interest and a number of them proposed to invite fisheries and development experts from their capitals to attend the meeting. Delegates from Iceland, Japan, the Netherlands, New Zealand and Norway committed to contribute case studies.

18. The importance not to overlook the governance aspects of the themes proposed was underlined. In this context, the proposal to organise a final round table on the governance implications raised during the four thematic sessions was greatly appreciated (see the program below).

19. The World Bank and FAO have committed to invite non-member countries to participate in the Joint Session in addition to established COFI partners (Argentina, Chinese Taipei, Thailand and the Russian Federation).

20. The Secretariat seeks contributions in view of financing the event, in particular to support wider participation of developing country representatives at the meeting. A voluntary contribution of NOK 100.000 has kindly been offered by the Government of Norway. One DAC delegation also offered to look into the possibility of a voluntary contribution. COFI Delegates are requested to look into the possibility of providing additional funding. Commitments will be needed by the 112th Session of COFI.

Program

21. A preliminary programme for the joint session that includes the presentation proposals received from member states before early September is outlined below. It is subject to change and addition of further proposals for submission of case studies.

Day 1

Introductory session (10:00-12:00)

Why is PCD important in the fisheries and aquaculture sectors, where do developing countries seek assistance, where do OECD countries see scope for more coherence?

- Proposed chair: Ambassador David Balton, Deputy Assistant Secretary for Oceans and Fisheries, U.S. Department of State's Bureau of Oceans and International Environmental and Scientific Affair
- Introduction by Angel Gurria, the OECD Secretary General
- Introduction by the Indonesian fisheries Minister (tbc)
- Introduction by Mr. Árni, Assistant-Director-General, Fisheries and Aquaculture Department, FAO
- Introductions by the DAC and COFI Chairs

Session 1. IUU (2:00-3:45)

- Background paper presentation by OECD Secretariat
- Case-study presentation by the Norwegian delegation: "IUU and fisheries crime – from a national to a transnational problem"
- Discussion

Session 2. RFMOs (3:45-5:30)

- Background paper presentation by OECD Secretariat
- Discussion

Day 2

Session 3. Rebuilding

- Background paper presentation by OECD Secretariat
- Presentation by John Goodlad, The Prince's Charities' International Sustainability Unit: "private industry involvement in securing sustainable fisheries"
- Discussion

Session 4. Aquaculture

- Background paper presentation by OECD Secretariat
- Case-study presentation by the Norwegian delegation: "Regulations contribution to stable and sustainable growth in aquaculture"
- Discussion Background paper presentation by OECD Secretariat
- Case-study presentation by the Norwegian delegation: "Regulations contribution to stable and sustainable growth in aquaculture"
- Discussion

Closing session: Roundtable on implications for governance and policy coherence for development

Summary of practical questions to be discussed

22. The following practical questions would usefully be set during the 112th COFI session:

- Chairing arrangements
- Member countries presentation proposals
- Non-member invitations (World Bank and FAO)

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DRAFT PROPOSAL - 2015-16 PROGRAMME OF WORK AND BUDGET OF THE FISHERIES COMMITTEE

23-25 October 2013

This document is submitted for DISCUSSION and GUIDANCE at the 112th Session of the Committee for Fisheries to be held 23-25 October 2013.

For further information, please contact:
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1. Introduction

1. Although we are only half way through the implementation of the 2013/14 Programme of Work, it remains that the COFI needs to finalise its 2015/16 Programme of Work and Budget (PWB) recommendations at its April 2014 session. The OECD Budget Committee and Council will undertake OECD-wide PWB deliberations in June 2014.

2. Following the results of the 2011-12 Programme Implementation Report (PIR) and the 2015-16 Medium Term Orientation (MTO) survey at the end of this year, the Secretary-General will circulate in February/March 2014, Guidance to Directors and Committees for developing the 2015-16 PWB. Some preliminary indications of priorities have already been provided by the Secretary-General in his note "Strategic Orientations of the Secretary-General 2013 and Beyond"[1] submitted to the Meeting of the Council at Ministerial Level in May 2013.

3. The purpose of this short paper is to launch a reflection at the COFI's 112th Session, 23-25 October 2013. Based on that discussion, and additional written input from Delegates, the Secretariat will prepare a decision paper for the COFI to consider at the 113th Session in April 2014 and for subsequent submission to the Secretary General.

2. Context

4. The COFI's 2013/14 PWB focusses on green growth in fisheries and aquaculture, development aspects of fisheries and aquaculture (with a joint session of the COFI/DAC/WB/FAO to take place in April 2014 focussing on policy coherence), and policy monitoring (Review of Fisheries -- Policy Review and Statistics). An expert workshop on government financial transfers (GFTs) took place in April 2013 and has started a discussion on how future work on GFTs might take place. Traditionally, the COFI has placed highest priority on this monitoring work..

5. The available resources to the COFIs are not expected to change. The COFI disposes of 36 person-months professional staff, 12 person-months of administrative assistance, and 5 person-months of statistical assistance.

6. The Programme Implementation Report (PIR) for the COFI provided by members, covering the year 2009-10, produced the weakest results for the committees served by the Trade and Agriculture Directorate and below average results for the OECD as a whole. It is important that the COFI addresses these weaknesses when considering its future PWB. The 2011-12 PIR results will become available in Autumn 2013 and will serve as a basis for further reflection as the planning of the next PWB gets underway. Central to this will be to ensure that the COFI has a shared vision of the priority deliverables for the upcoming PWB, in particular in terms of policy relevance and potential impact.

7. Delegates are reminded that during the first quarter of 2014, the Committee will, once more, be the subject of an In-Depth Evaluation (the first such IDE took place in 2008). The focus of the IDE has evolved to include a qualitative description of how and how well a particular committee: (1) establishes its policy direction through the development of its mandate and work programmes; and; (2) implements its work programme [C(2011)123/REV1].

8. The COFI mandate expires on 31 July 2015 and some time and effort will therefore be required (in late 2014 and first half of 2015) by the Committee to prepare a timely revision for consideration by the

[1] C/MIN(2013)1

OECD Council. In this regard the Committee may wish to consider setting up a Mandate Renewal Working Group to lead this task. A temporary mandate extension was provided to the COFI until such time as the IDE can be completed and thereby inform the mandate renewal decision.

9. The COFI's work on a green growth strategy in fisheries and aquaculture has opened a number of areas for discussion including on energy, waste, recreational fisheries, and the role of governance, institutions and stakeholder involvement. An underlying theme has been that fisheries and aquaculture activities are taking place in a shared physical and policy environment; while it is important to achieve high growth potential of the fisheries and aquaculture sectors this should not be achieved at the cost of other economic activities (e.g. the environment, tourism, recreational fishing, energy extraction, etc.). Ultimately, society should aim at the maximum economic contribution possible from each of the economic activities in ocean, coastal zone or on land. This calls for policy coherence at both domestic and international level.

3. Core Activities

1. Monitoring, Evaluation and Statistics of Fisheries Policies

1A. Monitoring and Outlook

10. Comments to date by Delegates show that the *Review of Fisheries* has the highest priority and is seen as the main output of the Committee's work. There is a commitment to continued improvement in the quality of submissions from participating countries; this concerns both the information on policy developments as well as the data submitted for the fisheries database. A *Policy Review of Fisheries* will be published in 2015 Q2 (with work starting in the second half of 2014).

11. The addition of a fisheries module to the OECD-FAO Agriculture Outlook has been welcomed by delegates and there is a shared view that additional resources and time of COFI meetings be directed to support this work. In practice it is suggested that a dedicated time slot at COFI sessions will be reserved for a discussion of recent policy developments of importance in production and trade with potential influence on the outlook work. This is a practice that started in 2011 and will continue as an on-going exercise. The Outlook process produces 10-year projections of capture and aquaculture production each year, and COFI members have an important role to play in informing these. In particular, countries with recent experiences with fisheries policy reforms will be asked to share their views. To make the review more attractive it is proposed that future General Surveys' contain a chapter on development aspects/dimension of fisheries and aquaculture. As China and Indonesia were included in the 2013 edition of the Review attempts will be made to include additional economies as well.

1B. Statistics for Monitoring Fisheries Developments

12. A *Statistics Review of Fisheries* has been published every year but in due course, with the transfer of data to a new platform, will be available in electronic form only. The Secretariat reviews and organises the information submitted by participating countries and ensures that the database is kept up to date. This is an on-going priority activity.

2. Government Financial Transfers

13. COFI remains the only body that collects GFTs in a systematic manner, thereby supporting policy dialogue and consideration of best practice across countries. The generation and publication of quantitative policy information, including the GFT, is also available to other international and regional organisations and the academic and research communities, and serves as an effective means of communicating with the media and a wider public.

14. Recognising that improvements are possible, Delegates to the April 2013 Experts Meeting responded positively to undertaking a review of the GFT methodology although the specific issues to be addressed need further elaboration. To this effect the Experts Meeting reviewed the existing methodology for the GFT and the data collection process. A document outlining the outcome of the meeting was subsequently circulated and the COFI will review the outcome in October 2013 and decide on next steps.

15. In the existing framework, GFTs include direct payments from government budgets to fishers, cost-reducing transfers, general services (e.g. management, surveillance), and cost recovery. A key characteristic of these transfers is that they can be measured using available budget data. Market price support is in principle included in the present GFT terminology but data have not been collected primarily due to methodological problems. In the meantime, transfers to the fisheries sector are also being provided through other channels, notably through the tax system and specific fisheries unemployment and social security schemes. These are at present not included in the GFT database and further insights and clarification of their importance is desirable.

16. The overall aim of this work would be to enhance the GFT classification to facilitate policy analysis, add value to the database for OECD members and other users, and create new opportunities for outputs with high media impact. Based on the discussion and recommendations of the ad hoc expert group, the COFI may decide on any changes to the present GFT classification and on the addition of new data and any additional work it deems appropriate to enhance the policy relevance of the GFT exercise.

4. Thematic priorities

17. A wide array of interesting issues has been raised by delegates over recent months; in fact many more topics have been identified than there is capacity to address. The challenge for COFI, then, is to narrow the range of interesting topics and to identify the one or two highest priority policy issues that are being confronted in capitals AND where COFI can contribute an important additional value. The following questions are not exhaustive and are intended simply to initiate discussion, with a view to clarifying emerging policy priorities that COFI could address in 2015-16:

- Do we know enough about the role of policy in encouraging innovation in capture fisheries and aquaculture, and how this might contribute more to green growth? Have the lessons learned by countries that have implemented market based economic instruments in support of greener growth been adequately captured?

- How important are use conflicts in coastal areas and the high seas? Would members benefit from a deeper understanding of spatial planning methods, experiences and outcome?

- At the level of the OECD, improving global relations with accession countries of course, but also with key partners and SE Asia more generally, are a priority. Within this broad context, what are the key interests on COFI, both in policy and geographic terms?

5. Conclusion

18. This note has outlined the context for the 2015/16 PWB and highlighted some key questions for consideration and discussion. Over the past program of work period many interesting issues have been brought up which highlight the role of the fisheries and aquaculture sectors in the national and international economy. A stated above, the challenge is to identify not the interesting, but the most policy relevant issues likely to be confronted by delegates over the coming several years.

19. Carrying out work that is of high policy relevance and public interest is essential to increasing the impact of the COFI. This means, *inter alia*;

- Making a contribution to international fisheries and aquaculture debates that is based on the OECD's comparative advantage of economic analysis,
- Providing substantive information and quantitative analysis to support policy analysis and debate,
- Engaging with key partners and others on a targeted basis,
- Actively participating in COFI through submission of country notes and specific studies that improve the quality and practical application of the work of the committee and, perhaps most importantly, engaging in open and frank policy discussion on COFI meetings.

20. To help advance the discussion at the 112th Session, delegates are invited to submit written comments in advance reflecting their emerging policy priorities and any ideas on how COFI could contribute.

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Organisation de Coopération et de Développement Économiques
Organisation for Economic Co-operation and Development **30-Sep-2013**

English - Or. English

TRADE AND AGRICULTURE DIRECTORATE
FISHERIES COMMITTEE

TAD/FI(2013)9/ADD1
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DRAFT PROPOSAL - 2015-16 PROGRAMME OF WORK AND BUDGET OF THE FISHERIES COMMITTEE

SUBMISSION BY NORWAY

This document is presented to the 112th Session of the Committee for Fisheries under item 8 of the draft agenda and is distributed for CONSIDERATION and DISCUSSION.

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JT03345256

Complete document available on OLIS in its original format

English - Or. English

Aquaculture licensing

i) objectives of work

The aquaculture industry is extremely diverse. Amongst OECD-countries, highly different forms of aquaculture – with regard to species, scale, technology, maturity, etc. – are found. Yet, some common policy goals are likely to exist. Four such common policy goals may be 1) environmental sustainability, 2) allocation of rights to utilize a public and often scarce resource, 3) stable and sustainable growth and 4) access to financing (for operators).

Most countries demand their aquaculture sector to operate in an environmentally sustainable way. As aquaculture often requires use of a public and scarce resource – whether sea, fresh water, or land for land-based aquaculture – a government may find it necessary to regulate who should be allowed access, and perhaps where. Most countries also want their aquaculture industry to be profitable, to create jobs and activity in rural communities and for the economy at large. Given that production growth is environmentally sustainable, many countries may also want to see their aquaculture industry grow, in a stable and sustainable manner, to create even more jobs and economic value, as well as increased food production. Finally, in order to develop a sound industry, capable of undertaking investments and conducting research, access to financing for operators is essential. Most countries want to see their aquaculture industry able to attract capital from banks and investors, rather than being dependent on public funding.

In this context, we propose a study of licensing systems. At the outset, we suggest a broad discussion of how the goals listed above, or any other policy goals that may be of relevance, can be reached. There may be other, perhaps better, ways of achieving the said goals. After an introductory chapter, we propose outlining the particular traits of licensing systems, their pros and cons, followed by a discussion of how effective licensing systems are in achieving key policy goals in aquaculture. It should be noted that licensing systems are not a conforming mass. Rather, there is likely to be a plethora of varieties, tailor-made to the industry and specie at hand. A licensing system may allow the government to "steer" overall production by effectively setting a roof for production, thereby facilitating environmental sustainability while also preventing over-supply which may impact markets unfavorably, allowing for stable growth and profitability. A licensing system may be a feasible and effective way of allocating production rights. By being used as collateral, a license can also be used by the owner to obtain financing. The latter feature should be a topic of particular interest for the OECD.

In addition, we foresee a number of interesting questions related to licensing systems which may arise. For instance, should licenses be free of charge or should the government collect a fee? In case of the latter, what is a reasonable fee for a license? Other interesting topics for discussion may be whether licenses should be time-limited or not and if they ought to be freely transferrable or not.

ii) intended outcome

A discussion of whether licensing systems can play an important role in the regulatory framework governing aquaculture and whether they are effective for reaching key policy goals.

iii) policy relevance

Are licensing systems an appropriate tool for all countries? Is there a particular way in which a licensing system ought to be constructed? Are licensing systems a common feature amongst countries with successful aquaculture industries?

iv) suggested method

Off-the-shelf discussion of different types of licensing systems and alternative ways to achieve key policy goals in aquaculture. Case study from Norway, supplementary case studies are welcome.

Cooperation to combat crime in the fishing sector

i) background

OECD has for a number of years highlighted the adverse effects of Illegal, Unreported and Unregulated (IUU) fishing on sustainable fisheries management. In this context 'IUU fishing' is an umbrella term for all forms of fishing activities that undermine fisheries management and conservation efforts, where the solutions to this problem have been focused on inspections - often referred to as 'monitoring, control and surveillance' or 'MCS' - of fishing vessel activities at sea and in port.

Yet, recent research suggests that some forms of IUU fishing are both transnational and highly organized and probably involves sophisticated criminal networks engaged in complex forms of economic and environmental crime. These activities - known as transnational organized fisheries crimes - are not easily defied by MCS, but require police intervention and cross border law enforcement cooperation and coordination to be stemmed.

Some international organizations are currently working on various aspects relating to transnational organized fisheries crime, either directly or indirectly through other criminal activities that are intimately associated with fisheries crime. In 2008 the United Nations General Assembly noted "the concerns about possible connections between international organized crime and illegal fishing in certain regions of the world" in the fisheries resolution. In 2011 the United Nations Office on Drugs and Crime (UNODC) issued a study on transnational organized crime in the fishing industry and the same year and in 2013 the United Nations Commission on Crime prevention and Criminal Justice (CCPCJ) adopted resolutions against transnational organized crime committed at sea. In the 2013 resolution CCPCJ also noted with "concern that the problem of transnational organized crime committed at sea has a significant impact on the environment". On 26th February 2013, INTERPOL hosted the 1st International Fisheries Enforcement Conference during which the INTERPOL Fisheries Crime Working group had its first official meeting with 47 member countries participating. In OECD the Task Force on Tax Crimes and Other Crimes (TFTC) are currently working on a typology study on tax crime in the fishing industry which deals with economic crimes which are often associated with illegal fishing.

ii) intended outcome

Combating transnational organized fisheries crime requires a multi-dimensional, comprehensive, system-wide approach, which can be referred to as a "whole-of-government-approach". Through a holistic view on transnational organized fisheries crime which, in addition to examine illegal fishing, also includes up- and downstream crimes such as tax crime and money laundering, requires internal cooperation within OECD but also externally in member states and developing countries. This view has also been highlighted by the OECD Task Force on Tax Crimes and Other Crimes and through their work on tax crimes in the fisheries sector. TFTC also recognize the need to explore opportunities for collaboration with the OECD Fisheries Committee.

iii) suggested method (desk study, country submissions, etc.) for the work

COFI should explore opportunities and areas of cooperation with the OECD Task Force on Tax Crimes and Other Crimes and present a working paper on this issue.

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Organisation de Coopération et de Développement Économiques
Organisation for Economic Co-operation and Development **05-Nov-2013**

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TRADE AND AGRICULTURE DIRECTORATE
FISHERIES COMMITTEE

TAD/FI/M(2013)2
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SUMMARY RECORD OF THE 112TH SESSION OF THE COMMITTEE FOR FISHERIES

Paris, 23-25 October 2013

This Summary Record was adopted at the 112th Session of the Committee for Fisheries held 23-25 October 2013.

For further information, please contact:
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JT03347891

Complete document available on OLIS in its original format

English - Or. English

COMMITTEE FOR FISHERIES

Summary Record of the 112th SESSION

OECD Conference Centre, Room 10
2, rue André Pascal, Paris 75016

23-25 October 2013
9:30 – 18:00

1. Adoption of the Draft Agenda for the 112th Session

The draft agenda was adopted with a change in the order of items.

2. Statement by Mr. Ken Ash, Director of Trade and Agriculture Directorate

Ken Ash spoke of the need for the COFI to maintain a focus on issues of high priority reflecting the key strengths of the OECD in developing the programme of work. He mentioned the possibility of investing additional Secretariat resources in the GFT database renewal project if the COFI signalled its importance. He also provided background on upcoming OECD activities including the next MCM meeting.

3. Fisheries and Green Growth

The Committee was reminded that in 2014, the COFI is expected to finalise and approve a report on Fisheries and Green Growth and a Synthesis Report on Green Growth.

i) Green Growth in Fisheries and Aquaculture: An Introduction and Clarification of Concepts

The COFI welcomed the revisions made to the document and approved this version subject to changes in the text suggested by several delegations. The document will be used as an input into the Green Growth and Fisheries and the Synthesis report and other publication options may eventually be considered. Some Delegates suggested that they would submit editorial comments and updates to data.

Follow-up	Timing
Delegates: None **Secretariat**: Use document as input for synthesis report, propose eventual publication options for document.	Draft of synthesis report for 113th session. Publication options presented on completion of GG work.

ii) Green Growth and Aquaculture

The COFI welcomed the second revision of this document and noted the improvements made in the text. The COFI approved the paper subject to a number of revisions in the text suggested by several delegations. The document will be released as an OECD publication, either by itself or as part of a larger publication integrating COFI's Green Growth work. Some Delegates suggested that they would submit editorial comments and updates to data.

Follow-up	Timing
Delegates: None **Secretariat**: Use document as input for synthesis report, propose eventual publication options for document.	Draft of synthesis report for 113th Session. Publication options presented on completion of GG work.

Green Growth and Fisheries

A presentation previewing the content of the Green Growth and Fisheries report was presented. Delegates were asked to provide case studies and other suggestions for content. Delegates welcomed the presentation and looked forward to receiving a first draft at the 113th Session.

Follow-up	Timing
Delegates: Provide comments and suggestions for next version. **Secretariat**: Draft of document produced for 113th Session.	Input from delegates is requested by 30 November 2013.

iii) Energy Use in Fisheries: Policy Responses

Delegates welcomed this version of the document and noted that it could serve as a useful tool to promote discussion of this topic. Delegates provided many suggestions for improvements to the draft document as well as some specific editorial comments. Among the comments received, Delegates noted the strong connection between stock status and energy efficiency but that careful discussion when considering this link is required. Whether energy use or energy efficiency is the main issue was discussed, as was the best way of measuring these. The absence of a discussion of aquaculture was noted and the Secretariat undertook to include it in the revised version of the paper. Comments received during the meeting will be addressed in the next version of the document. Delegates were also asked to provide comments in writing as well as any references, case studies or other content for inclusion.

Follow-up	Timing
Delegates: Provide comments and suggestions for next version. **Secretariat**: New version of document produced for 113th Session.	Input from Delegates is requested by 30 November 2013.

iv) Green Growth: Governance Issues for Marine Capture Fisheries

A presentation on the different elements of the governance work was made, along with a description of the consultant's report prepared by David Symes. A second consultant's report by Claude Menard is planned under this item as well as further work by the Secretariat using the consultants' reports as input.

Delegates appreciated the progress report but also identified needs for improvements, which the Secretariat acknowledged. Specifically, the need for a specific discussion of tools for governance was mentioned, as well as a clear definition of governance and better connection to the OECD GGS. A number of factual errors and out-of-date information were pointed out.

The inclusion of international aspects of fisheries governance was discussed. The Secretariat noted that the international aspects of governance mentioned in the Symes paper are not currently intended to be a focus of the governance work planned under the Green Growth heading, except to the extent that they importantly impact national governance. It was noted that international cooperation in fisheries management will be covered in the Joint Meeting to be held in April, and that these discussions could form the basis of any future work on this subject. Delegates were asked to provide comments in writing as well as any references, case studies or other content for inclusion.

Follow-up	Timing
Delegates: Provide comments and suggestions for future work of the Secretariat on governance and GG.	Input into the work on governance is requested by 30 November 2013.
Secretariat: A governance perspective will be integrated into the GG and Fisheries paper and the synthesis report; a stand-alone supporting document on governance may be produced depending on the quality of the Menard report on institutions and governance.	New versions of GG and Fisheries document and synthesis report will be produced for 113th Session. A first version of a stand-alone Secretariat document on governance may be produced for discussion for 113th Session.

4. Outcome and follow-up to the GFT Experts Workshop, 25 April 2013

A document on the key discussion points and suggestions for further work on GFT was presented that proposed work on this topic to take place starting in 2014 and extending into the 2015/16 Programme of Work period. Delegates welcomed the document and had a substantial discussion regarding the options for GFT work in the future. Delegates expressed support in principle for improving the GFT, but expressed concerns regarding timing, cost, and work required. It was agreed that countries would begin the process of inventorying and describing their policies as preparation for a new proposed classification system. A revised classification proposal taking into account comments received may be presented at the 113th Session in April 2014, depending on available Secretariat resources.

Follow-up	Timing
Delegates: Collect information on implementation modalities of policies currently in GFT after clarification of request from Secretariat. Collect information on management systems for major (top 5) fisheries.	Information request from Secretariat for Delegations by 30 November 2013. Information collection through 2014, but first view by 113th Session would be helpful.
Secretariat: Clarify information request for Delegations. Prepare a proposal for a revised classification system including options regarding management systems.	Timing contingent on decision on secretariat resources. Ideally a new proposal will be produced for 113th Session, but this may be as late as 115th Session.

5. Preparations for the Joint Session with DAC-WB-FAO on Policy Coherence for Development to take place on 10-11 April 2014

The COFI was informed about the progress made on the preparations for the joint session. The Secretariat proposed a draft agenda, a way to organise the meeting and chairing arrangements. Delegates were requested to look into the possibility of submitting case studies for the thematic sessions, to identify key experts, to look into the possibility of acting as lead discussants for the thematic session debates and to look into the possibility of inviting developing countries partners with whom they have privileged relations to fully participate in the meeting.

The World Bank and the FAO reiterated their keen interest for this initiative and noted that they will soon make arrangements to invite interested parties from developing countries partners. Delegates also welcomed this initiative and noted their interest in seeing a concrete product coming out of it, notably for outreach purposes and in view of maybe initiating longer-term collaborations. The Secretariat noted that a document will be produced that summarizes the outcomes of the meeting, notably in view of informing future investments by the DAC community, the FAO and the WB in the field of fisheries. Ideally, this document could take the form of an "Action Plan". Yet the exact form of the publication will be easier to determine after the meeting. It was also noted that one of the objectives of the meeting is to identify avenues for future work and collaborations.

In addition to the cases studies submitted by Norway, the delegations from New Zealand, Sweden and Iceland also offered to submit case-studies. There was a discussion about the sessions on IUU and RFMOs. The Secretariat acknowledged that the IUU session, including case studies, should be focused on how IUU is a hindrance to development and how developing countries can be supported in their fight against IUU (i.e. training, capacity building, etc.). The IUU session could also consider the link between IUU and trade and market access. The RFMO session should not only address current RFMO membership issues but also look at ways to include regions not covered by existing RFMOs. A suggestion was taken that the role of fisheries for food security should be treated in the background documents and that Rio +20 conclusions on sustainable development should be considered.

Follow-up	Timing
Delegates will propose - case studies for the thematic sessions - names of experts they would like to hear from - lead discussant names for each session - names of counterparts in developing countries they would like to invite or suggest the FAO or WB to invite They will also provide comments on the background papers and the new version of the agenda that the Secretariat will post on the Delegates' corner	Before the end of November
Secretariat will put together an updated version of the agenda and post it on the Delegates' Corner as well as the background documents for the thematic sessions	Papers will be posted as soon as they are available. The agenda will be finalised towards the end of the year

6. Review of Fisheries Statistics

Delegates were updated regarding progress in producing the 2013 Review of Fisheries Statistics.

Follow-up	Timing
Delegates: Delegations that have not yet submitted data should do so. **Secretariat**: Complete the preparation of statistics.	Data submissions should be completed as soon as possible.

7. Results of the PIR 2011/2012

PIR results not yet available. See item 10.

8. Draft Proposal – 2015-16 Programme of Work and Budget of the Fisheries Committee

The Secretariat presented the draft proposal, noting core items such as monitoring and statistics plus the proposed work on the GFT database. For thematic work, some ideas were presented, including two from Norway, and other suggestions were solicited. After discussion, there was consensus on the priority of core items such as statistics, Review of Fisheries, Outlook and the GFT work. There was also broad consensus on innovation as a part of the thematic work, in particular because of its close connection with the GG work and its relevance to areas of interest to Delegates.

There was support for the proposal regarding aquaculture licensing, in particular with regards to policy comparisons across countries, collecting data on national experiences and identifying social and economic benefits.

Tax crime was recognised as an important issue, but some Delegates were of the view that this fell too far outside the expertise of the COFI. Spatial planning was also considered important but was considered to be controversial at this stage.

It was acknowledged that improving collaboration across OECD committees for example EPOC and the committee on fiscal affairs working in these and other relevant areas would be desirable.

Recreational fishing was mentioned as a potential area of interest. It was noted that the Secretariat has already done some work in this area and that more would be forthcoming.

It was suggested by the Chair that the Secretariat could use the discussion under this item to prepare a more complete set of proposals to be considered at the 113th Session. It was also noted that the Bureau could play a constructive role in this regard.

Follow-up	Timing
Delegates: Prepare any additional proposals and work with Secretariat to refine existing proposals **Secretariat**: Develop, in collaboration with the Bureau and other interested delegations, revised proposals for the 113th Session	New proposals will be considered at the 113th Session. Delegates wishing to submit written proposals should consider the usual request that materials be available four weeks before the meeting.

9. Other activities

Report on other OECD activities related to Fisheries

Wayne Jones and Stefania Vannuccini presented the work plan of the 2014 OECD-FAO Agricultural Outlook. They noted this is the fourth year that fisheries projections are a part of the Outlook; it makes 10-year projections of prices, production and trade, and include a special feature on India. The FAO takes a lead role on the fisheries component and is responsible for the baseline projections and drafting of the fish chapter. The OECD role is to review the baseline and text and produce and promote the publication.

The COFI's role is to review and contribute to the content of the fish chapter, and Delegates are invited to contribute boxes on market or policy developments and other special features. There is potential for a seminar on the fish model to be held adjacent to the 113th Session.

Follow-up	Timing
Delegates: Participate in review of data and text of fish chapter. Contribute content to fish chapter **Secretariat**: TAD/ATM staff primary responsible. TAD/FISH review and comment. Seminar organised adjacent to 113th Session if sufficient interest exists.	19-20 March 2014 APM –Policy Boxes 26-27 March GCM –baseline/storyline (Rome) 7-9 April - Presentation to 113th Session 19-21 May APM – Outlook Report 25 June – Tentative release date (events?) Mid July – Publication available.

Christina Van Winkle of the Environment Directorate made a presentation on Biodiversity Policy Indicators (see Delegates Corner). The purpose of the indicator exercise is to identify policy response indicators useful for measuring progress towards Aichi Biodiversity Target 3. The relevant OECD databases were identified and their role in producing indicators outlined. The GFT database has a role to play, but provides limited options in its current form. The potential contribution of a revised database was mentioned.

It was asked if this process was singling out fisheries or was part of a broader look at biodiversity policy indicators. It was clarified that this is a broad exercise and a sectoral approach to indicators is taken only because this is the way the data tends to be organised. Delegates were encouraged to contribute any information they may have.

Follow-up	Timing
Delegates: No formal follow-up, but interested delegations are invited to contribute comments on the document posted on the Delegates Corner. **Secretariat**: ENV work ongoing. Links to GFT database work.	

Eric Choi provided a brief training on the features of the OLIS document sharing system. Eric Epinasse provided further information on how to connect to the OLIS system. Delegates can contact olis@oecd.org for help or advice.

The work by CTP on tax crimes in fisheries was presented by Mark Johnson. It was pointed out that tax crime is not a fisheries-specific issue, but there are specific vulnerabilities in the fisheries sector stemming from the particular international dimension of fisheries (for example, fishing on the high seas) and the common use of flags of convenience and shell corporations in the sector. A number of tools to fight tax crime were mentioned and the recommendations of the report were discussed. Delegates were encouraged to attend the upcoming meeting in Istanbul on 6 and 7 November. This report is available on the Delegates' Corner. Delegates are asked to provide any comments directly to Mark Johnson.

Follow-up	Timing
Delegates: Attend meeting in Istanbul if possible. Provide comments on report. **Secretariat**: Follow and report on relevant work in other areas of OECD. Possibility of a joint meeting with COFI in early 2015.	

Reports from Observers

The World Bank updated on two items of interest to the COFI. The first was the Global Partnership for Oceans (GPO), noting the work of the Blue Ribbon panel advising the GPO on prioritising investments, and the availability of a new report on the GPO website that brings together broad views on principles for and prioritising investment. The second item was to inform on fisheries investments being undertaken, which now total more than USD 650 million across many nations.

The FAO reported on its restructuring around six strategic objectives. The impact of this on fisheries and aquaculture work is unclear at this point. The FAO also reported on improvements in their co-operation with other International Organisations and private-sector groups.

10. In-depth Evaluation Phase 2

Kevin Williams of the SG's Internal Audit Evaluation made a presentation on the progress on the second phase of the in-depth evaluation. An overview of the PIR exercise and timing between now and the end of 2014 was presented. Delegates were reminded that the PIR results are important for the in-depth review (IDE2) process and potentially for the renewal of the committee mandate. The IDE2 process is to place strong focus on relevance and effectiveness and to understand the impact of the work.

Follow-up	Timing
Delegates: Participate in review process through interviews and other elements of the process **Secretariat**: OECD Internal Audit Evaluation staff responsible for process will lead and facilitate. TAD/FISH support as required.	Launch April 2014 with COFI Bureau. Data collection May-July 2014 Reporting October 2014 with COFI Bureau. Council Report end 2014

11. Election of Officers to Serve in 2014

The following Delegates were elected to serve on the Bureau in 2014:

Phillipe Ferlin, Chair, France.

Geir Evensen, Vice Chair, Norway.

Greg Schneider, Vice Chair, USA.

Leon Lomans, Vice Chair, Netherlands.

An Ho Lee, Vice Chair, Korea.

12. COFI relations with non-members (CONFIDENTIAL)

*** Item 12 will be reported separately in a Confidential Summary Record***

13. Other business

No other business.

14. Adoption of the Summary Record of the 112th Session of the Fisheries Committee

The Summary Record was adopted on25 October 2013.

Dates of next meetings

7-9 April 2014	113th Session at the OECD Conference Centre
10-11 April 2014	Joint Session DAC-WB-FAO at the OECD Conference Centre
27-29 October 2014	114th Session at the OECD Conference Centre
13-15 April 2015	115th Session at the OECD Conference Centre (to be confirmed)

List of Participants
Fisheries Committee (COFI)112th Session

Liste des participants
Comité des pêcheries 112e Session (COFI)

OECD Conference Centre, Paris
23-25 October 2013

Président/Chairman

Dr. Philippe FERLIN
Inspecteur général de l'agriculture
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