出國報告（出國類別：其他）

參加「經濟合作發展組織（OECD）第110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：繆自昌組長
派赴國家：法國（巴黎）
出國期間：101年10月27日至11月2日
報告日期：101年12月20日

參加「經濟合作發展組織（OECD）第110屆漁業委員會（COFI）」報告

摘要

一、OECD第110屆漁業委員會（COFI）於101年10月29日至31日在法國巴黎OECD總部會議中心召開，各國出席代表為OECD各永久會員國、觀察員及秘書處，包括德國、澳洲、比利時、加拿大、智利、韓國、丹麥、西班牙、愛沙尼亞、美國、法國、匈牙利、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、英國、斯洛伐克、瑞典、捷克、土耳其、歐盟代表、及俄羅斯、印尼、阿根廷、泰國、聯合國糧農組織（FAO）、世界銀行與我國等共約60人與會，主席由法國籍Mr. Philippe FERLIN擔任，漁業委員會秘書長 Mr. Carl-Charistian SCHMIDT 及秘書處 Mr. Roger MARTINI列席，我方由漁業署繆自昌組長及駐法國台北代表處經濟組徐炳勳秘書代表出席。

二、本（110）屆漁業委員會（COFI）會議繼續討論前（109）屆尚有爭議之議題，包括：「OECD與綠色成長」、「OECD漁業管理者手冊」、「能源與綠色成長」、「政府財政轉移（GFT）」、「OECD之發展策略及FAO/OECD之農業展望」等議題之研究報告，並由會員國討論俄羅斯入會案（秘密會議）及 OECD 2013-2014 年工作計畫等。另原列「綠色成長與漁業廢棄物及改進漁業與養殖漁業資源利用」議題留至下（111）屆會議中討論。韓國代表表示將於今（101）年12月12日至13日在韓國舉辦綠色成長與養殖漁業工作研討會（Workshop on Green Growth and Aquaculture），屆時將以中國、越南、泰國及印尼近年發展養殖漁業與綠色成長為案例作分析比較，請各會員國踴躍參加。

三、本次會議以專家論壇方式進行，並以秘書處提供文件為核心範疇進行討論，討論議題多屬國際經濟貿易形勢與未來發展趨勢等前衛政策性議題或先進策略性分析模式（工具），所做成文件內容將影響未來聯合國農糧組織（FAO）及世界貿易組織（WTO）漁業政策方針之制定及對各國漁業行為之限制，受到重要漁業國家之高度重視。我國現以觀察員身分參與漁業委員會相關會議，透過參與會議獲取國際漁業新知與趨勢與交換我國在養殖漁業技術升級與海洋漁業管理經驗，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110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 Cooperation and Development,簡稱 OECD)下轄漁業委員會(Committee for Fisheries，COFI）為我國得以「一般觀察員」身分參與 OECD 年會的世界組織之一。每年定期於四月及十月間召開二次會議，該委員會以責任制、永續性、全球化及生態和諧等思維為宗旨，針對當前貿易、經濟、漁業面臨等問題及未來漁業發展趨勢，透過專家學者分析與提供可行性研究、成果，由會員會在年會中充分討論，進而作成報告或建議案提報理事會裁決，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。

二、漁業委員會（COFI）代表團多為各國參與國際組織（如 WCPFC、FAO、WTO）之參加人員，多熟悉國際相關漁業管理情形。我國以一般觀察員身分每年積極參與 OECD 年會，並於會前定期繳交我國國家報告（Country Note）、漁業統計報告（Statistics），持續透過建立各方聯繫管道，有利於未來國際漁業合作、區域性管理及交流，且經漁業委會秘書處彙整各國資料與專家評估意見後，不定期出版相關漁業資訊並登載於 OECD 網站（http://www.oecd.org），涵蓋全球漁業現況暨發展趨勢，其內容豐富可供我國產官學界參考應用。

三、經瞭解歷次出席會議之各國代表團多為參與國際組織（如 WCPFC、FAO、WTO）代表人員，熟悉國際相關漁業管理情形，且多為政府官員、國際組織代表及學者專家，我國參與會議能建立與各國出席漁業事務會議代表間之聯繫管道與人脈，有助於未來我國與各國間國際漁業合作及交流。

貳、 會議過程

一、經濟合作及發展組織（OECD）漁業委員會（COFI）於本（2011）年 10 月 29 日至 31 日假法國巴黎 OECD 總部召開第 110 屆會議，各國出席代表為 OECD 各永久會員國、觀察員及秘書處，包括歐盟執委會（EC）等 30 餘個會員會及俄羅斯、印尼、阿根廷、泰國、聯合國糧農組織（FAO）、世界銀行與我國等觀察員，共約 60 人與會，主席由法國籍 Mr. Philippe FERLIN 擔任，漁業委員會秘書長 Mr. Carl-Charistian SCHMIDT 及秘書處 Mr. Roger MARTINI 列席，我方由漁業署繆自昌組長及駐法國台北代表處經濟組徐炳勳秘書代表出席。

二、會議各討論議題係以專家論壇的模式進行，程序上由漁業委員會（COFI）秘書處於會前（可能數個月）研擬議題報告內容大綱，委請專家學者草擬報告草案，並登載於 OECD 網站，由各會員會於會前審視內容並提供評論意見後，由秘書處彙整於四月及十月定期委員會會議時提出，並於委員會中

由各國代表表達意見及充分討論，最後由委員會確定方向交秘書處統一修正再登載於網站，作為各國施政及研究參考。

三、本（110）屆漁業委員會（COFI）會議繼續討論前（109）屆尚有爭議之議題，包括：「OECD 與綠色成長」、「OECD 漁業管理者手冊」、「能源與綠色成長」、「政府財政轉移（GFT）」、「OECD 之發展策略及 FAO/OECD 之農業展望」等議題之研究報告，並由會員國討論俄羅斯入會案（秘密會議不開放一般觀察員與會討論）。另原列「綠色成長與漁業廢棄物及改進漁業與養殖漁業資源利用」議題，變更議程至下（111）屆會議中討論。

四、我國已於會前依限提出國家報告(Country Note)及漁業統計報告(Fisheries Statistics）送交委員會，本次委員會無異議通過。我國家報告內容除依格式提供海洋保撈漁業、養殖漁業發展及管理情形外，新增內容主要以推動中各項重要措施為主，包括：「漁船輸出管控」、「鯊魚鰭不離身」及「魚翅進口」政策、「保育太平洋黑鮪」措施、「打擊 IUU」、劃設「海洋保護區」、推廣娛樂漁業等。另依格式向 OECD 秘書處提供我國「2009-2011 年漁業統計報告（Fisheries Statistics）」，包括：（一）總容許捕獲量(TAC)、魚種配額、漁獲量(業填列我國三大洋 5 個區域管理組織(RFMOs)不同魚種資料）；（二）政府財政轉移表；（三）政府財政轉移之其他特別項目；（四）我漁船於本國港口之卸魚量；（五）我漁船於外國港口之卸魚量；（六）外國漁船於本國港口之卸魚量（查依據我國「外國籍漁船進出漁港許可審查作業要點」規定，無許可外國籍漁船於本國港口卸魚，爰無資料提供）；（七）養殖生產統計；（八）漁業從業人數；（九）漁船數統計；（十）娛樂漁業捕獲量；（十一）內陸漁業捕獲量。五、韓國代表表示將於今（101）年 12 月 12 日至 13 日在韓國舉辦綠色成長與養殖漁業工作研討會（Workshop on Green Growth and Aquaculture），將以中國、越南、泰國及印尼近年發展養殖漁業與綠色成長為案例作分析比較，請各會員國踴躍參加。

五、本次出國開會行程如次：

10 月 27、28 日（星期六、日）搭機經荷蘭阿姆斯特丹轉機赴法國巴黎

10 月 29 日（星期一）參加 OECD 的 COFI 第一日會議

10 月 30 日（星期二）參加 OECD 的 COFI 第二日會議

10 月 31 日（星期三）參加 OECD 的 COFI 第三日會議

11 月 1 日（星期四）返程，由法國巴黎經荷蘭阿姆斯特丹轉機

11 月 2 日（星期五）返國

參、 會議紀要

本（110）屆會議主要針對錄色成長對海洋捕撈及養殖漁業關聯性、燃油稅捐減免、設計與執行漁業重建計畫之原則與指導方針、審議 2011 至 2012 年及以後的工作等報告或計畫構想等事宜交流研議。並討論 OECD 與發展之策略及 FAO/OECD 農業展望等議題，另會中也選出 2012 年漁業委員會主席及副主席。會議主要議題及會議文件內容，茲按日分述如下：

<u>10 月 29 日</u>：第一日除工作報告及業務檢討外，並針對綠色成長與養殖漁業及海洋捕撈漁業、漁業課徵能源稅等議題進行討論。

一、議程草案：Mr. Philippe 主席宣布會議開始，並調整會議議程將原列「綠色成長與漁業廢棄物及改進漁業與養殖漁業資源利用」議題改至下(第 111）次會議中討論，經各與會國同意後通過會議議程。

二、綠色成長議題：

（一）秘書處邀請荷蘭哥本哈根大學教授 Mr. Max Nielsen 專題報告 「綠色成長在漁業及養殖漁業」（Green growth in fisheries and aquaculture），分享其研究綠色成長定義、如何達成、及應用於漁業及養殖漁業。

（二）Mr. Max 強調綠色成長（green growth）係追求資源永續利用，並在環境、經濟、社會三種層面達成平衡。可透過對特定產業之綠色補貼（subsidies to green industries）與加強研發（R&D）來達成綠色成長，並指出 1.在海洋漁業部分－因長期過度開發，全球漁業資源不足，產量受到限制，可透過調整傳統漁法（如 ITQ/稅、海域使用費等措施）導入綠色成長概念達到資源永續利用目的，然而短期而言會衝擊產業包括：漁民利潤下降、產值下降；2.在養殖漁業部分－因未來人口增加、經濟成長、食魚促進健康因素等需求增加及技術增進等因素，將促進養殖漁業發展，透過產業適度調整措施（如 ITQ/稅、分配飼料額度、疾病控制與水產生物防逃措施等）達成飼料及藥物減用、養殖排放水與廢棄物減量，降低對環境之衝擊。

（三）各國評論：各會員國提出評論意見，瑞典、冰島、加拿大代表認為此模式係以北歐國家漁業作為樣本研究，建議俟 2013 北歐委員會（Nordic Council）討論確定後再納入本會討論，美國、紐西蘭、日本等國代表認為應再研究更有用之模式後再一起討論，主席裁示此工作納入 2013 至 2014 重點項目，並由秘書處與歐盟執委會 DG MARE 合作研究發展適合分析模式。

三、綠色成長漁業和養殖議題：

（一）秘書處邀請韓國貿易及農業處專案經理 Mr, Doglike WOO 專題報告「A Green Growth Perspective on Aquaculture」，分享其研究挪威及智利創新措施（運用疫苗技術及減少養殖廢棄物排放）在鮭魚產業案例，可提升產量、降低抗生素用量與疾病發生率，有效降低養殖漁業對環境之衝擊，就是綠色成長最佳證明。

（二）各國評論：各會員國分就秘書處依據上（第 109）屆討論共識彙整報告草案（TAD/FI（2012）11）及 Mr. WOO 提出評論意見，挪威、智利、加拿大同意 Mr. WOO 研究及說法，美國、法國、歐盟代表及日本建議 Mr. WOO 再提出個別養殖水產物（如貝類、藻類）或特殊條件下（如突然市場價格滑落、需求增加或天然災害發生）之產業快速反應案例分析。歐盟及瑞典代表建議增加已發展與發展中國家之案例比較。韓國於會場中正式表達將於今年 12 月 12 日至 13 日在韓國麗水市舉辦 Workshop on Green Growth and Aquaculture，會中將以中國、越南、泰國及印尼近年發展養殖漁業與綠色成長為案例作分析比較，請各會員國踴躍參加。

四、能源與綠色成長、漁業課徵能源稅之可行性：

（一）秘書處邀請荷蘭哥本哈根大學教授 Mr. Max NIELSEN 專題報告「Modeling fuel tax concessions in Nordic fisheries」，以北歐漁業做為樣本，分析課徵漁業能源稅之模式與可行性。

（二）Mr. Max 說明以北歐漁業做為樣本，分析課徵漁業能源稅之模式與可行性模式，雖可針對漁業 FTCs（fuel tax concessions）進行 Bio-economic 量化分析，惟需要考量長時間之資料累積與投入收集所需經費，模式亦需修正等問題，故短期內不易達成。

（三）各國評論：瑞典、冰島、加拿大代表認為此模式係以北歐國家漁業作為樣本研究，建議俟 2013 北歐委員會（Nordic council）討論確定後再納入本會討論，美國、紐西蘭、日本等國代表認為應再研究更有用之模式後再一起討論，主席裁示此工作納入 2013 至 2014 重點項目，並由秘書處與歐盟 DG MARE 合作研究發展適合分析模式。

<u>10 月 30 日</u>：第二日討論 OECD 漁業管理者手冊、FAO 與 OECD 農業未來展望、政府部門財政移轉與檢視各國漁業國家報告與漁業統計議題。

一、OECD 漁業管理者手冊議題（議程四）：

（一）秘書處提出已彙整 OECD 漁業管理者手冊（The OECD Handbook for Fisheries Managers）修正報告草案（TAD/FI(2012)7/REV1），主席強

調此份報告係節錄並綜整歷年與漁業管理相關之專家研究報告，且已在本委會討論多次，本報告共有十個章節。

（二）本報告草案主要章節包括：

第一章：介紹漁業管理者之目標、工具、好處及受益者。

第二章：回顧與漁業管理之主要經濟理論。

第三章：探討漁撈能力過剩之問題及可能解決方法。

第四章：管理工具描述，包括市場機制與個別可轉讓配額。

第五章：重建及恢復漁業經濟之途徑。

第六章：漁業管理中漁民對漁業長期變化之調整。

第七章：漁業發展之政策連貫性及實際應用案例。

第八章：漁業和養殖認證。

第九章：養殖、娛樂漁業、水生資源使用者之競爭。

第十章：檢視關鍵議題及總結。

（三）各國評論：加拿大、歐盟、美國、瑞典、日本認為報告中應參考各國產業發展現況提出具體原則、方法及檢視條件，供漁業經營者有效運用，同時應多補充說明漁業經營者運用此手冊的好處（誘因），以鼓勵業者使用。荷蘭認為國際間共同打擊 IUU（illegal、un-regular、un-report）行為是目前重要漁業管理工作之一，建議報告中增加相關文字。多數會員均認同秘書處所準備報告草案是有用的。主席裁示秘書處再依會員意見更新漁業現況資料及近年 OECD 對產業所做努力，同時，請會員邀請專家提供具體評論意見供秘書處參考運用，讓本報告未來公佈後可以作為漁業經營者好上手利用之參考手冊。

二、FAO 與 OECD 農業展望議題：

（一）秘書處邀請 FAO 統計及資訊部門 Mr. Stefania VANNUCCINI 專題報告「FAO 與 OECD 農業展望--漁業模型及計劃」（Fish Model and Projections in FAO-OECD Agriculture Outlook）。

（二）Ms. Stefania 在特定假設條件下（包括：2015 及 2020 年南美洲發生聖嬰現象、各國漁業配額降至最低、全球養殖生產力持續增加但規模較前百年小、新飼養技術但仍無法降低對魚油及魚粉需求比例），展望未來海洋漁業資源不足、陸上水土資源有限、能源價格維持在高檔、飼料價

格上漲，生產成本提高、生產力下降，預測 2012 至 2021 年間 OECD 與 FAO 農業成長趨勢，包括：2021 年全球產量達 1.6 億噸，期間海洋漁業生產量維持 3%微幅變動，養殖漁業產量將增加 22%、全球養殖水產品消耗量將從 20% kg/capita 提升到 50% kg/capita、對 OECD 會員國而言水產品消耗將達 25 kg/capita，並以挪威、韓國（>60 kg/capita）、及日本（>55 kg/capita）居前三名，全球水產品價格將從 2000 年 2000 美金/公噸提高到 2021 年 3500 美金/公噸。

（三）各國評論：各國代表均認為該報告符合現況及未來發展趨勢，均表認同且資料非常具參考價值，日本、歐盟、美國、紐西蘭及加拿大代表建議 Mr. Stefania 再參考 FAO 發佈 SOFEI 內容補充貝類及藻類資料及分析，並認為未來中國大陸將在水產品國際貿易市場上扮演重要角色，包括其將成為全球水產品最大生產供應者及最大能源及小型魚類（如魚粉及魚油）消耗者，請 Mr. Stefania 一併分析。

三、政府財政移轉（Government Financial Transfer, GFT）議題：

各會員國針對秘書處（TAD/FI（2012）13）報告草案內容提出評論意見，瑞典、美國及歐盟認為，應就 GFT 作明確定義，FAO 及世界銀行代表亦表示 OECD、WTO 及 FAO 間定義不同，會導致資料及分析結果錯誤。主席裁示請秘書處於報告中詳予說明，並請會員於期限內提出專家具體研究報告俾納入該草案

四、漁業回顧（Review of Fisheries）議題：

秘書處針對此議題之一般性調查（General Survey）、特殊章節（Special Chapter）、各國統計（Statistics）及國家報告（Country Note）等項目，分別提出 TAD/FI（2012）14/PART1、TAD/FI（2012）14/PART2、TAD/FI（2012）14/PART3 及 TAD/FI（2012）14/PART4 報告草案，會員均無評論意見。主席請俄羅斯代表簡報說明國家報告（Country Note），並請會員評論，美國及歐盟針對該國漁船管理提出疑問並由俄羅斯代表回應該國漁船管理情形。

<u>10 月 31 日</u>：第三日討論其他漁業活動議題、確定本次會議紀錄及選舉 2013 年委員會工作成員，當日會議重點如次：

一、其他漁業相關議題：

秘書處邀請 Barrie Stevens 提出藍色經濟國際趨勢計畫（International Futures Program on the Blue Economy）、Myriam Linster 提出發展綠色

成長之重要指標、Nik Mohamed 提出漁業逃漏稅問題之研究等簡報，廣受各會員國讚許，並針對漁業逃漏稅問題研究報告納入下（111）屆會中討論。

二、審查俄羅斯入會案：秘密會議進行，不開放一般觀察員與會討論，結果不公開。

三、秘書處宣讀本次會議初擬結論，並經各會員國討論修正確認。（TAD/FI/M(2012)2）

四、選舉 2013 年委員會工作成員：

主席：法國籍 Mr. Philippe Ferlin

副主席團：冰島籍 Mr. Brynhildur Benediktsdóttir、加拿大籍 Mr. Robert Day、荷蘭籍 Mr. Leon Lomans 、日本籍 Mr. Joji Morishita

五、下屆會議將於 2013 年 4 月 22 日至 24 日在法國巴黎 OECD 總部會議室舉行。

肆、 心得與建議

一、本次會議依慣例由秘書處依工作計畫討論議題委託專家學者提出研究報告方向，並經 COFI 會議各會員國討論且獲得共識後始可進行研究報告內容之撰寫。由於各會員國漁業發展程度不同，對有關議題看法亦有所不同，因此會中各會員國多針對各研究議題之計畫構想內容一再表示修正意見。主席裁示，仍請會員國代表會後於 OECD 網站表示評估意見，由秘書處人員綜整意見再於下次會議討論，因此相關重要議題內容，如漁業綠色成長、政府財政移轉等議題研究報告將可能順延至 2013-2014 年後才能定稿。

二、綜觀本次各國代表參與 OECD COFI 討論情形，美國、歐盟執委會、紐西蘭、加拿大、瑞典、挪威代表團於各項議題上，均積極參與討論及表達專業立場試圖引導會議走向，日本及韓國則以該國發展情形提出相關案例或特殊性供各國參考，充分顯示該國參與國際會議討論之企圖心。

三、因應全球化時代的來臨，各國對於水產品貿易及品質管制政策，均要求應以透明化、公開化為原則，以促進自由貿易之公平性，因此綠色成長與海洋保撈漁業、綠色成長與養殖漁業之關聯性及發展策略、能源與補貼、政府財政移轉議題，已逐漸發展成為近幾次委員會討論重點議題，爰我方應積極把握出席 OECD COFI 會議機會，適時掌握國際規範及趨勢，並將相關資訊提供給國內各界參考，輔導產業符合國際趨勢，提升產業競爭能力。

四、OECD 下轄 COFI 漁業委員會各國代表團多為長期參與國際漁業管理組織之代表人員，透過參與 OECD 會議可建立與全球各漁業主要國家聯繫管道，並

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，積極派員參與年會與相關國際會議，儘可能分享經驗及表達看法，或俟機發表論文，以增加參與程度。另 OECD COFI 會議討論議題大部份具有連續性，建議指派固定與會人員，除可維繫與各會員國代表情誼及聯絡管道外，較能掌握國際相關議題發展趨勢，如區域管理組織（RFMOs）針對海洋補撈跨域魚種管理議題，並透過意見表達與參與有效掌握會議動向。

伍、 附件：

1.本次會議議程：TAD/FI/A(2012)2。

2.綠色成長議題報告：

(1)政府管理與綠色成長：TAD/FI(2012)15。

(2)能源與綠色成長：TAD/FI(2012)2/REV1

(3)養殖漁業與綠色成長： TAD/FI(2012)11

(4)漁業課徵能源稅之可行性：TAD/FI(2012)10

3.漁業管理手冊草案：TAD/FI(2012)7/REV1。

4.政府財政移轉議題報告：TAD/FI(2012)13

5.2012 綠色成長與養殖漁業研討會議程(12-13 December 韓國,麗水市)：
Green Growth and Aquaculture Workshop

6.本次會議紀錄暨與會者名單：TAD/FI/M(2012)2。

附件 1

本次會議議程：TAD/FI/A(2012)2

For Official Use **TAD/FI/A(2012)2**

Organisation de Coopération et de Développement Économiques
Organisation for Economic Co-operation and Development **03-Sep-2012**

English - Or. English

TRADE AND AGRICULTURE DIRECTORATE
FISHERIES COMMITTEE

TAD/FI/A(2012)2
For Official Use

DRAFT AGENDA OF THE 110TH SESSION OF THE COMMITTEE FOR FISHERIES

Paris, 29-31 October 2012

The meeting will start at 09:30 on Monday, 29 October 2012 and will be held at:

Organisation for Economic Co-operation and Development (OECD)
Conference Centre, Room CC2
2, rue André Pascal
75016 Paris

For further information, please contact:
Carl-Christian SCHMIDT (Email: carl-christian.schmidt@oecd.org)

JT03325744

Complete document available on OLIS in its original format

English - Or. English

COMMITTEE FOR FISHERIES

DRAFT AGENDA of the 110th SESSION

OECD Conference Centre, Room CC2
2, rue André Pascal, Paris 75016

29-31 October 2012
9:30 – 18:00

Monday, 29 October *(morning)*		
1.	**Adoption of the Draft Agenda for the 110th Session**	TAD/FI/A(2012)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) Governance and Green Growth – new paper*** This new paper has benefitted from inter-sessional work by the ad hoc group. This version of the paper clarifies the main concepts and identifies the main governance issues related to green growth and the instruments available. ***ii) Energy and Green Growth*** • Revised TAD/FI(2012)2/REV: Working paper series This work was presented in preliminary form at the 109th Session of the Committee for Fisheries. This revised version responds to the comments made at that meeting, in addition to being generally expanded. It paves the way for policy-focused work in this area as part of the 2103-14 PoW.	TAD/FI(2012)15 ***Action required***: Discussion and guidance TAD/FI(2012)2/REV ***Action required:*** Discussion and approval

	• Modelling paper This paper provides a look at the potential for the FISHRENT model to be used as part of an OECD investigation of fuel tax concessions (FTC), and discusses goals and potential work on FTCs generally. Review of fuel tax concession modeling efforts by Nordic Council of Ministers. Mr. Max Nielsen, Associate Professor Institute of Food and Resource Economics of the University of Copenhagen, Denmark will provide an overview of the work.	TAD/FI(2012)10 Information Information
Monday, 29 October *(afternoon)*		
	***iii)* Green Growth and Waste and Improved Use of Fisheries and Aquaculture Resources** The report builds on input from the 109th Session. The COFI, in its summary record from 109th Session indicated that completion of this report should have the highest priority.	TAD/FI(2012)3/REV ***Action required:*** Discussion and approval
	***iv)* Aquaculture and Green Growth** • Aquaculture and Green growth Based on discussion at the 109th Session a revised version of the paper on Green Growth and Aquaculture has been developed. • Information on the Korean Government-hosted workshop on Aquaculture and Green Growth (December 2012)	TAD/FI(2012)11 ***Action required:*** Discussion and guidance Information
Tuesday, 30 October *(morning)*		
4.	**Draft Fisheries Managers Handbook** This version of the document is a complete draft. It has benefitted from additional editing by a consultant. The final version of the document will take into account comments from Delegates at the 110th Session as well as final editing (presentation and graphics) to prepare it for publication.	TAD/FI(2012)12 ***Action required:*** Discussion and approval

5.	**FAO-OECD Agriculture Outlook: The Fisheries Module, data validation, modelling, review Fish Chapter** The AGLINK model incorporating fisheries production is making important contributions to OECD and FAO analysis of food commodities. Fisheries model outputs are featured in a chapter of the OECD-FAO Agriculture Outlook and potentially in the Review of Fisheries. The role of the COFI in the future development and use of this model is to be discussed.	Information
6.	**Government Financial Transfers (GFT) Review: Agenda and introduction to the planned meeting of experts back-to-back with the 111th Session of COFI** The OECD GFT database will benefit from a review aimed at improving its usability and compatibility with other OECD data sources (principally the PSE). This document provides an agenda for an experts meeting plus some background information for delegates.	TAD/FI(2012)13 ***Action required:*** Discussion and guidance
Tuesday, 30 October *(afternoon)*		
7.	**Review of Fisheries:** • General Survey A draft of the General Survey chapter will be presented. The first part of the General Survey is in line with previous editions. The forward looking outlook chapter is based on work and results of the OECD/FAO Outlook (Agenda item 5). • Special Chapter This special chapter discusses the main issues and challenges in managing fisheries when both industrial and recreational fisheries are taken into account. This special chapter is written by Professor Ragnar Arnason and will be presented at this COFI meeting. • Statistics • Country Notes	 TAD/FI(2012)14/PART 1 ***Action required:*** Discussion and approval TAD/FI(2012)14/PART 2 ***Action required:*** Information and approval for inclusion as a special chapter. TAD/FI(2012)14/PART 3 TAD/FI(2012)14/PART 4 to PART 34

Wednesday, 31 October *(morning)*		
8.	**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 Organisation that have relevance to the work of the Fisheries Committee. Representatives from other directorates of the OECD will provide the Committee with an update of their work.	***Action required:*** Information
	ii) Report on activities of the Fisheries Secretariat The Secretariat will report on past and planned activities of the Secretariat, including attendance at meetings. ***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 Information
Wednesday, 31 October *(afternoon)*		
9.	**Council Recommendation on Decommissioning Schemes**	Information
10.	**Russian Federation: Consideration of Committee for Fisheries formal opinion on the Russian Federation's accession to the OECD** ***[Observers are kindly asked not to be present in the meeting room]*** Following discussions at the 109th Session, a revised version of the Formal Opinion will be available.	**CONFIDENTIAL Item** TAD/FI/ACS(2012)1/REV ***Action required:*** Discussion and approval

11.	**Committee for Fisheries Global Relations Strategy** • Extension of observerships • The COFI will be informed of the new rules of the OECD regarding non-member economies. In particular the COFI will need to prepare a revised global relations strategy to be approved at the 111th Session in April 2013.	**CONFIDENTIAL Item** ***Action required:*** Approval Discussion and information
12.	**Election of officers to serve on the Bureau 2013**	***Action required***: Discussion and approval
13.	**Other business**	
14.	**Adoption of the Summary Record of the 110th Session of the Fisheries Committee**	TAD/FI/M(2012)2 ***Action required:*** Approval

附件 2 綠色成長議題報告：

2-1 政府管理與綠色成長：TAD/FI(2012)15

For Official Use **TAD/FI(2012)15**

Organisation de Coopération et de Développement Économiques
Organisation for Economic Co-operation and Development **05-Oct-2012**

English text only

TRADE AND AGRICULTURE DIRECTORATE
FISHERIES COMMITTEE

TAD/FI(2012)15
For Official Use

GREEN GROWTH PERSPECTIVES ON FISHERIES GOVERNANCE

Paris, 29-31 October 2012

This document is presented to the 110th session of the Committee for Fisheries under Draft Agenda item 3 i) for DISCUSSION and GUIDANCE.

Contact: Gunnar Haraldsson (email: gunnar.haraldsson@oecd.org)

JT03327939

GREEN GROWTH PERSPECTIVES ON FISHERIES GOVERNANCE

TABLE OF CONTENTS

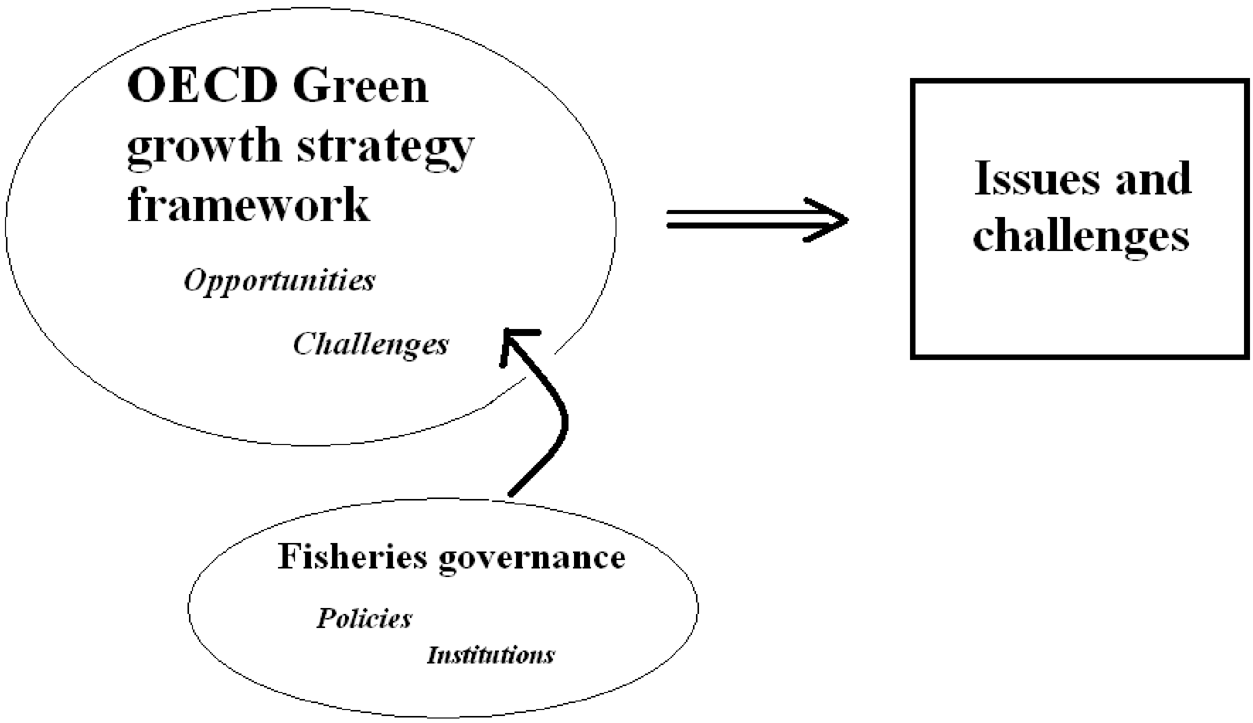
1. Introduction

1. The objective of this paper is to improve our understanding of the role of governance for green growth in fisheries. The paper does so by clarifying and aligning the definitions and key concepts relevant for green growth as used by the OECD to fisheries governance. The framework is adapted from *Towards Green Growth. A summary for policy makers*, published by the OECD in 2011.

2. This paper is the first step in a process intended to providing policymakers with recommendations regarding how the governance of fisheries and aquaculture can support green growth through fostering green growth opportunities and in addressing challenges to green growth.

3. The methodology used in this paper consists of fitting fisheries governance into the OECD Green growth strategy framework, and thereby mapping out the main issues and challenges for governance towards green growth.

Figure 1. Methodology of the paper



4. This document includes five chapters. The first chapter discusses the OECD Green growth strategy and its relevance to fisheries. The second chapter reflects on the role of governance for achieving green growth in fisheries. Fisheries governance includes both policies and institutions to manage fisheries, taking into account the economic, social and environmental factors. The third chapter focuses on the opportunities and challenges in greening fisheries. In this respect issues of implementation and stakeholder acceptance are of key importance. The fourth chapter highlights some of the challenges to the implementation of green growth strategies in fisheries and proposes some policy options for addressing these challenges. The final chapter sums up the lessons learned and next steps for governance in getting fisheries on a green growth path.

5. While this is a first attempt to understand the issues of governance and green growth it nevertheless highlights some important messages. Governance is central to fisheries management due to the need for public intervention. Governance in fisheries deals with both the policies developed for managing fisheries and also the institutional set up for delivering these policies.

2. OECD Green growth strategy and fisheries

6. At the OECD Ministerial Council Meeting in June 2009, Ministers acknowledged that green and growth must go together and asked the OECD to develop a Green growth strategy. Ever since the OECD has worked on this issue and published numerous documents in which the green growth methodology and green growth strategy are developed further.

7. The OECD has provided the following definition of green growth (OECD, 2011):

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. To do this, it must catalyse investment and innovation which will underpin sustained growth and give rise to new economic opportunities.

8. Green growth is necessary as traditional growth erodes natural capital. The underlying tenet is that to base our development at the cost of natural capital is unsustainable and will lead to a number of problems for human societies, including resource scarcity, increased pollution, climate change and loss in biodiversity. Traditional growth may compromise future growth prospects for at least two reasons;

- It is becoming increasingly costly to substitute natural capital with physical capital.
- Changes do not necessarily follow a smooth, foreseeable path.

9. This means that unless we succeed in achieving green growth, growth will grind to a halt and the increases in living standards that we have enjoyed for the last decades will cease. In other words, green growth is a prerequisite for future growth.

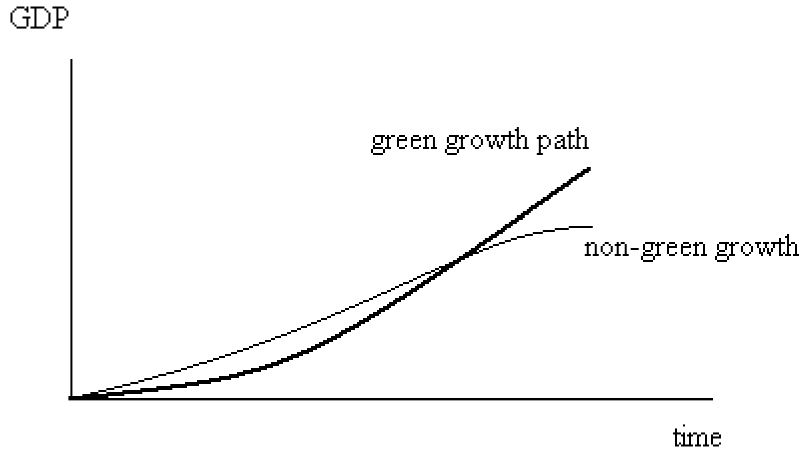
10. Green growth may also *spur* new growth through different channels, such as:

- Increased productivity
- Innovation
- New markets
- Increased confidence for investors.

11. However, there are also reasons to believe that green growth may, in the short term, *reduce or constrain growth* measured as GDP growth. This short term contraction in growth may, for example, be due to less extraction from natural resources such as fish stocks.

12. This is shown on Figure 2 where green growth strategies may lead, in the short term, to lower growth of GDP than with current policies, while later on generate greater sustained growth in the future.

Figure 2. Green vs. traditional growth



13. Figure 2 also conveys the fundamental observation that by not choosing a green growth path a situation will arise where there is no growth, as shown by the flat end of the non-green GDP curve. The "non-green growth" curve might actually decline over time. In fisheries this is characterised by a situation of overfished or depleted fish stocks.

14. In implementing green growth strategies in fisheries a number of challenges may emerge. These challenges arise due to the inherent uncertainties of natural renewable resource systems, including fisheries. This again gives rise uncertainties about the size of returns and the timing of those returns.

15. Fisheries fit well into the green growth framework. Many fisheries are in a poor state with regards to low stock sizes, ecosystem vulnerabilities and poor economic performance. However, there are numerous possibilities for improvement. For example, a recent OECD study on the economics of rebuilding fisheries has demonstrated that substantial gains can be made from rebuilding efforts where economic growth and ecosystem health go hand in hand (OECD, 2012).

3. What is governance and why is it needed?

16. The key role of the public authority is to provide public goods, which by definition are not provided through markets.[1] In this respect governance is central to fisheries. Examples of public interventions in fisheries abound, such as the setting of total allowable catch, rules and regulations concerning gear, seasonal closures and safety, to name a few. Such measures are needed to provide public goods and to avoid harm due to market imperfections. Market imperfections may include lack of functioning markets and information asymmetries. It is well-known that many of the problems facing fisheries, such as overfishing and over-capitalisation have their roots in the existence of externalities and public good nature of space and resources (OECD, 2006).

1 In economics, a public good is a good that is both non-excludable and non-rivalrous in that individuals cannot be effectively excluded from use and where use by one individual does not reduce availability to others.

17. Another important role for public intervention is when there is a long time-lag between costs incurred and the benefits received, for example when greening fisheries. Additionally some of the costs may be borne by those that do not directly reap the benefits. This may call for public intervention in the absence of well functioning markets and well defined property rights (Ayalew, *et al.*, 2007).

18. The type and need for public intervention is different from one fishery to the next (de Vivero *et al*., 2008). For instance, fisheries management systems that rely on gear controls to restrain catches need efficient surveillance mechanisms to ensure that the restrictions are not circumvented, while fisheries management systems that use vessel quotas need monitoring systems that track the catch levels of individual vessels e.g. logbooks and landings data. Hence the choice of management system and specific instrument will require different governance and institutional set-up.

19. Although there is no official OECD definition of what constitutes governance when it comes to fisheries it is generally acknowledged that governance includes the institutions and mechanisms that are put in place to deliver public policy. As is often the case with vaguely defined concepts they are used differently by different authors and are often context dependent. Rewording somewhat the OECD terminology it is proposed that, *governance is the exercise of political, economic and administrative authority necessary to manage a nation's fishery*.[2]

20. It is worthwhile to keep in mind that although the role of government is to provide public goods the government is not the sole provider of such goods. Public goods are also provided through institutions and institutional structures that emerge through tradition and social interactions (Eggertsson, 1990, Ostrom, 1990).

21. Governance can be good or bad to a varying degree. According to the OECD 'good governance' in the fisheries context implies *inclusiveness*, *empowerment*, *transparency*, *flexibility* and a *predictable set of rules and processes* for fisheries management (OECD, 2012).

22. Also, good governance acknowledges the *tensions* and *balance* between objectives of different stakeholders and contributes to resolving those tensions. Transparency helps to build trust and foster dialogue among stakeholders. The inclusion of a wide range of stakeholders (including different levels of government, environmental and scientific communities, industries and local communities) calls for a clear specification of each group's role and responsibilities in institutional structures and processes (OECD, 2012).

23. Green growth governance includes two broad sets of policies. The first set consists of broad framework policies that reinforce economic growth. These include fiscal and regulatory settings such as tax policies, competition policies and innovation policies. If these policies are properly designed and executed they will maximise the efficient allocation of resources.

24. The second set of policies provides incentives for efficient natural resource use, which at the same time address environmental and ecosystem concerns. These policies include a mix of price-based instruments; rights based instruments as well as non-market instruments such as regulations, technology support policies and voluntary approaches. If these policies are properly designed and implemented they will contribute to the conservation of natural capital.

25. Through governance systems governments deliver policies that are meant to benefit society at large and will affect the *economic*, *social* and *environmental* outcomes of the fisheries sector. The

---

2 OECD Glossary of Statistical Terms. Available at http://stats.oecd.org/glossary/detail.asp?ID=7236

interaction of economic, social and environmental policies can reinforce, oppose or be neutral in terms of delivering intended results. A green growth strategy needs to take such considerations into account to secure policy coherence.

3.1. Governance instruments

26. Fisheries managers have many governance instruments to achieve green growth in fisheries.[3]

27. *Market instruments* focus on influencing price signals in fisheries and influence the behaviour of participants in the fishery. The most common market instruments are fees. There is also a wide range of *rights based management tools* such as ITQs, IQs, TURFs and community quotas. Such instruments have proven to be very effective in managing fisheries in particular by addressing overcapacity and energy use (OECD, 2006a).

28. *Fiscal policy* can be used to influence behaviour of participants in fisheries. Taxes can, for example, be used to alter the input mix in fisheries such as by taxing fuel in order to reduce GHG emissions. Fiscal policy can also be used to tackle discards and by-catch, energy use, waste as well as trade issues.

29. *Government financial transfers* can be used in many ways to green fisheries. Subsidies towards funding of research to spur innovation that enhances green growth, such as with regards to energy use, waste, biodiversity (for example through gear selectivity), can be taken as examples.

30. Fisheries managers use *regulatory instruments* to green fisheries. Regulatory instruments can be used in different ways and at different 'levels'. There are *performance and technological standards* that can be used to help fisheries get on a green growth path. Some of these standards are set by public authorities while others are industry/commercial (e.g. MSC). Most of these standards focus on sustainability and environmental friendly production processes.

31. *Spatial policies* deserve a special attention. They are considered by many to be central to successful green growth in fisheries (van Hoof, 2012) as well as in ecosystem management. Spatial policies are widely used in fisheries (Makino, 2008) and are often an integral part of other policies, such as those aimed at enhancing stock structures, protecting habitat and/or in the implementation of more general ecosystem management approaches.

3.2. Governance institutions

32. Governance also encompasses the institutions and the institutional setting through which fisheries policies are delivered. Fisheries governance is the outcome of a complicated judicial, social and political process. It is therefore difficult to generalise about governance across countries where the institutional structures have evolved under different historical, judicial and political circumstances.

33. Nevertheless, when focusing on fisheries management, the policy setting itself is in most cases decided upon at the highest echelons of political power, such as ministries. Implementation of services, such as research, management and enforcement are carried out by agencies with varying stakeholder participation. As an example and drawing on previous COFI work, Table 1 provides a mapping of how fisheries policies and services were delivered across a number of OECD countries.

---

3 What follows is a general discussion. For a more comprehensive and detailed analysis see, for example, OECD (1997), OECD (2006) and OECD (2012).

Table 1. Key features of fisheries management frameworks in several OECD countries (OECD, 2003)

Country	Policy setting	Delivery of research services	Delivery of management services	Delivery of enforcement services	Stakeholder participation
Iceland	Ministry of fisheries	Marine Research Institute; Directorate of Fisheries (for statistics)	Ministry of Fisheries (TAC setting); Directorate of Fisheries	Directorate of Fisheries; Icelandic Coast Guard	Institutionalised consultation with Icelandic Fishermen's Association and Federation of Icelandic Fishing Industry
New Zealand	Ministry of fisheries	Ministry of Fisheries contracts research organisations to carry out research services	Ministry of Fisheries contracts out some management system services (*e.g.* fishing vessel registrations)	Ministry of fisheries	Consultation with all stakeholders (commercial, recreational, environmental, Maori) compulsory under fisheries law. Consultation occurs in Ministry planning, stock assessment and advice to the Minister of Fisheries on management controls. For some fisheries, stakeholders prepare fisheries plans that are then assessed and, if agreed to by the Minister, implemented by the Ministry.
Norway	Ministry of fisheries	Institute of Marine Research; Norwegian Institute of Marine and Aquaculture Research	Ministry of Fisheries; Directorate of Fisheries	Directorate of Fisheries; Coast Guard; Sales Organisations	Institutionalised consultation with Norwegian Fishermen's Association and Federation of Norwegian Fishing Industry
Australia	Central ministry, with advice from Australian Fisheries Management Authority (AFMA)	Independent statutory authority (Fisheries Research and Development Corporation), contracting out research to institutions	Independent statutory authority (AFMA)	Independent statutory authority (AFMA)	Through AFMA Management Advisory Committees and Stock Assessment Groups
Canada	Central government (Dept of Fisheries and Oceans (DFO))	Government laboratories and universities; priority setting by DFO, with advice from Fisheries and Oceans Science Advisory Council, Fisheries Resource Conservation Councils	DFO	DFO is the primary provider of enforcement services. Industry sponsored dockside monitoring programmes and cost-sharing of at-sea observers	Industry participation on advisory committees; some comanagement and Joint Project Agreements
European Community	Centrally through European Commission	EC through framework programs	Rule setting at EC level; Implementation by EU member states	EU member states	Limited at EC level to advisory committee on fisheries (industry and consumers) and Economic and Social Committee. Varies widely between states

United States of America	Broad goals in Magnuson-Stevens Act, objectives set regionally through Regional Fisheries Management Councils (RFMC)	National Marine Fisheries Service (NMFS); Science Centres; universities; RFMCs	NMFS	NMFS for dockside enforcement; US Coast Guard for at-sea enforcement	High degree through RFMCs, Marine Fisheries Commissions
Japan	Centrally through Fisheries Agency	Through Fisheries Research Agency (independent but attached to central government)	Fisheries Agency through regional Fisheries Coordination Offices	Fisheries Agency through regional Fisheries Coordination Offices	Limited, through Fisheries Cooperative Associations
Korea	Centrally through Ministry of Maritime Affairs and Fisheries (MOMAF)	MOMAF through National Fisheries Research and Development Institute	MOMAF through Fisheries Administration Bureau and Fisheries Resource Bureau	MOMAF through Fisheries Resource Bureau; Fishing Vessels Management Office and National Marine Police Agency	None
Mexico	Centrally through Secretariat of Agriculture, Rural Development, Cattle Raising, Fisheries and Food	National Fisheries Institute	Secretariat of Agriculture, Rural Development, Cattle Raising, Fisheries and Food	Federal Bureau for Environmental Protection and National Commission for Aquaculture and Fisheries	National Chamber of Fisheries Industry and Aquaculture; Fisheries Cooperatives
Turkey	Centrally through Ministry of Agriculture and Rural Affairs (MARA)	MARA through four research institutes as well as universities	MARA	MARA	Through producers organisations

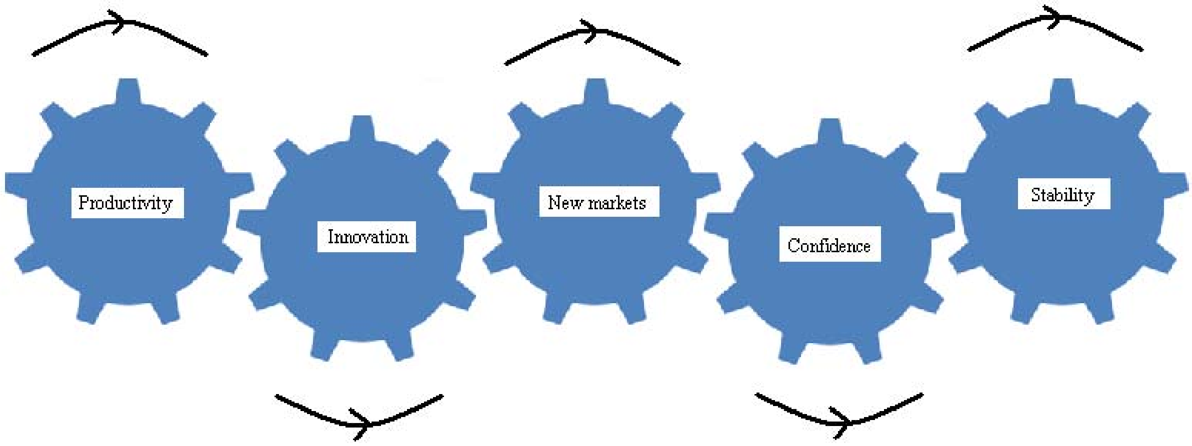
34. Getting fisheries on a green growth path calls for a wider approach than outlined in Table 1 and requires coherence between the economic, social and environmental policies of fisheries management. This might involve other ministries, agencies and private institutions that deliver services or have an impact on the fisheries sector (e.g. agriculture, surveillance, education). What is needed is synergies that produce sustainable outcomes for fisheries and general growth (Nielsen *et al*. 2012). For that to happen a more holistic approach to fisheries governance may be necessary.

4. Seizing the opportunities of green growth in fisheries

35. Green growth strategies for fisheries should, if properly designed and implemented, increase general welfare, taking into account the economic, social and environmental factors. Below we discuss the opportunities and challenges of green growth in fisheries, focusing on the relationship with governance.

36. The growth opportunities exist in many real-world fisheries situations. Figure 3 provides a schematic overview of what has been identified as the possible sources of green growth (OECD, 2011a).

Figure 3. Green growth sources for growth



37. It is important that fisheries governance systems support the different sources of green growth and that they work together in delivering the green growth. The following discussion uses the framework provided by the OECD green growth strategy to identify some of the important governance issues related to fisheries; respectively for productivity, innovation, new markets, confidence and stability.

4.1. Productivity

38. Productivity can be dramatically increased in many fisheries as fewer inputs are used to produce sustainable outputs. The challenges related to productivity in fisheries are multi facetted as productivity can be enhanced both through better management of the resources (stocks) as well as reducing the use of inputs.

4.1.1. The state of stocks

39. One aspect of increasing productivity relates to the fish stocks as well as stock interdependence. This is most evident by the state of many of the worlds' fish stocks which are far from being close to sustainable levels in spite of various national and international efforts to curb overfishing. Setting enforceable TACs for stocks is a necessity and is often aimed at specific biological reference points such as the Maximum Sustainable Yield. The use of biological reference points is common and specific policies have been adopted to deal with uncertainties in stock measurements, including the precautionary principle.

30. Policy actions regarding stocks are, however, not limited to stock sizes, measured in tonnes. There are also various measures taken to influence the catch composition which can have considerable influence on the growth rates and thereby on the reproduction capacity of the fish stocks. Other policies that may influence growth rates include spatial measures, including area closures, gear limitations (e.g. mesh sizes) and seasonal closures.

40. The economics of rebuilding fisheries project highlighted many of the productivity gains that can be expected to be made from rebuilding fisheries (OECD, 2012). Furthermore, studies by the OECD and others have shown that considerable increases can be made in productivity, especially through the use of rights based fisheries management measures (OECD, 2006a).

4.1.2. Discards and by-catch

41. By-catch is incidental catches, i.e. catches of species which are not targeted by fishers. It is likely that discarding waste significant resources, reduces productivity and thereby runs counter to green growth. Although it is difficult to estimate the degree of discarding with much precision, evidence suggests that a considerable amount of fish is discarded. Pauly *et al*. (2003) estimate the discard to be equivalent to 30% of landings. By-catch is often due to ecosystem interactions. Efforts to decrease by-catch are very different from one regulatory framework to another. For example, the European Union generally forbids landings of non-targeted species while other encourages the landing of all catch, targeted or not.

42. As the price varies both between species and for the species itself (e.g. due to different size), restrictions on catch composition increase the incentive to discard a part of the catch (Asche, 2011). This is a considerable problem in many fisheries.

4.1.3. Overcapacity of fishing fleets and efficiency enhancing management tools

43. Overcapacity is a major problem in many fisheries which results in waste of economic inputs as excess capital is tied in non-productive fishing assets such as vessels and gear. At the same time overcapacity can lead to increased fishing pressure. Both outcomes lead to a loss in productivity and do not support green growth in fisheries. On way to address overcapacity is through decommissioning vessels. The OECD has published guidelines on the design and implementation of decommissioning schemes to help tackle overcapacity, highlighting the need for preventive actions and economic efficiency ("best value for money") of such schemes (OECD, 2009). Also, market based management instruments have proven to be very efficient in reducing overcapacity of fishing fleets, especially when based on transferable rights (OECD, 2006a). The use of such instruments, such as individual transferable effort quotas, individual transferable quotas, territorial user rights and community-based catch quotas, should therefore be considered as tools in a green growth strategy.

4.2. Innovation

44. The OECD Innovation Strategy (OECD, 2010) provides guidance on a broad range of issues from education and training policies, to policies that provide a conducive business environment and infrastructure for innovation as well as policies that foster the creation and diffusion of knowledge. It sets out the priorities for government action being; *empowering people to innovate*, *unleash the innovation in firms*, *creation, diffusion and application of knowledge*, *the application of innovation to address global and social challenges*, *improving the governance and measurement of policies for innovation* and finally, *changing the emphasis in policies for innovation*. Not all of these innovation policy priorities are easily applicable to green growth innovation strategies for fisheries.

45. The OECD tool box for achieving green growth through innovation includes policies which identify ways to increase output where possible while decreasing the pressure on natural resources. Public authorities have various ways of supporting such research and innovation, for example through research funds, education policies, patent policies and tax policies.

4.2.1. Reasons for government intervention for innovation in fisheries

46. It can be argued that government intervention is needed to spur green growth innovation when market forces provide inadequate incentives for investment in the development or diffusion of green

technologies. As the outcomes of many R&D activities are public goods, firms tend to invest less in such activities than is socially optimal.[4]

47. There are many barriers to the innovation and uptake of green technologies. Firm size can play a role in that small firms may lack financing and qualified staff to engage in green growth innovation. According to the Eurobarometer survey (European Commission, 2011) uncertainties regarding market demand, returns on investment and lack of funds are the three biggest obstacles to the uptake of green innovation. Such uncertainties are prevalent in fishing companies and fishing related industries and further strengthen the argument for governments to play an active role. In addition, fishing companies are often small family run businesses with limited capacity to innovate.

4.2.2. Technological innovations

48. But where should governments put the emphasis of their innovation strategies for green growth when it comes to fisheries? Great strides have been made in technological innovations in fisheries in the last decades. Many of these innovations have increased fishing capacity e.g. design of motors, vessels and gear. Other innovations have increased economic efficiency in processing and transport. Such innovations have not always greened fisheries, but have contributed to overfishing and overcapitalisation as well as rent dissipation. It should be noted, however, that many innovations have led to fuel efficiency, both in the design of engines and fishing gear [TAD/FI(2012)2/REV1]. Innovations have also reduced waste in fisheries [TAD/FI(2012)3].

4.2.3. Institutional innovations

49. Innovation in fisheries can also take place as alternative and new ways of managing fisheries (soft innovation). Institutional innovations and new methods in controlling and measuring catches, surveillance and enforcement of fishing laws may be important elements of greening fisheries. The introduction of electronic fishing log books and satellite surveillance are cases which has required institutions to adapt to new technologies. In this regard also stakeholders have an important role in research and innovation (Clement, Wells and Gallagher, 2008, Sobol and Craig, 2008) and that holds true not only for technical innovations but also institutional innovations.

---

4 DSTI/STP(2012)6/REV1. *STI Outlook 2012: Transitioning to green innovation and technology (Chapter 4)*.

Box 1. Use of Clusters for Innovation

The Nordic Ministers of Trade and Industry have emphasised the importance of Nordic cooperation to meet the challenges the countries face due to climate change and global competition. The Nordic Council of Ministers has created *The Nordic Innovation Forum* to focus on innovation and how innovation can enhance the transformation to an economy based on green growth and simultaneously secure welfare for the Nordic citizens. It is through persistent innovation that the Nordic countries can be in the forefront, create new jobs and maintain a competitive edge.

In a recent report (Nordic Innovation, 2012) some best practices for advancing green innovation are presented, based on the Nordic experience and suited for Nordic countries. One of the pathways which is proposed is the use of clusters. Recognising that innovation is inherently based on inputs from multiple actors across the public and private sectors, the cluster concept can be used to provide a framework for cooperation between companies, public institutions, academics and various other stakeholders.

There are numerous fisheries related clusters around the world, most focused on specific geographic regions. The Iceland Ocean Cluster (IOS) can be taken as an example. The IOC started as a university project but has grown into a running company. It brings together different companies and institutes and serves as a melting pot for new ideas related to oceans and fisheries. Among the projects that are already underway are many that can contribute to greening of fisheries, including *Turning Waste into Value*, *Codland, focused better raw material utilisation*, *Improving education for fishers and processers*, *School presentations on oceans issues*, and *Marketing tech companies*.

An innovation strategy for green growth in fisheries could include mechanisms to reduce barriers to the formation of such clusters and encourage cooperation between different clusters.

Source : OECD, Nordic Innovation (2012), Iceland Ocean Cluster (www.sjavarklasinn.is)

50. The capacity to innovate is also related policies outside the fisheries domain such as general education. Education policies that foster creative thinking may be very effective in inciting people to innovate. Higher education levels all along the value chain in fisheries might have the same effect. Patent policies and tax breaks may also spur innovation in general by creating incentives for innovation for both individuals and firms (OECD, 2004).

4.3. Market development

51. Many people depend on fish for food, income and employment and seafood is the most traded food commodity in the world with around 39% of production traded. Interestingly rich countries export low value fish and import high value fish. The trade patterns seem to have changed recently as income levels increase and former exporting countries are becoming consumers of fish.

52. Demand for “green” fish products can be stimulated. This can be done for example through certification schemes. The OECD has done considerable work on certification in fisheries and aquaculture focusing on sustainability of production. The *Certification in Fisheries and Aquaculture* report[5] (OECD, 2011) analyses the growing trend in information requirements for fisheries and aquaculture products in particular with respect to sustainability. The work focuses on the economics of private eco-labelling and certification schemes, and examines the interface between public authorities, business operators and the

5. The analytical work was preceded by an OECD and FAO Round Table on labelling and certification which took place in The Hague in 2009. The outcome of the Round Table underscores the importance of such certification instruments for green growth in fisheries.

consumer (OECD, 2011d).[6] The report recommends that public authorities and private operators in the fisheries and aquaculture sector agree on a definition of sustainable production. A commonly agreed standard can enhance the credibility of a label or certification, provide transparency, and enable consumers to make informed choices when they buy fish products.

53. Various other policies affect fisheries markets, such as trade policies and development policies. Examples include tariffs or technical hindrances which may create or close down markets for fish products. One particular case related to greening fisheries is the banning of imports of fish products from IUU fishing activities.

4.4. Confidence

54. As outlined in the OECD green growth strategy, investor confidence is important. Building confidence can be achieved through greater predictability and continuity concerning the future of the industry, including the delivery of policies and in how governments address major issues, i.e. communication from the public to market participants. In fisheries investors will be particularly interested in a predictable business environment with respect to the stock size, catchability and environmental factors. This may be achieved through the advancement of science and the use of scientific methods in collecting, analysing and disseminating appropriate information for management purposes and the participation of stakeholders in the fisheries management process. Greater predictability concerning the fishery management process itself, transparency of fisheries management decisions and accessible institutions will also help in building confidence. Clearly set out rules and procedures are central to achieve this.

4.5. Stability

55. Stability of the ecosystem reduces the risk to sustainable growth in fisheries. For example, ecological imbalances may lead to changes, which are sometimes irreversible or only reversible over long time periods and at great costs to the environment and societies.[7] The use of the precautionary principle and ecosystem management methods can be effective in reducing the risk of imbalances and provide a more stable fisheries environment.

Box 2. The precautionary approach

The precautionary approach to fisheries management postulates that uncertainty should be taken explicitly into account by setting specific reference points which trigger specific actions. It further stipulates that the absence of scientific information should not result in lack of conservation actions. This approach requires that, given uncertainties, conservative actions are taken first and relaxed only when scientific evidence convincingly demonstrates that those actions are no longer needed. One can say that uncertainty favours the ecosystem, as opposed to harvesting. Seen in this light, the precautionary approach gives priority to preventing a crisis rather than responding to it (Garcia, 1994).

The precautionary approach to fisheries management is prevalent in many international agreements, such as the FAO Code of Conduct for Responsible Fisheries (FAO, 1995) and the UN Agreement on Straddling and High Migration Fish Stocks (UN, 1995).

Source : OECD

6 OECD (2011d). *Fisheries and Aquaculture Certification*. OECD, Paris.

7 The collapse of the Canadian Atlantic cod fishery can provide an example of such abrupt changes.

4.5.1. Biodiversity and climate change

56. Biodiversity has become a major issue for green growth as it is the basis of sustainable provision of ecosystem services. Diverse ecosystems are more resilient and have a greater ability to withstand changes in the environments. Also it is important to preserve biodiversity to safeguard genetic variability [ENV/EPOC/WPBWE(2011)/REV3]. Green growth strategies should therefore include mechanisms to safeguard biodiversity.

57. Climate change impacts the ocean ecosystem and changes in sea temperatures and ocean acidification produce challenges to fisheries management. There is a great deal of uncertainty associated with how, where and when climate change will affect individual fisheries. While global models exist which provide some indication of the magnitude of impacts, more work needs to be done to improve our understanding of effects of climate change on individual fisheries. However, climate change will result in the redistribution of costs and benefits for the fisheries sector and coastal communities and have social and economic consequences for fishers. But by how much, when and for whom these benefits and costs will flow are less clear. This calls for strategies to adapt to climate change under uncertainty, while taking into account social and economic consequences (OECD, 2010).[8]

58. To address climate change most countries have enacted policies related to pollution, green house gas emissions, including quotas and taxes. Such policies can be important in fisheries where considerable waste and additives result from the production process and can cause considerable environmental harm.

59. Global collaborative efforts may be needed to address pollution issues as increased cost of polluting may result in a temporary loss of competitiveness unless other countries apply similar measures. Some countries may find it difficult to apply strict pollution regulation due to the cost of such measures. Official Development Assistance (ODA) can play an important role in helping to clean up dirty industries in such countries while at the same time fostering green growth (Beslay, 1995).

5. Fisheries sector characteristics and green growth – identification of policy options

60. The introduction of green growth policies need to take into account a number of fisheries sector specific issues including low human and social capital, incomplete (or non-existent) property rights and subsidies, regulatory uncertainties and externalities related to information and the environment. In the following we will discuss these in turn, focusing on how fisheries governance can be constructed to help addressing such fisheries sector specificities.[9]

5.1. Low human and social capital

61. Many fisheries are characterised by low human and social capital, which manifests itself in low education levels and an ageing labour force. Job opportunities and pay levels may be better in other sectors of the economy resulting in recruitment problems for fisheries; this may also be linked the working life in the fishers sector. Jobs in fisheries often mean low and/or fluctuating incomes, dangerous work and extended periods at sea. Furthermore, technological advances and capital substitution combined with improved management has reduced the labour intensity in many fisheries.

---

8 OECD (2010). *The Economics of Adapting Fisheries to Climate Change*, OECD Publishing. Paris.

9 Several other challenges are listed in the OECD publication *Towards green growth. A summary for policy makers*, OECD, Paris but these are not directly linked to common challenges in fisheries.

62. To address low human and social capital in fisheries, policies that provide more certainty about the future of the industry can be useful. Educating fishers and the introduction of fisheries management measures that lead to sustainable futures will induce young people to engage in fisheries and fisheries related activities. Concurrently, a higher level of education may also help foster innovation in fisheries. More flexible labour markets and retraining can also encourage a more fluid exit/entry from fisheries.

5.2. Incomplete property rights and subsidies

63. It has been well established that many of the problems facing the world's fisheries are due to absent or incomplete property rights. Overfishing and overcapitalisation are the most apparent results, but they are far from being the only ones. Other problems include illegal, unreported and unregulated (IUU) fishing, waste of fuel and other inputs and a race to fish.

64. Subsidies are common in many fisheries and many are harmful from a green growth perspective as they distort prices and lead to economic sub-optimal use of resources.[10] Fuel is subsidised by means of tax concessions in many fisheries, leading to excessive use of fuel, waste, pollution and greenhouse gas emissions.

65. Many policy options are available to address the issues highlighted above. Removal of subsidies is necessary. Property rights can be created at many levels, that is, for individuals, companies, specific groups or communities. Property rights based systems do not only create economic benefits but also help in creating stability, predictability and sustainability in fisheries and can replace more traditional flanking measures, such as monetary transfers (OECD, 2006). The latter points to the importance of ensuring a coherent set of policies across the fisheries governance system.

5.3. Regulatory uncertainty

66. Most fisheries operate under complex regulatory frameworks. Uncertainty in the application of regulatory frameworks can work as an impediment to green growth adding an additional layer of uncertainties to uncertainties linked to natural fluctuations in stock abundance. For example, stopping fishing activities when quarterly fishing quotas have been exhausted is an uncertain event for fishers and may lead to the use of excessive effort (including fuel) around expected closure time.

67. Good governance of fisheries requires a predictable set of management rules and processes (OECD, 2012). Regulatory uncertainty can be reduced, for example, by setting explicit targets. Transparent and predictable rules help fishers and stakeholders in planning. This holds true for a wide variety of targets such as TACs for different species, as well as other parameters of fisheries management.[11]

68. Many fisheries take place outside national jurisdictions where many of the policy options are not easily applicable. However, governance structures and mechanisms are in place to strengthen the management of such fisheries. With the development and entry into force of the United Nations Fish Stocks Agreement in 1995, the international community made a commitment to strengthen Regional Fisheries Management Organizations (RFMOs). Sustainably managing fisheries through RFMOs has

10 See for example "Environmental Harmful Subsidies: Policy Issues and Challenges" OECD, 2003.

11 One example of this is the Icelandic harvest rule for cod which aims at 20% catch rate of 4-year and older cod. See http://www.fisheries.is/main-species/cod/management_plan/nr/349

however proven to be a challenge. Earlier work by the COFI has provided insights into ways in which governments and RFMOs can be strengthened in order to make them more efficient in managing fisheries (OECD, 2009b). Also, the use of governance networks should be considered to pave the way for green growth on the international level (Slaughter, 2004).

69. Regulatory uncertainty is also related to the way in which regulations are implemented. IUU fishing exists inter alia because of difficulties in implementing the rules and regulations that are in place. Various remedies have been proposed and implemented such as restricting market access of IUU catches, use of eco-labels, traceability standards as well as other measures that disclose information about the origins of catches and catch method.[12] At the international level the FAO has developed an “International Plan of Action to Prevent, Deter and Eliminate IUU Fishing” (FAO, 2001).

5.4. Information externalities

70. The fact that information is not always credible or easily communicated along the value-chain can hinder green growth in fisheries. For example, if green growth practices are in place but this information unavailable in the market place, consumers cannot to make informed buying decisions.

71. There exist policy instruments that can be used to overcome such information externalities. Labelling and certification schemes can be of great help in identifying green growth products and processes.

3.2.5 Environmental externalities

72. Environmental externalities abound in fisheries. The harvesting activity itself affects biodiversity and many fishing gear affect the marine habitat. Fishing and processing does also have environmental effects through emissions and pollution from waste and processing.

73. Marine ecosystems are complicated webs and interactions between habitats, environmental conditions and a multitude of living species of many trophic levels. Given that many ecosystem services are not priced in the marketplace, government policies should aim at preserving or enhancing whole ecosystems.

74. An interesting feature of the ecosystem approach in fisheries is the emphasis on spatial management. Although spatial management have a long history in fisheries management, this approach focuses on sustaining the productive capacity of ecosystems which goes beyond the simple goal of creating safe-havens for spawning stock or vulnerable species.

6. Challenges for green growth in fisheries – political economy of reform

75. The introduction of green growth policies in fisheries may be challenging. According to the OECD, challenges to green growth can broadly be divided in two categories, that is, low short term economic returns and potentially low probability of returns. The OECD has proposed a set of policy options to address this implementation challenge. As Asche (2011) points out the barriers to implementation of green growth policies is the classical tension between sound long-run fisheries policies that require investments against short-term aspiration of some stakeholders. Different fisheries stakeholder groups have different expectations on what a green growth reform may produce. Should stakeholders

---

[12] The OECD hosted a Workshop on IUU fishing in 2004. The chair’s report with key findings can be found at www.oecd.org/fisheries.

perceive that their welfare is at stake, reform may be difficult to implement unless compensation measures are proposed.

6.1. Employment and other social issues

76. Green growth policies will affect fisheries employment all along the value chain. For example, rights based management systems may be very effective in reducing fishing effort and may have positive fish stock effects, however, it may also lead to a reduction in overcapacity including a reduction in the number of persons employed. The introduction of green growth strategies may also effect labour composition, including gender.

77. Therefore, green growth policies may be met with scepticism from stakeholders, in particular if there are few alternative employment opportunities available. The OECD has done extensive work on how to ease the transition of employment from one sector to another (OECD, 2006). Other policy areas (e.g. education, labour market flexibility, retraining, early retirement programmes) may be brought to bear to ease the adjustment burden and make reform acceptable.

Box 3. The importance of stakeholders involvement in green growth

Designing and implementing a green growth strategy for fisheries is not solely a technical issue but requires specific actions by stakeholders. Some of the common "governance failures" for traditional fisheries management systems are likely to resurface in the green growth context. There are many reasons for governance failures including; special interest effects, short-sightedness and decoupling of costs and benefits. The special interest effect may run counter to welfare enhancing reforms as the interests of some stakeholders are not aligned with the green growth strategy. Some stakeholders might feel threatened by the strategy, and will resist reform. This may call for mitigation mechanisms or side-payments. Various forms of rights based systems, such as individual quota systems or community management measures can also align stakeholders' interests with welfare enhancing reforms, although other challenges may surface such as the distribution of benefits.

Tensions between different stakeholders can be addressed by making use of the elements of good governance, i.e. *inclusiveness*, *empowerment*, *transparency*, *flexibility*, and *predictability*. These elements are important in two important stages of green growth reforms in fisheries; i) determining and agreeing on the status of the sector and the objectives of the reforms; ii) decisions regarding the mechanisms used to achieve the objectives. Defining the role of different stakeholders (inclusiveness and empowerment) in a transparent and flexible process is a prerequisite for successfully implementing green growth strategies in fisheries. Enhanced predictability can be achieved by having clear rules and processes as well as collecting and disseminating relevant information using the best available scientific methods.

Source : OECD, Ostrom (1990), Sutinen (2008), Arnason (2007). Arnason (2010), Cox *et al.* (2010), OECD (2011b), OECD (2012), OECD Principles of Good Governance, http://www.oecd.org/gov/principalelementsofgoodgovernance.htm

6.2. Industrial policies and green growth

78. Many policies are directly aimed at controlling or supporting the fishing industry itself. Common are fleet and capacity policies aimed at matching capacity to available resources, which are clear green growth policy measures. As previously discussed, the OECD has provided guidelines on how to implement decommissioning schemes (OECD, 2009a).

79. But industrial policies outside the fisheries policy domain may be counterproductive to green growth. One example is input subsidies, i.e. fuel, bait, ice, boat building. Such policies, which in some

cases are delivered by other government agencies[13] not directly involved in fisheries management distort real prices and incite wasteful use of inputs and are not making fisheries greener. Getting the prices right is a fundamental objective of greening fisheries (Nielsen *et al*., 2012).

80. There are many other activities than fishing that take place at sea, such as energy production (wind farming, oil extraction, wind energy, tidal energy), tourism, offal, gravel and mining, transport, pharmaceuticals and biotechnologies. These activities will compete for marine space, harbours, etc. and may have externality effects on fishing activities.

81. It is therefore important to give attention to policy coherence and great care must be taken in seeking to ensure that the different policies pull together in advancing the green growth. This underscores the importance of a more holistic approach to greening fisheries and in seeking synergies across policy domains.

6.3. The need to develop green growth indicators and measures

82. Measuring progress of fisheries towards green growth is important. An element in the design and implementation of a green growth strategy for fisheries is a set of green growth indicators that can measure the speed, path and the success of fisheries reforms. Some work has been done by the OECD in designing green growth indicators (OECD, 2011c). The OECD indicators proposed for green growth in fisheries are crude and may not be sufficient for the work of the COFI.[14] However indicators are central for monitoring and evaluating policy outcomes.[15]

83. As with other policy reforms that are intended to enhance welfare, it is necessary to have an estimate of the benefits that will accrue from the new strategy as well as the costs involved. The indicators should cover both monetary and non-monetary benefits, such as those not reflected in market prices. Cost indicator should include both monetary costs and non-monetary costs, such as environmental losses and social costs which do not necessarily have an observed market value. The lack of such indicators for fisheries is hampering governments and stakeholders in moving forward on designing and implementing green growth strategies. Additional work in this area is needed.

7. Conclusions and next steps

84. This paper has outlined how governance of fisheries fit into the OECD green growth strategy framework, discussed governance tools and the key challenges related to getting fisheries on a green growth path.

85. The OECD green growth strategy has identified five sources of green growth which also apply to fisheries i.e. increased productivity, innovation, new markets, enhanced confidence and stability.

86. Key messages from the above discussion are:

---

13 Tax rules, regional development agencies for example may affect the “subsidy level”.

14 Concurrently, the OECD’s work on Green Growth indicators includes only one indicator for fisheries, i.e. proportion of fish stocks (globally) within safe biological limits. 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 (OECD, 2011c).

15 Some progress has been made in benchmarking fisheries governance in general (Grafton *et al*., 2007) but expanding that exercise to green growth governance is not yet accomplished.

- Green growth strategies should improve the prospects for long term growth by reducing imbalances in natural systems that raise the risk of abrupt, highly damaging and potentially irreversible effects.

- In the short term, green growth may also constrain economic growth as traditionally measured as increase in GDP. This may happen where natural systems are depleted or otherwise in a fragile state calling for less current extraction.

- Good fisheries governance plays a key role in greening fisheries by aligning incentives towards creating the greatest social welfare for all.

- Good governance is characterised by inclusiveness, empowerment, transparency, flexibility and predictability of rules and processes for fisheries management.

- Policy makers have a wide variety of tools at their disposal to achieve green growth in fisheries such as market based tools, regulations, fiscal instruments and spatial policies. These may be delivered by different government and private agencies. It is important to ensure that the policies are coherent over the policy spectrum, e.g. with regards to taxes, regional policies, etc..

- Productivity in fisheries can be greatly enhanced by better management of the natural resource base and capital tied up in fishing. Rebuilding overfished stocks, reducing discards and by-catch and reducing overcapacity are all sources of green growth. Rebuilding fisheries and decommissioning schemes provide important tools to unleash such growth.

- A case has been made for fostering innovation in fisheries. Government intervention to spur innovation may be needed due to fisheries sector characteristics with fishing firms often without a capacity to do so themselves. Institutional innovations including in the delivery of fisheries management, control, surveillance and enforcement can also contribute to green growth.

- Governments can stimulate the demand for green fish products. Policies regarding specification and standards can be used for this purpose, as well as trade, education and development policies.

87. Achieving green growth in fisheries may encounter numerous challenges and constraints. For fisheries the most important ones are possible short term low economic returns to green growth policies. Policies that enhance human and social capital, as well as policies that reduce uncertainties in the fisheries will help. Removal of harmful subsidies and the allocation of property rights also play a part in addressing challenges to green growth. Furthermore, regulatory certainty based on a predictable set of rules and transparent fisheries management processes also helps.

88. The implementation of green growth strategies for fisheries may be challenged by stakeholders who may not be comfortable with fisheries policy reform. Transitional measures towards sustainable and efficient fisheries management systems may be needed.

89. This paper is a first step in analysing green growth perspectives on fisheries governance. The next step should include a more thorough analysis of the different sources and challenges for green growth governance in fisheries.

- One way forward is to compile and compare *case studies* on the implementation of green growth policies from different fisheries with the analysis focusing on how different governance set-ups and tools reinforce or undermine green growth. Such analysis could be based on the OECD green growth strategy framework.

- A prerequisite for advancing the green growth agenda in fisheries is to design *green growth indicators* for fisheries. Without such indicators it will be difficult to monitor and evaluate policy outcomes.

- Also, *cost-benefit analyses* for green growth strategies, mapping institutions and fisheries management objectives are needed. Such analyses should include elements of both monetary and non-monetary elements.

- An in-depth study on the *role of different stakeholder's* in fisheries governance for green growth could highlight various important issues, such as collection and dissemination of information, capacity building, incentives for green growth, empowerment and responsibilities.

- Green growth related to the international fisheries agenda is a little researched area. Analysing how Regional Fisheries Management Organisations, government networks and other mechanisms can be used to advance green growth in international fisheries could be a timely contribution by COFI.

REFERENCES

Arnason, R. (2007). Fisheries Self-manageme

nt under ITQs. *Marine Resource Economics*, Volume 22.

Arnason, R. (2010). Community Fisheries Management : What Structure and Why? *KMI International Journal of Maritime Affairs and Fisheries*. Vol. 2, Issue 2 (December).

Asche, F. (2011). *Green Growth in Fisheries and Aquaculture*, a consultant's report to the OECD, [TAD/FI(2011)6].

Ayalew, D. S. Dercon and M. Gantan (2007). Property Rights in a Very Poor Country. Tenure Insecurity and Investment in Ethiopia. *Policy Research Working Paper Series* No 4363. World Bank.

Beslay, T. (1995). Property Rights and Investment Incentives: Theory and Evidence from Ghana. *Journal of Political Economy*, Vol. 103, No. 5.

Clement, G., R. Wells and Charmaine Marie Gallagher (2008). Industry management within the New Zealand quota management system: the Orange Roughy Management Company. In FAO (2008).

Cox, M., G. Arnold and S. Villamayor Tomás (2010). A review of design principles for community-based natural resource management. *Ecology and Society*, Vol. 15, Issue 4.

de Vivero, J.L S., J.C. Rodriguez Mateos, D. Florido del Corral (2008). The paradox of public participation in fisheries governance. The rising number of actors and the devolution process. *Marine Policy*, Vol. 32.

European Commission (2011). *Attitudes of European entrepreneurs towards eco-innovation*. Analytical report", Brussels.

FAO (2001). *International Plan of Action to prevent, deter and eliminate illegal, unreported and unregulated fishing*. FAO, Rome.

Eggertsson, T. (1990). *Economic behavior and Institutions*. Cambridge University Press.

Garcia, S.M., A. Zerbi, C. Aliaume, T. Do Chi and g. Lasserre (2003). The ecosystem approach to fisheries. Issues, terminology, principles, institutional foundation, implementation and outlook. *FAO Fisheries Technical Paper*, No. 443, FAO, Rome.

Grafton, R.Q., T. Kompas, R. McLoughlin and N. Rayns (2006). Benchmarking for Fisheries Governance. *Economics and Environment Network Working Paper*. EEN0608. Australian National University.

Makino, M. (2008). Marine protected areas for the snow crab bottom fishery off Kyoto Prefecture, Japan. In FAO (2008).

Nielsen, M., L. Ravensbeck and R. Nielsen (2012). *Achieving green growth through improved regulation of fisheries and aquaculture*. Report prepared for the OECD Committee of Fisheries. OECD. Paris.

Nordic Innovation (2012). *Towards a new innovation policy for green growth and welfare in the Nordic Region*, Nordic Innovation Publication, Oslo.

OECD (2003). *The Costs of Managing Fisheries*. OECD Publishing, Paris.

OECD (2004). *Patents and Innovation. Trends and Policy Challenges*. OECD Publishing, Paris.

OECD (2006a). *Using Market Mechanisms to Manage Fisheries*. OECD Publishing, Paris.

OECD (2006b). *Boosting Jobs and Incomes. Lessons from the Reassessing the OECD Jobs Strategy*. OECD Publishing, Paris.

OECD (2009a). *Reducing Fishing Capacity: Best Practices for Decommissioning Schemes*. OECD Publishing, Paris.

OECD (2009b). *Strengthening Regional Fisheries Management Organisations*. OECD Publishing, Paris.

OECD (2010). *The OECD Innovation Strategy. Getting a Head Start on Tomorrow*. OECD Publishing, Paris.

OECD (2011a). *Towards green growth. A summary for policy makers*. (May 2011). OECD Publishing, Paris.

OECD (2011b), *Government at a Glance 2011*, OECD Publishing. Paris.

OECD (2011c), *Towards Green Growth: Monitoring Progress: OECD Indicators*, OECD Green Growth Studies, OECD Publishing, Paris.

OECD (2011d). *Fisheries and Aquaculture Certification*. OECD Publishing, Paris.

OECD (2012). *Rebuilding Fisheries. The Way Forward*. OECD Publishing, Paris.

Ostrom, E., (1990). *Governing the Commons: The Evolution of Institutions for Collective Action*. Cambridge University Press.

Pauly, D., J. Alders, E. Bennett, V. Chrisensen, P. Tyedemers and R. Watson (2003). The Future of Fisheries. *Science* 302 (November).

Pomeroy, R.S. and F. Berkes (1997). Two to tango: the role of government in fisheries co-management. *Marine Policy*, Vol. 21. No. 5.

Slaughter, A-M. (2004). The Power and Legitimacy of Government Networks, in Susan Stern and Elisabeth Seligmann (eds.) *The Partnership Principle. New Forms of Governance in the 21st Century*. Alfred Herrhausen Society for International Dialogue. Achetype Publications, London.

Sobol, M.L. and A. Craig (2008). Self governance in New Zealand´s developmental fisheries: deep-sea crab. In *FAO* (2008).

Sutinen, J. G. (2008). Major Challenges for Fishery Policy Reform: A Political Economy Perspective. OECD Food and Agriculture and Fisheries Working Papers, No. 8. Paris.

Van Hoof, L. (2012).A Green Sea;Towards a Fisheries Governance structure fostering Green Growth. Consultant report to the OECD. Paris.

附件 2 綠色成長議題報告：

2-2 能源與綠色成長：TAD/FI(2012)2/REV1

For Official Use TAD/FI(2012)2/REV1

Organisation de Coopération et de Développement Économiques
Organisation for Economic Co-operation and Development 14-Sep-2012

English - Or. English

TAD/FI(2012)2/REV1
For Official Use

TRADE AND AGRICULTURE DIRECTORATE
FISHERIES COMMITTEE

GREEN GROWTH AND ENERGY USE IN FISHERIES AND AQUACULTURE

Paris, 29-31 October 2012

This document is presented to the 110th session of the Committee for Fisheries under Draft Agenda item 3 ii) for APPROVAL.

Contact: Roger Martini (roger.martini@oecd.org)

JT03326257

Complete document available on OLIS in its original format

English - Or. English

NOTE BY THE SECRETARIAT

This document evaluates the determinants of energy use in fisheries. It is undertaken as part of the Committee for Fisheries' work on green growth in fisheries and aquaculture. This work was presented in preliminary form at the 109th meeting of the Committee for Fisheries. This version responds to the comments made at that meeting, in addition to being generally expanded. It is presented for approval.

TABLE OF CONTENTS

Tables

Figures

Boxes

GREEN GROWTH AND ENERGY USE IN FISHERIES AND AQUACULTURE

Introduction

1. The purpose of this report is to examine energy use in fisheries and aquaculture from a green growth perspective. The OECD "Green Growth Strategy" represents a set of principles that aim to ensure that policies can best promote economic growth that is sustainable and matched to public objectives. In the case of energy use in fisheries, there are several reasons to believe that looking at policies through the perspective of Green Growth principles is important:

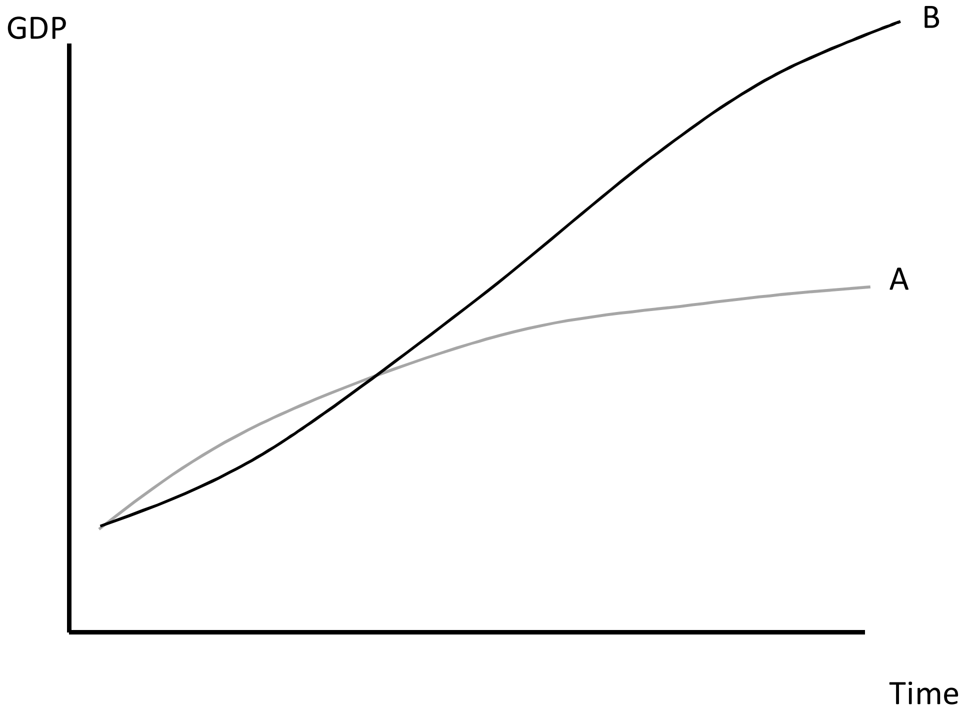
- Energy use is a strong proxy for the climate change impacts of the sector. Climate change is an important environmental externality that can have important and widespread long-term impacts. As such, many countries have objectives and policies in place to mitigate the risks of climate change. Good fisheries policies help the sector to contribute to climate change objectives.

- Energy, mainly in the form of diesel fuel, is a major component of the overall cost of fishing in many cases. Improved energy efficiency is one way to help improve the profitability of fisheries, which is an objective of fisheries policy in many OECD countries. Improved policy coherence can help improve efficiency while not compromising other objectives for the sector.

- Impediments can slow the adoption of new technologies or techniques that improve energy efficiency. Identifying and removing barriers that prevent cost-effective investments will improve efficiency and profitability.

2. The scale of energy use and efficiency in the sector is an outcome of the conditions and options facing fishers and aquaculture producers. Operators are acting to maximise their profitability as best they can, so the current situation is economically optimal in the sense that there are not systematic and predictable errors being made on the part of individuals. Consider two possible growth paths of the sector over time (Figure 1). Paths A and B both represent possible levels of economic activity over time. If we consider path A to be business as usual and path B to be a possible path of growth given some changes in the underlying policy environment, then we can define the "green growth" problem as finding the set of policy reforms that move the economy from path A to path B.

Figure 1. Possible growth paths



3. In the figure, path B is drawn as having slower growth in the near term with better long term growth prospects while path A has stronger short-term growth followed by stagnation. This is a commonly-seen metaphor in discussions of green growth principles: Near-term investments in sustainability lead to a longer term payoff in higher, more sustainable rates of growth.[1]

4. The importance of policy coherence and a broad view of policy impacts are central principles of the OECD Green Growth strategy. Recognising that improvements in energy efficiency are possible and that reductions in climate change emissions will be necessary should not immediately lead the policy maker to conclude that policies should be put in place to maximise fuel efficiency. This is because it is important to maintain policy coherence with other objectives in the fishery that could be harmed by a single-minded focus on efficiency. Not only should improvements in fuel efficiency be compatible with profit-maximising behaviour, any improvements in efficiency should be the result of choices that maximise profits in efficient markets. Anything else is unlikely to be sustainable as a policy. In particular, subsidies and market interventions are by definition distortions of markets and imply deadweight losses and other costs that bring their long-term sustainability into question.

5. This report has the following objectives. It will review the literature on the relationship between energy use and other aspects of the fishery, including the management regime, technology, and the range of behavioural options available to the fisher. It will synthesise the results of this literature review in order to draw conclusions as to the likeliest path for improvement, taking into account the OECD Green Growth principles. It will set the stage for future analysis of the potential benefits available from different policy

1. This is just an illustration and is unlikely to be true in every situation. One can imagine that in the case of fisheries, it depends on the current stock status and fleet size relative to optimal levels, among other things.

actions. While the document will have capture fisheries as a main focus, it will also evaluate energy use in aquaculture operations and from downstream in the marketing chain. The paper will conclude with recommendations for next steps for this work.

Assessing energy use in fisheries.

6. There exists a broad literature on the subject of energy use in fisheries, and more generally on the costs of fishing. There are many different ways to categorise this body of work. Energy efficiency can be considered on a fishery-specific basis, either by species or by gear type. It can be considered across countries, fleet types, or region. It can focus on the technical relationships between hull style, engine, propeller or other physical characteristics, or it can focus on the choice of the skipper regarding steaming speed or distance travelled to fishing grounds or to markets. Energy efficiency can be considered in terms of energy used per weight of fish caught or landed, or per value. The limitations imposed by the management regime can be studied, or the market forces at work, such as the price of fuel versus the price of fish.

7. Given the number of different angles at which one can approach this subject, there is no single best way to structure a discussion of the determinants of energy use. It is, however, useful to consider three main categories that divide along issues of technical efficiency, behaviour and the management system:

- **Technical efficiency** is the impact of investments in gear or vessel components that can increase fuel efficiency. That is, they increase fuel efficiency regardless of behaviour or management system. Some investments in efficiency may imply or require changes in vessel operation.

- **Behaviour** of the fisher or aquaculture producer describes the choices determining relative factor intensity between energy and other production inputs. Fishers can increase fuel efficiency by trading-off between time and other costs for example with respect to steaming time and other operational – on the fishing ground - choices.

- **The management system** sets the overall framework that is important in determining how energy is used by fishers. Not only can it shape decision-making, it can be decisive in technology and techniques of fishing through regulatory requirements. Most importantly, its effectiveness in maintaining a healthy stock status helps determine overall efficiency of fishing as measured by catch per unit effort (CPUE).

An Overview of Energy Use in Fisheries

8. The FAO (2006) estimates that capture fisheries consumed 41 million tons of fuel per year, costing USD 22 billion and corresponding to about 25% of the sector's revenue. Estimates of fuel costs over the past several years show an increasing share of costs of fuel over time (Table 1). OECD member country estimates of fuel costs are generally higher for mobile-gear fleets than for fixed-gear fleets that fish close to the coast (Table 2). For example, UK North Sea beam trawlers have fuel costs that can reach as much as 78% of all operating costs; while in some fixed-gear coastal fisheries fuel costs can reach a percentage as low as 3% to 5% of operating costs. While fuel costs are high as a share of total costs in fisheries, this does not imply that capture fisheries are inefficient relative to terrestrial food sources (Box 1).

Box 1. Fuel Consumption in fisheries vs. other food sources

Fisheries account for about 1.2% of global oil consumption and directly emit more than 130 million tonnes of CO_2 into the atmosphere. The energy content of the fuel burned by global fisheries is 12.5 times greater than the edible protein energy content of the resulting catch. While the fishing sector consumes a substantial amount of fuel, its use of energy is far more efficient than many other contemporary food production systems, a finding that flies in the face of some widely held perceptions of capture fisheries in general. This seeming incongruity between perception and reality may, in part, result from the relatively high proportion of total energy inputs, and resulting energy-related costs that accrue at the level of the fishing enterprise itself. In contrast, in the case of many other animal protein production systems, the majority of energy inputs tend to occur farther back in the production chain.

Source : Tyedmers *et al.* (2006)

9. Fuel use generally represents a higher share of costs in mobile-gear fleets. However, the "catch effectiveness" of fishing gear can make mobile gear more fuel-efficient per tonne landed than some fixed gears, e.g. Danish seine for mackerel vs. set nets for plaice. Higher value fish can be profitably targeted even when the required gear has higher fuel intensity - prawn is a good example of a high-value product with high fuel intensity.

Table 1. Fuel costs of developing and developed countries

as a percentage of revenue from fish landed

	1995-97	1999-2000	2002-03	2005[1]
Developing Countries				
Active demersal	17.19	30.28	26.15	52.30
Active pelagic	17.33	17.60	16.99	33.98
Passive gear	18.78	17.06	19.33	38.66
Average	18.52	20.65	21.63	43.26
Developed Countries				
Active demersal	10.57	8.64	14.37	28.74
Active pelagic	n.a.	7.65	5.48	10.96
Passive gear	5.57	4.95	4.61	9.22
Average	11.08	9.78	10.20	20.40
Global Average	14.85	16.70	18.53	37.06

1 Estimate

Source: FAO

Table 2. Fuel costs as a proportion of operating costs in selected OECD countries

Country and fishery	Fuel costs as percentage of operating costs
Australia	
Torres Strait prawn	39
Commonwealth trawl sector	23
Eastern tuna and billfish	17
Gillnet, hook and trap sector	10
France	
Chalutiers de fond exclusifs (12-16m)	22
Chalutiers drageurs (12-16m)	16
Arts dormants (12-16m)	7
Iceland	
Pelagic trawlers / purse seiners	15
Trawlers	13
Freezer trawlers	15
Coastal vessels (<10m)	3
Norway	
Trawlers	19
Purse seiners (blue whiting)	15
Purse seiners (other)	12
Pelagic trawlers (herring, blue whiting)	20
Trawlers (cod)	20
Coastal vessels (<13m, cod)	5
Spain	
Mediterranian National waters/longliners	35.4
North Atlantic national waters/longliners)	30.5
North Atlantic No-National waters longliners	31.5
Ùnited Kingdom	
North Sea beam trawl (over 300 kW)	78
Area VIIA nephrops twin-rig trawl	38
Irish Sea demersal trawl	36
UK pelagic (over 40m)	25
UK pelagic (10-40m)	16
Potters and creelers (over 12m)	12

Source: Vieira and Hohen (2007), Vieira *et al*. (2007), Seafish Industry Authority (UK). Planchot and Daures (2008), STECF (2006).

10. In a study carried out in 1989, Watanabe and Okubo calculate the energy budget for several different fishing operations. While the data is quite old, the distribution of energy in the fish production process remains interesting (Table 3). They demonstrate that direct fuel use by vessel operations strongly dominates the use of energy implicit in other inputs, representing 92% of the total for large trawlers. As a proportion of total energy used, direct fuel use is even more important than as a share of operating costs.

Table 3. Estimated annual energy input per fisheries management unit for selected types in Japan

10^9 kilocalories

	Large Pacific Trawl	Squid Angling	Tuna long-line	Salmon drift net
Energy input				
Fuel oil	20.20	1.63	9.92	0.40
Boat building and repair	0.50	0.04	0.22	0.03
Gear manufacturing and repair	0.94	0.05	0.24	0.07
Bait	0.00	0.00	0.99	0.00
Ice	0.19	0.00	0.00	0.00
Casing	0.12	0.03	0.00	0.00
Misc. goods.	0.13	0.02	0.00	0.01
Building and Facilities	0.03	0.00	0.00	0.00
Total	22.11	1.77	11.37	0.52
Ratio of direct energy to total	0.91	0.92	0.87	0.77

Source: Watanabe and Okubo (1989)

11. A majority of recent work to identify the fuel intensity of fishing appears to have taken place in Norway, though a number of other countries have been studied. The results indicate that, as expected, active forms of fishing are more fuel intensive and that there is a great variation in the fuel intensity across country and gears (Tables 4 and 5). It is likely that the differences between countries are driven by the nature of the fisheries in those countries, differences in fleet size and age of vessels (perhaps policy-driven) and difference in stock size with respect to MSY as well as the management system in place. It is possible that fuel tax concessions play a role as well. The age of each study can also be a factor. Newer studies will show the effects of improved fishing technology (which should reduce fuel use per amount landed) and perhaps worsening stock status (which has the opposite effect). In particular, the Watanabe and Okubo data is quite out of date relative to the other studies cited.

Table 4. Fuel use by gear type, selected countries

litres diesel per kg fish landed

Country	Gear	Fuel use	Source
Australia	Danish seine, 16m vessel	0.48	*Thomas et al (2010)*
	Demersal trawl (prawn)	4.99	
Belgium	Beam Trawl 12-24m	3.10	*STECF (2008)*
	Beam Trawl 124-40m	3.50	
Denmark	Demersal Trawl or Seine	0.20	*STECF (2008)*
	Polyvalent Passive Gear	0.30	
Faroe islands	Pair trawlers	0.36	*Thomsen et al. (2010)*
	Large Single Trawlers	0.78	
	Large Longliners	0.24	
	Small Single Trawlers	0.50	
	Factory Trawlers	0.63	
	Pelagic vessels	0.08	
France	Demersal Trawl or Seine	1.90	*STECF (2008)*
	Polyvalent Passive Gear	3.40	
Ireland	Demersal Trawl or Seine 12-24m	1.40	*STECF (2008)*
	Demersal Trawl or Seine 24-40m	1.70	
	Pelagic Trawl or Seine 24-40m	0.20	
	Pelagic Trawl or Seine >40m	0.10	
Italy	Demersal Trawl or Seine 24-40m	4.40	*STECF (2008)*
	Polyvalent Passive Gear	1.70	
	Pelagic Trawl or Seine	0.30	
	Beam trawl	3.20	

Country	Gear	Fuel use	Source
Japan	Trawl-Mothership	0.01	*Watanabe and Okubo (1989)*
	Trawl-Large Pacifc	0.04	
	Trawl-Large Southern Ocean	0.08	
	Trawl-Large East China Sea	0.15	
	Trawl-Shrimp	0.09	
	Trawl-Medium offshore	0.09	
	Trawl-Medium offshore Pair	0.12	
	Trawl-Small coastal	0.08	
	Purse seine-one boat tuna	0.15	
	Purse seine-one boat sardine	0.02	
	Purse seine-large two boat	0.01	
	Purse seine-small one boat	0.01	
	Purse seine-small two boat	0.01	
	Saury dip net	0.06	
	Salmon gill net	0.18	
	Seine net-beach	0.01	
	Seine net-patch	0.05	
	Seine net-boat	0.08	
	Set net-salmon large	0.08	
	Set net-small	0.07	
	Tuna Long Line-Distant	0.40	
	Tuna Long Line-Offshore	0.20	
	Tuna Long Line-coastal	0.14	
Malaysia	Lines	0.19	*Smith (2007)*
	traps	0.24	
	gillnets	0.23	
	purse seines	0.25	
	trawls	0.40	
Netherlands	Beam Trawl 12-24m	1.80	*STECF (2008)*
	Beam Trawl 24-40m	4.60	
	Beam Trawl >40m	3.80	

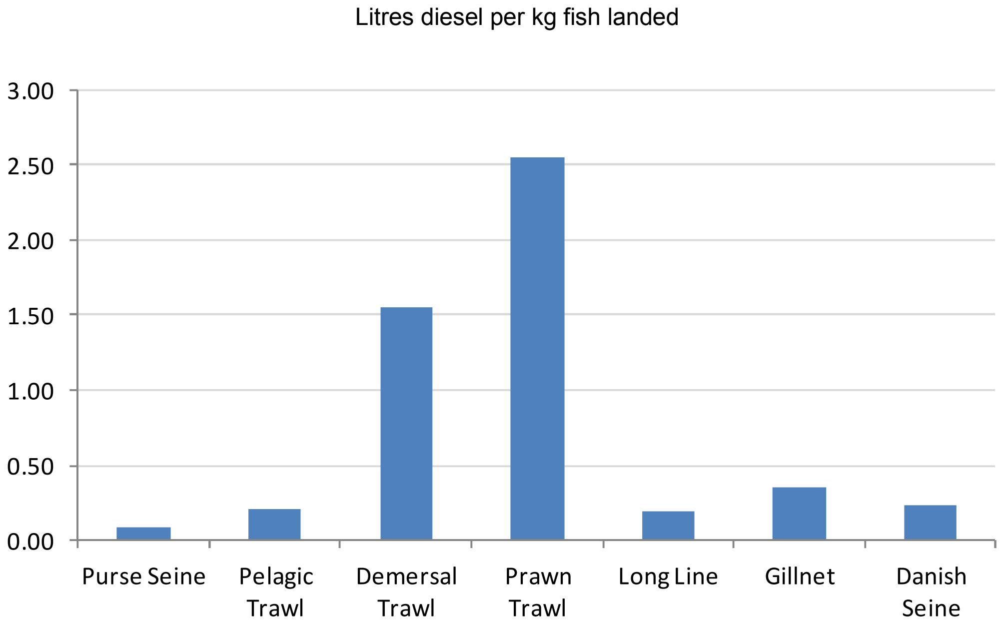
Table 5. Fuel use by gear type, selected countries (continued)

litres diesel per kg fish landed

Country	Gear	Fuel use	Source	Country	Gear	Fuel use	Source
Norway	Other long line	0.15	*Winther et al. (2009)*	**Sweden**	Gillnet	0.34	*Ziegler and Hansson (2003)*
	long line (Autoline)	0.31			trawl	1.41	
	Bottom Trawl (Bunntral)	0.43					
	Trolling Line	0.14			Creel	2.20	*Ziegler and Valentinsson (2008)*
	Pelagic line	0.10					
	Pelagic trawl	0.10			Net, <12m	0.25	*Swedish Fisheries Agency (2007)*
	Pelagic pair trawl	0.09			Net, 12-24m	0.47	
	Hand line/jig	0.15			Cages and traps <12m	1.29	
	Gillnet	0.15			hook vessels	0.45	
	Purse Seine	0.09			nephrops (creel)	1.42	
	Danish Seine	0.12			nephrops (trawl) <12m	2.54	
	Undefined gillnet	0.25			nephrops (trawl) 12-24m	3.80	
	undefined seine	0.08			shrimp 12-24m	1.49	
					shrimp 24-40m	1.82	
	Bottom trawlers	0.63	*Eyjolfsdottir et al 2003*		demersal trawl <12m	0.87	
	Purse Seiners	0.08	*Tyedmers 2001 and 2004*		demersal trawl 12-24m	0.28	
	Long liners	0.03			demersal trawl 24-40m	0.41	
					Vendace <12m	0.26	
	Autolining	0.37	*Schau et al. (2009)*		Vendace 12-24m	0.24	
	Purse Seiners	0.11			Pelagic trawlers and seiners 12-24m	0.18	
	Shrimp trawling	1.25			Pelagic trawlers and seiners 24-40m	0.14	
	Bottom trawl	0.34			Pelagic trawlers and seiners >40m	0.13	
	Double trawl	1.21					
	pelagic trawl	0.11		**UK**	Demersal Trawl or Seine 12-24m	1.00	*STECF (2008)*
	gillnet	0.23			Demersal Trawl or Seine 24-40m	1.10	
	hand line and trolling line	0.18			Demersal Trawl or Seine >40m	1.40	
	Danish seine	0.11			Pelagic Trawl or Seine >40m	0.20	
	trap (crustaceans)	0.13			Beam trawl	2.50	
North Sea	Beam trawling	2.91	*Smith (2007)*	**USA**	Purse seine atlantic herring	0.02	*Driscoll and Tyedmers (2010)*
	Bottom trawling	1.43			Midwater trawl	0.11	
	Shrimp trawling	1.41			Pair Trawl	0.12	
	Mid-water trawling	0.69			Average	0.09	
	Gillnetting	0.81					
	Danish pair seine	0.82			Gillnet	0.29-0.56	*Kitts, Schneider and Lent (2008)*
	Danish Seine	0.20			Longline	0.38-.57	
					Otter Trawl	0.23-1.45	
					Pots/traps	0.92	
					Purse Seine	0.025	
					Mid-water pair trawl	0.49	
					Single mid-water trawl	0.1	
					Dredge	0.07-0.35	

12. Prawn trawling is the most energy intensive method studied, with demersal trawls also being relatively fuel intensive. Other forms of fishing have broadly comparable intensities (Figure 2). Considering the high variation in fuel use by different gear types, Driscoll and Tyedmers (2010) observe: "*While such large differences in energy performance between gears within a fishery seem remarkable, it attests to the fact that fuel costs, while never trivial, have clearly not dominated decision-making amongst skippers and vessel owners.*" The relationship between fuel costs and profitability is not obvious, depending on other input costs, the price obtained for fish, and spatial dynamics of the fishery and "catchability" i.e. how easy is it to catch the fish. Fuel subsidies may also play a role in sustaining fuel intensive techniques.

Figure 2. Fuel use by gear type, simple average of selected studies



Source: Winther *et al.* (2009, Eyjolfsdottir *et al.* (2003), Tyedmers (2001) (2004), Schau *et al.* (2009), Thomas *et al.* (2010), Thomsen *et al.* (2010), Ziegler and Hansson (2003), Smith (2007), Swedish Fisheries Agency (2007), STECF, Kitts, Schneider and Lent (2008).

13. Taking a look at fuel efficiency of harvest by species rather than gear reinforces the view that fishers are willing to spend more on fuel when the value of the targeted species is high. Prawn and demersal flatfish consistently are seen to exhibit the highest fuel consumption per landed quantity (Table 6). In particular, forage species such as mackerel or herring tend to have relatively low intensities of fuel use (Figure 3).

Table 6. Fuel use by species

Litres diesel per kg fish landed

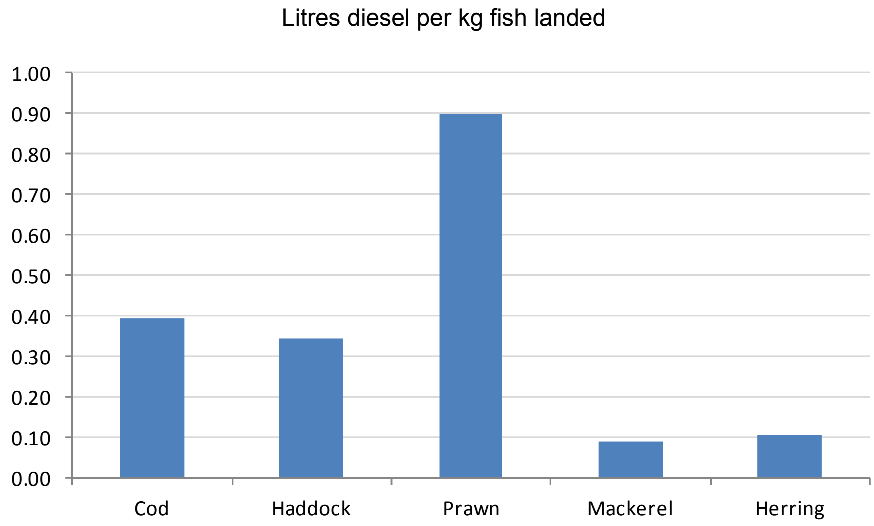
Country	Species	Fuel factor	Source	Country	Species	Fuel factor	Source
Denmark	Cod	0.36	*Thrane (2004)*	**Norway**	Cod	0.24	*Winther et al. (2009)*
	Flatfish	0.97			Haddock	0.29	
	Prawns	0.76			Saithe	0.29	
	Shrimp	1.03			Herring	0.09	
	Norway Lobster	6.05			Mackerel	0.09	
	Mussels	0.01					
	Herring	0.18			Cod	0.56	*Ellingsen and Aanondsen (2006)*
	Mackerel	0.06			pelagic for feed	0.08	
	Industrial Fish	0.06					
					Antartctic krill	0.19	*Parker (2011)*
Iceland	Capelin	0.02	*Agustsson et. al. (1978)*				
	Groundfish	0.28	*Eyjolfsdottir et. al. (2003)*	**Spain**	Atlantic Tuna	0.53	*Hospido and Tyedmers (2005)*
					Indian Ocean Tuna	0.45	
	Cod	0.23	*Fulton (2010)*		Pacific Tuna	0.63	
					Average all tuna	0.52	
Japan	Tuna	0.28	*Watanabe and Okubo (1989)*				
	Marlin	0.29			horse mackerel (trawl)	0.60	*Vasques-Row et. al. (2010)*
	Bonito	0.14			horse mackerel (purse seine)	0.21	
	Shark	0.22					
	Salmon	0.13		**Sweden**	Cod	1.01	*Ziegler and Hansson (2003)*
	Pacific herring	0.10			Nephrops	7.32	*Ziegler and Valentinsson (2008)*
	Sardines	0.02					
	Horse mackerel	0.02		**USA**	Atlantic Herring	0.09	*Driscoll and Tyedmers (2010)*
	mackerel	0.03					
	pacific Saury	0.06			Alaskan Pollock (trawl)	0.04	*Fulton (2010)*
	Flounder	0.08			Alaskan Pollock (catcher/processor)	0.10	
	Pacific Cod	0.07			Alaskan Pink Salmon	0.06	
	Alaska pollock	0.06					
	Crab	0.09			Groundfish/Flat fish	0.94	*Kitts, Schneider and Lent (2008)*
	Squids and cuttlefish	0.16			Groundfish/Round fish	0.73	
	Shellfish	0.05			Groundfish/Small mesh species	0.63	
					Summer Flounder	1.33	
Norway	Cod	0.35	*Schau et al. (2009)*		Scup	0.58	
	Herring	0.09			Black Sea Bass	1.12	
	Wolffish	0.34			Dogfish	0.36	
	Beaked redfish	0.48			Herring	0.09	
	Blue Ling	0.32			Mackerel	0.11	
	Blue Whiting	0.09			Scallops	0.36	
	Prawn	1.04			Monkfish	0.57	
	Dover Sole	2.45			Surf Clam/Ocean Quahog	0.07	
	Greenland Halibut	0.43			Squids	0.31	
	Haddock	0.4					
	Hake	0.29					
	Mackerel	0.09					
	Plaice	1.84					
	Turbot	2.08					
	Whiting	0.4					

14. Tyedmers (2001) conducts a similar review of energy use for capture of different species, using older data in many cases. The data indicates a trend toward lower energy efficiency over time, despite higher fuel prices:

"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 U.S. 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." (Tyedmers, 2001).

Figure 3. Fuel use by species, simple average of selected studies



Source: Winther *et al.* (2009), Eyjolfsdottir *et al.* (2003), Tyedmers (2001) (2004), Schau *et al.* (2009), Ziegler and Hansson (2003), Hospido and Tyedmers (2005), Ellingsen and Aanondsen (2006),Agustsson *et al*. (1978).

Technical Efficiency

15. Investments in improvements in the technical efficiency of fishing operations can yield benefits in terms of increased energy efficiency. Improving technical efficiency increases energy efficiency independently of behavioural choices or the incentives and requirements of the management system. It is worth returning to the point that this does not imply that all such investments are desirable - this depends on the return to such investments relative to other possible investments (in fisheries or elsewhere). From a policy perspective, the question is whether the policy environment may be altered to render such investments more attractive without compromising other policy objectives, including importantly the green growth principles of market-orientation and trade openness.[2]

16. Leaving aside the optimality of any particular investment in efficiency, this section will discuss some of the technical changes available to fishers to reduce the energy intensity of fishing operations. The range of possible improvements is large, but not all claimed improvements have been proven in practice. There are a number of modifications that are the subject of current research and development, and many of the products in the marketplace are associated with claims that cannot be independently confirmed.

2. This thread runs through this entire document; identifying a possible measure to increase energy efficiency is not sufficient to justify implementing that measure. Ultimately, investments need to be profitable for the fisher. The role of public infrastructure and policy in determining whether such investments are profitable is more relevant for the policy maker. For example, fuel tax concessions act as a disincentive to invest in energy efficiency by making fuel cheaper.

17. Potential areas for improvement are in hull design, propulsion systems, power-plants and engines, non-fishing power demand (mainly refrigeration), and gear modifications. The potential for improving fuel efficiency depends on the physics of energy (mainly diesel fuel) transformation into useful work (Box 2).

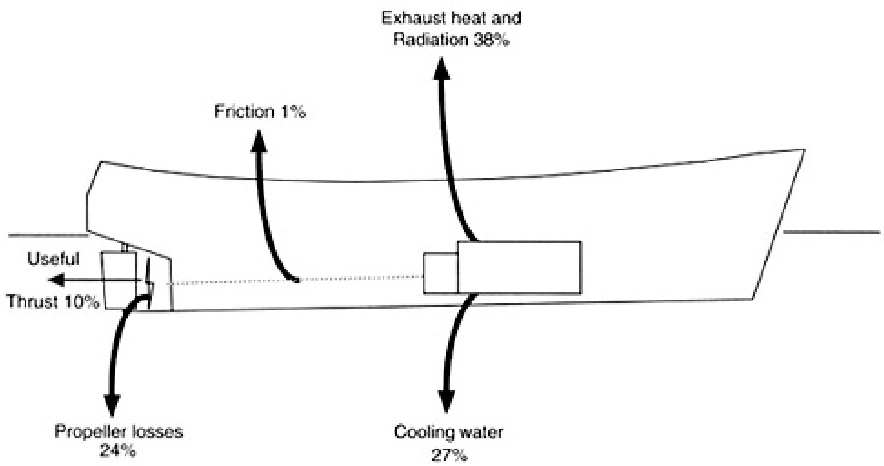
Box 2. Sources of Inefficiency

In addressing the problem of energy efficiency it is useful to understand just where the energy is expended in a fishing vessel and what aspects of this can be influenced by the operator, boat builder or mechanic.

In a small slow-speed vessel, the approximate distribution of energy created from the burning of fuel is shown in the figure below. Only about *one-third* of the energy generated by the engine reaches the propeller and, in the case of a small trawler, only one-third of this is actually spent on useful work such as pulling the net.

In a vessel that does not pull a net or dredge, of the energy that reaches the propeller:

- 35% is used to turn the propeller;
- 27% to overcome wave resistance;
- 18% to overcome skin friction;
- 17% to overcome resistance from the wake and propeller wash against the hull; and
- 3% to overcome air resistance.



Source : Wilson (1999)

18. The Institute for Marine Resources and Ecosystem Studies produced a report for the European Commission (IMARES 2006) that considers a number of different technology adaptations. This research covers independent work carried out in study countries as well as research comprising vessel case studies and simulation analysis (for larger modifications such as hull optimisation). They find that the benefits of different technological adaptations vary by vessel type and location such that generalised conclusions are

hard to reach. It is clear that there are a number of technologies available and more under development that have the potential to reduce energy costs and increase profits.

19. The IMARES study does identify some adaptations that are more likely to be feasible (Table 7). The authors estimate that the extent of feasible improvements in energy efficiency by technical or operational improvements for a fishing vessel ranges from between 5% and 30%. They note that the investment decision in improvements is very sensitive to the price of fuel, which is itself quite volatile. This volatility may delay investment decisions that may be profitable at a given moment but would be undesirable at lower fuel prices.

20. Many of the improvements cited in the literature refer not to overall fuel efficiency, but only to the efficiency gain for the particular system under investigation[3]. The role of that system in overall efficiency has to be considered to determine the potential net gain (see Figure 15 for an example of this calculation). Bjorshol (2007) cites research demonstrating gains from using two ducted propellers instead of one. He also points out the potential from recovering the 60% of energy in diesel fuel that is lost as waste heat, either to supply on-vessel heating requirements or to generate electricity. Van Balsfoort, and Grandidier (2006) describe the efficiency gains and other benefits of the “pulse beam” modification to beam trawlers in The Netherlands. This design, which uses a hydrodynamic beam and replaces beater chains with electrical stimulation, also claims to reduce damage to the sea floor.

21. Sterling and Klaka (2007) identify a number of factors that increase resistance and reduce efficiency, including inefficiently designed rudders, poor trim, and hull appendages such as transducers or cooling ports. They suggest a number of improvements that could be retrofitted to existing vessels.

22. In most fisheries, towing gear represents the largest share of energy use. This mode of activity has the highest energy consumption and also usually the largest share of total operational time. However, in squid jigging operations, more than half of energy consumption is via lighting systems to attract shrimp. The potential energy savings by replacing a portion of the conventional metal halide lights with low-consumption LED versions can be up to 24% (Matsushita *et al.* 2012).

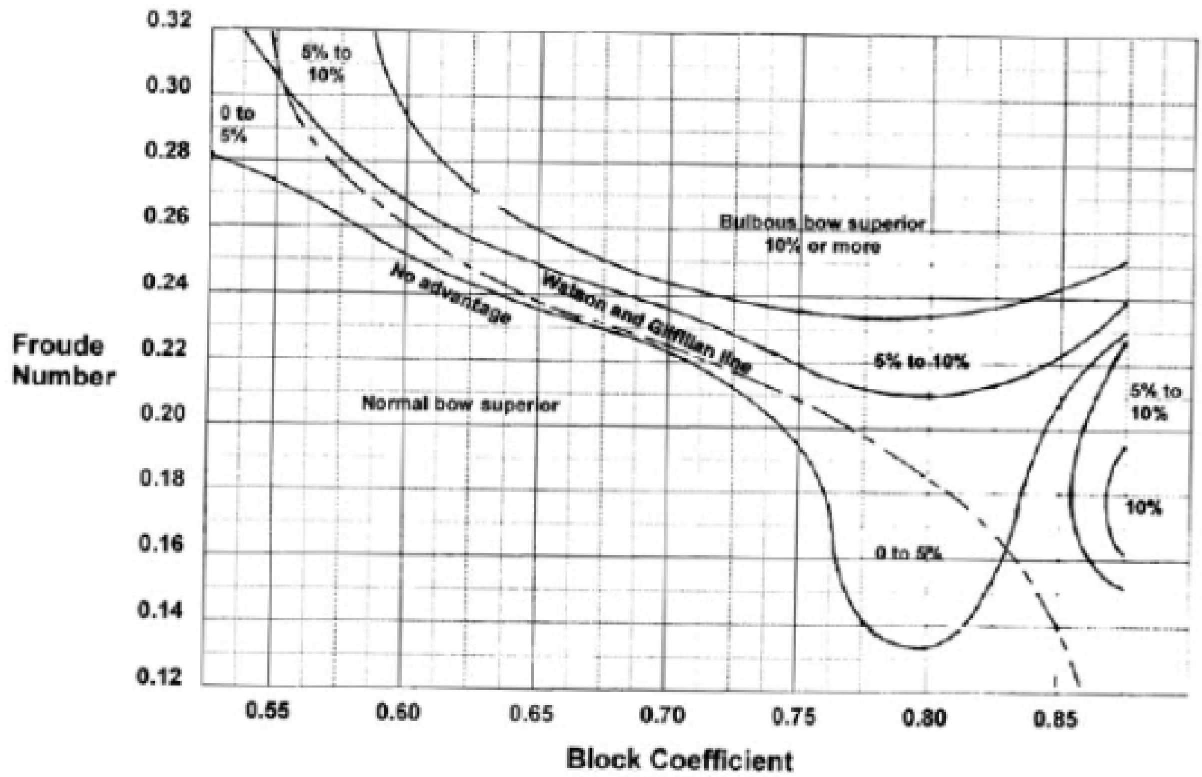
3 . For example, an improvement in the efficiency of the vessel propeller of 20% does not mean the overall fuel efficiency of the vessel has improved by 20%. If the propeller losses amount to 24% of the total energy used while steaming, a 20% improvement in propeller efficiency leads to a 4.8% improvement in overall vessel efficiency.

Table 7. Technical improvements to energy efficiency

Modification	Potential improvement *percent*	Comments	Source
Vessel Design			
Optimised Hull Shape	22	Total fuel saving based on simulation with respect to IT 606hp boat	IMARES (2006)
Bulbous Bow	6	Total fuel saving based on simulation of IT 606hp boat	IMARES (2006)
Additional Wind Power	20	Total fuel saving based on vendor estimate BE 1300hp vessel	IMARES (2006)
Reduced Hull protrusions	20	Change in total hull drag for all componenets	Sterling and Klaka (2007)
Bulbous bow	10	Reduction in hull resistance	Thomas et. al (2010)
Aerofoil rudder	4	Compared with flat rudder	Sterling and Klaka (2007)
Propulsion System			
Larger Propeller Diameter	4-15	Total fuel saving based on IT 606 and NL 2000hp vessels	IMARES (2006)
Fitting a Nozzle	18	Total fuel saving based on IRL 2000hp vessel	IMARES (2006)
Optimising Bollard Pull	1.5-4	Total fuel saving based on IRL cases	IMARES (2006)
Replacing fixed pitch with controll	4.5	Total fuel saving based on IT 606hp vessel	IMARES (2006)
Ducted propeller	20	For trawler	Wilson (1999)
Dual ducted propeller	20	With respect to single ducted propeller	Bjorshol, Nils Harald (2007)
Gear Design and Replacement			
Modified design and optimised components	5-25	Total fuel saving based on IRL 2000hp vessel	IMARES (2006)
Gear Replacement	15-50	Highest investment for IRL 700hp; highest saving for BE 1300hp	IMARES (2006)
Dynex Warps	5-15	Based on IRL cases	IMARES (2006)
Trawl lights	5	Change in total fuel efficiency due to bycatch reduction	Gaston et. al. (2012)
Hydrodynamic pulse beam	40	Improvement in total fuel efficiency over traditional beam trawl	Van Balsfoort and Grandidier (2006)
Power Systems			
Replacing Auxillary engines	15	Total fuel saving based on IRL 1000hp vessel	IMARES (2006)
Improved fuel quality	0.75	Total fuel saving based on UK 653hp vessel	IMARES (2006)
Switch to heavy fuel oil	6.7	Total fuel saving based on IRL	IMARES (2006)
Fitting a fuel meter	6.5-11	Total fuel saving based on Irish 606hp vessel	IMARES (2006)
Engine after-cooling	10	With respect to non-after-cooled motors. Improvement is with respect to fuel consumption per power output	Ziegler and Hansson (2003)
Waste heat capture	13	for heating or electrical production	Bjorshol, Nils Harald (2007)
Maintenance			
Antifouling	7	Reduced hull efficiency after one month without treatment	Swedish International Development Authority/FAO, 1986
Antifouling	44	After six months without treatment	Swedish International Development Authority/FAO, 1987
Propeller maintenance	4	Reduction in propeller efficiency after 12 months use without maintenance	Wilson (1999)
Engine maintenance	5-8	Total fuel saving based on Irish 606hp vessel	IMARES (2006)

23. Adding a bulbous bow can increase vessel efficiency by reducing wave resistance. Whether it provides a benefit depends on the Froude Number (speed divided by vessel length) and the Block coefficient (vessel cross-section), but an improvement of 10% can be achieved in the best case (Figure 4).

Figure 4. Benefits of a bulbous bow



Source: Sterling and Klaka (2007)

24. When actively trawling, about 80% of energy is expended on towing the trawl. For this reason, improving the energy efficiency of the gear can lead to significant improvement in the overall energy efficiency of fishing. Suuronen *et al*. (2012) suggest a number of modifications that can reduce the drag of gear in water, or improve gear performance (Table 8). They also compare the relative strengths and weaknesses of different types of fishing gear (Table 9). Gaston *et al.* (2012) find that trawling efficiency is affected by bycatch when the volume of bycatch increases the codend drag. This is relevant for prawn trawling, where 80% of the catch can be bycatch. They propose a method that can reduce bycatch through using light to cause a phototactic response in small fish and crustaceans, causing them to avoid the net.

Table 8. Potential energy saving techniques and adaptations for demersal trawling

Technique/Measure	Effect	Constraints-Barriers
Use of thinner and stronger twines, super fibres, knotless netting, square mesh netting, T90 net, less netting, larger mesh size	Reduces the amount, weight and surface area of netting and increases water flow through the net, thereby reducing the overall drag.	High price and availability of materials; use of larger meshes can reduce the catch of marketable species and sizes; cost benefit analyses not carried out for most fisheries.
Use of smaller and/or multiple nets for species that exhibit poor avoidance behaviour to the presence of the fishing gear (e.g. shrimp, flatfish)	Reduces the overall netting surface area and thereby the weight and the drag without reduction in catch.	Policy, complexity of rigging, resistance to change.
Use of effective bycatch and benthos reduction devices (BRDs)	Allows the escape of unwanted species or sizes of fish and other unwanted objects thereby reducing the weight and overall drag.	Variability in performance, lack of technical support to test and optimize BRDs, loss of revenues of target species and sizes, perceptions.
Using four-panel design (instead of typical two-panel) in the belly, extension piece and codend, using square mesh netting in the belly.	Ensures easier installation of BRDs and better geometry and stability for the back end of the trawl.	Cost benefit analyses not carried out for most fisheries.
Use of hyrodynamic trawl doors and use of optimal warp length (that corresponds to optimal door efficiency).	Less drag (traditional trawl doors contribute up to 25-35% of the overall gear drag), less weight, better fuel efficiency.	Price, performance monitoring, control in different sea conditions and depths.
Use of raised or flying trawl doors where the weight element of the door is separated from the spreading element (doors can be flown above the seabed to open the trawl).	Better spread, less drag and less pressure on the bottom (less seabed disturbances).	Price, performance monitoring, control in different sea conditions, depths, not suitable for all species.
Better rigging of the gear, lighter ground-gear, shorter ground-gear, less discs and better rotation capacity, self-spreading ground gear, composite ropes, lengthened bridles, off-bottom bridles, lightweight warps, and proper matching of trawl net and trawl doors.	Lighter and reduced contact points to seabed, less seabed pressure, smaller impact area, less drag.	Performance monitoring.
Use of hydrodrynamic shape of floats, kites, beams, pulse trawls, SumWing-design	Reduced drag, reduced seabed contact.	Performance monitoring, speed dependence.
Converting from single boat trawling to pair trawling.	Reduces fuel consumption, less seabed damages.	Policy, human behaviour.
Improving real-time monitoring and control of gear with acoustic gear surveillance technology.	Maintenance of optimal gear performance, reduces energy consumption and bycatch.	Price, training.
Installing real-time camera observation system for informing skipper of fish beahviour and composition in the trawl.	Helps to maintain optimal gear performance, reduces bycatch and collateral impacts. The next step may be an active mechanism to release unwanted catch.	Price, training.
Improving navigation and fish finding, and improving knowledge on fishing grounds (GPS, electronic charts, sea-bed mapping)	Maximises catches and minimises time, energy and collateral impacts.	Price, training.
Use of speed controls, reduction of towing speed.	Reducing speed directly reduces the fuel consumption.	Human behaviour
Vessel and propulsion system optimisation, preventive maintenance of vessel and engine, change in trip planning practices.	Reduces fuel consumption.	Price, human behaviour.

Source: Suuronen *et al.* (2012)

Table 9. Advantages and disadvantages of different demersal gears

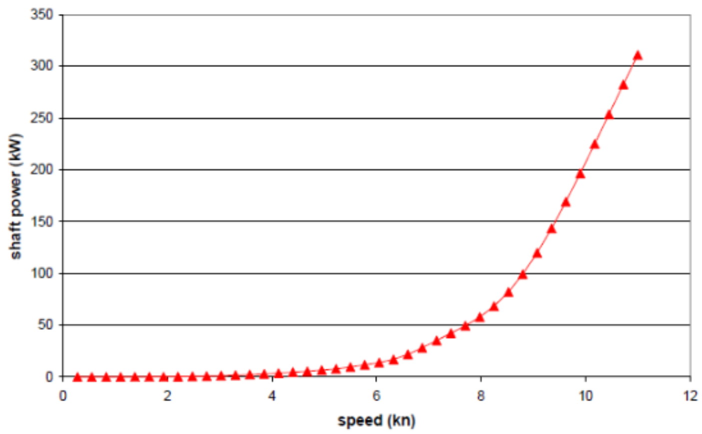
Gear	Advantages	Disadvantages	Priority actions
Trap-net and pound-net	Low energy use Selective for species and sizes (if properly designed) Live capture (possibility) Minimal habitat impact	Not easily portable Operation may be labour intensive Maintenance labour-intensive Expensive to construct Operation limited to relatively shallow waters Occasionally significant bycatches	Development of designs and practices that prevent the entangling of non-fish species in the mooring ropes and nettings of the trap
Pot	Low energy use Flexible and transportable Can be operated in rough bottoms Selective for species and sizes Live capture - good catch quality Portential for low bycatch mortality Minimum habitat impact Precadator safe Availability of wide variety of suitable local (natural) materials Cheap to construct	Low capture efficiency for many finfish species Ghost fishing of lost pot Lost pots contribute to marine debris Low catch rates	Fish behaviour studies to enhance ingress and reduce escape Alternative attractants Comparative fishing experiments De-ghosting technologies Human behaviour - barriers to a change Research and development work at infancy
Long-line	Low energy use Portable Flexible and versatile Species selective Minimal habitat impact Good catch quality Cheap to manufacture	Labour intensive and time consuming to operate Incidental bycatch of non-target species Snagging on benthic epifauna Availability and price of bait Low catch rate for many species	Bait issue/bait availability Alternative attractants
Gill-net	Low energy use Easily portable Versatile and flexible Good size selectivity (except trammel-nets) Possible to target specific size range allowing effective exclusion of small and large fish Relatively cheap to manufacture	Labour intensive Most fish die during capture Catch quality Poor species selectivity Capture of non-target species, often sea birds, turtles and other charismatic species Ghost fishing of lost nets Benthic impacts	Development of practices and technologies that reduce bycatch
Bottom seine	Relatively low energy use Possible to operate with low horsepower vessels Reduced bottom impacts compared to bottom trawling Requires less space than bottom trawling (possible to operate in small patches of good ground) Allows easy moving between fishing ground Relatively low gear costs Less gear damage and wear than in bottom trawl fishery Easier to use and repair (than bottom trawl) High fish quality Great scope for modifications and improvements	Not as flexible and effective as bottom trawling Operation limited to relatively flat and clean grounds (warps snag easily on boulders) Operation can also be restricted by depth, strong tides, bad weather and lack of daylight Not effective for non-herded animals such as shrimp and nephrops Operation requires good skills Workload can be relatively high Relatively poor selectivity for species and sizes Potential poor selectivity for species and sizes Potential sea bed impacts A large seine can be expensive to manufacture	Research and development work needed in improving the operation on rough grounds, in sea currents, and in deeper waters Substantial energy saving possibility Training is needed because the technology not well known
Beam trawl	Effective Relatively easy and practical to use	Seabed impacts High fuel consumption Bycatch Suitable only for relatively clean grounds Expensive	see Table 1
Bottom trawl	Effective Versatile	Seabed impacts High fuel consumption Bycatch Expensive Operation requires high skills and advanced equipments	see Table 1

Source: Suuronen *et al.* (2012)

Fisher behaviour

25. Changing operational procedures on the fishing vessel can lead to important changes in energy efficiency. The most important of these is steaming speed. Because the wave resistance of the hull increases dramatically as speed increases, at higher speeds a small reduction in speed can lead to significant improvements in fuel efficiency (Figure 5). For example, a 15m vessel that reduces its speed from 10 knots to 9 can increase efficiency by 40% (Sterling and Klaka 2007). Providing feedback on fuel-consumption by the use of on-vessel fuel consumption meters can help to change the behaviour of vessel captains (van Marlen and Salz 2010). This feedback quantifies the savings from slower speeds, but such savings will be compared against the opportunity cost of time in determining optimal speeds. These results are reinforced by a report by the Instituted for Marine Resources and Ecosystem Studes (IMARES 2009) which find potential overall system savings of up to 25% for reduced steaming speed and up to 40% for reduced towing speed. The IMARES report cautions that not all changes in fishing tactics are costless. Adapting vessels and gear for slower operating speeds can be costly, and there may also be a cost in terms of reduced catching efficiency and lower overall vessel productivity.

Figure 5. Required shaft power vs. speed for 15 m fishing vessels



Source: Hullspeed (2006)

26. Aside from steaming speed, gear choice and use are crucial determinants of energy efficiency. It is typically the case that passive gears are less fuel-intensive than active gears, and trawling usually has the highest level of fuel consumption per quantity of fish harvested. Fishers chose the most profitable gear, not the most fuel efficient one, but increases in the cost of fuel can motivate changes in gear choice over the long term. In addition, many factors complicate the decision to change gear types (Box 3).

Box 3. Considerations for changing gear type

As a rough estimate the costs of an average Belgian beam trawler can be split into 30% wages, 45% fuel and 25% other costs. Taking into account that almost the entire Belgian fleet consists of beam trawlers, this means that 45% of the value of all Belgian quota is spent on fuel… Today, many sea trips of beam trawlers are concluded with a financial loss for the vessel owner and it is clear that the beam trawler fleet is on the edge of not being profitable. Fuel is the critical factor and hits the beam trawler fleet very hard. On the other hand, there are examples in Belgium of fishing vessels carrying out a very profitable fishery based on passive fishing methods with a fuel bill less than 5% of the revenues. It is clear that profitable alternatives exist but a conversion is not straightforward. Problems of investment costs, conflicts between fishing methods, availability of sufficient quota and suitable fishing grounds, lack of fishermen's knowledge of alternative fishing methods, etc. can hinder a conversion. It is therefore necessary that potential alternatives are studied thoroughly so that realistic alternatives (in terms of vessel type and fishing method) can be presented to the industry and a restructuring of the fleet can start.

Source : Polet *et al*. (2006)

27. Changing fishing strategy can help maintain profits when fuel costs increase. Increased fuel costs have already led to some changes being observed. Some potential changes in strategy are as follows (Rossiter, 2006):

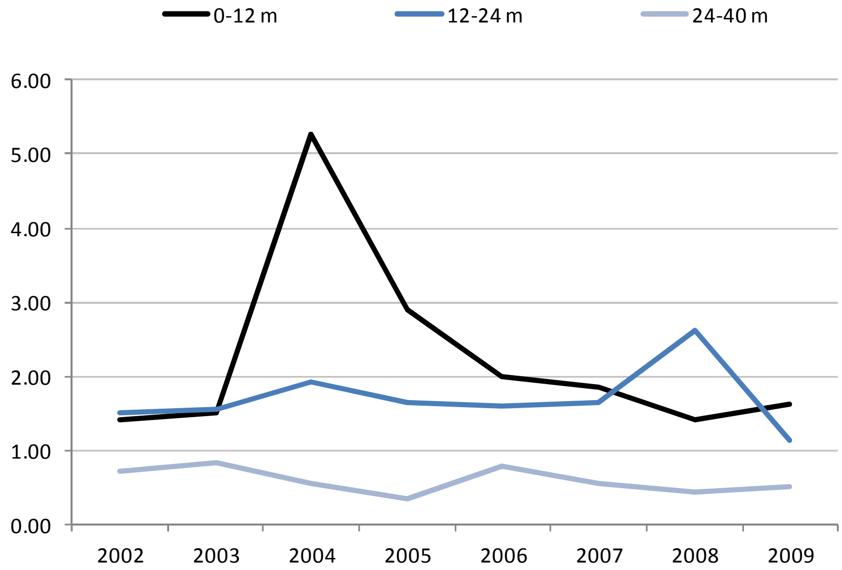
- Fishing on grounds closer to port, and focussing generally on inshore fisheries.
- Reducing effort during periods or conditions where CPUE is usually lower. This includes fishing in bad weather, fishing during tides and avoiding less "clean" fishing grounds.
- Changing the choice of port for landing catch, preferring ports closer to the point of catch to those with higher expected prices or home ports.
- Targeting (subject to quota availability and other restrictions) different species.
- Ceasing fishing activity entirely when fuel prices are high or fish prices low.

28. Fishers can also switch from single to pair trawling, where two vessels tow a single net. This can improve fuel efficiency by up to 10% (Wilson 1999).

29. For species such as *Nephrops,* Ziegler and Hornborg (2012) asks whether broadening the targeted species can bring improvements in efficiency: *an interesting question is whether it makes sense that fisheries target one species at a time or rather should harvest the ecosystem as it is composed in a sustainable way? The mixed fishery where Nephrops and groundfish are targeted together is fuel efficient compared to dedicated trawling for Nephrops, especially for the largest trawlers, which used more than 8 litres per kilo landed in the targeted Nephrops fishery* (Figure 6—compare with Figure 10).

Figure 6. Fuel use of Swedish mixed *Nephrops* fishery

litres per kilo landed



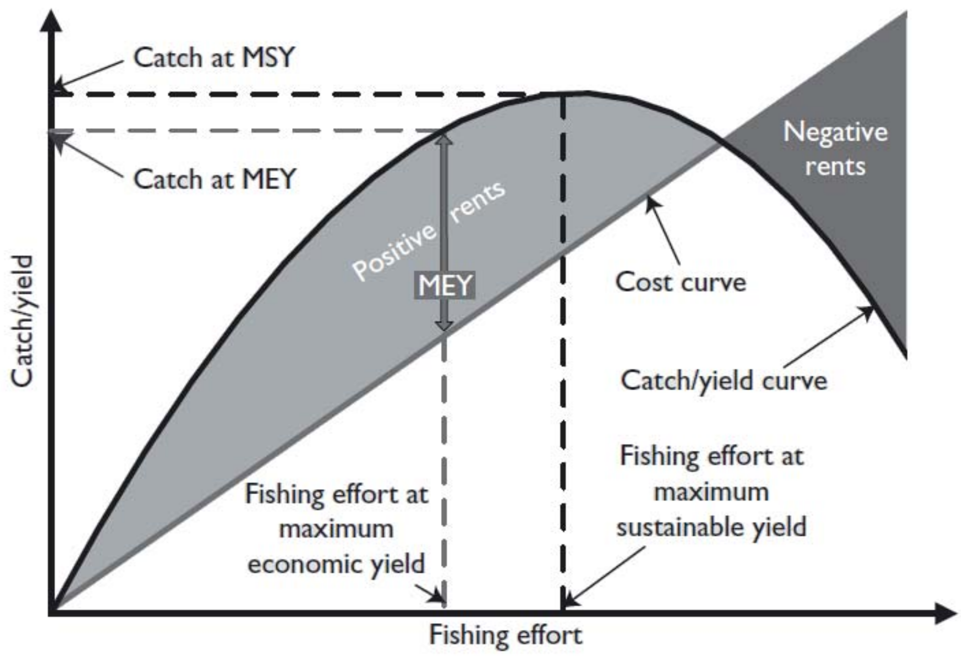
Source: Ziegler and Hornborg (2012)

Management regime

30. Changing the management regime – including technical requirements - is one of the more direct ways that the policy maker can influence the fuel efficiency of the fishing fleet. While it is unlikely that a first priority of fisheries management is energy efficiency, many changes in management seen as generally beneficial will also serve to increase fuel efficiency.

31. One of the most important single determinants of energy efficiency is the status of the fish stock. Depleted stocks, everything else being equal, lead to lower CPUE and therefore lower energy efficiency per quantity harvested. Maintaining stocks at maximum economic yield (MEY) can reduce fuel consumption by fishers by up to 50% and improve profitability generally by reducing effort and increasing the stock of fish (Figure 7). For example, fuel consumption by Icelandic fishers reduced by 45% after the introduction of the ITQ system that led to reduced numbers of vessels and improved fish stocks (Arnason 2010). Ishikawa et al (1987) studied a long-distance squid angling vessel to evaluate the relationship between CPUE and fuel consumption per kg harvested. They find that fuel consumption depends strongly on CPUE, and that the relationship between fuel consumption and CPUE is nonlinear, with small CPUEs requiring much larger amounts of fuel consumption. When CPUE is small fuel for steaming was the main energy demand. On the other hand, when CPUE is high, the majority of energy consumption is for refrigeration, lights and other on-vessel demands.

Figure 7. Profits vs. effort in fisheries



Source: World Bank (2009)

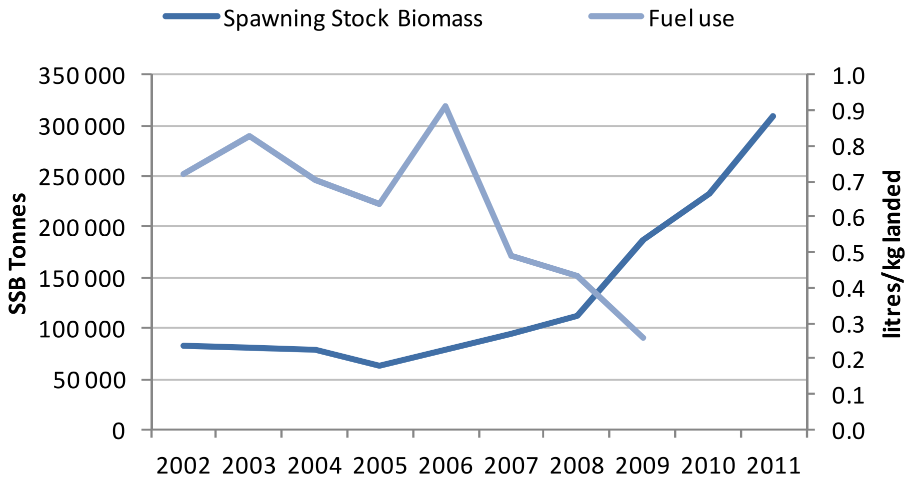
32. Improvements in energy efficiency subsequent to the introduction of an ITQ regime have also been observed in the groundfish fishery in eastern Canada (Grafton Squires and Fox, 2000) and the west coast Halibut fishery (Dupont and Grafton, 2001), as well as in Alaska longlining (Sigler and Lunsford, 2001). Deacon, Parker and Costello (2008) note that when management systems promote co-operation between fishers (in this specific case by allowing the formation of a profit-sharing cooperative), the result can be improved energy efficiency. This is because fishers can fish over a longer period of time, closer to port, and spend less effort searching for fish.

33. Mitchell and Cleveland (1993) demonstrate how much energy efficiency can decline when efforts above MSY lead to lower stocks and lower CPUE. In a study of the fishery in New Bedford in the United States, they observe a 500% increase in energy intensity of production between 1968 and 1988 due to the large increase in the fishing fleet over that period and the concomitant decline in stocks. This effect was observed more generally for US fisheries by Brown and Lugo (1981).

34. Ziegler and Hornborg (2012) consider the determinants of fuel use in selected fisheries in Sweden. They identify improved stock status as the cause for recent improvements in fuel efficiency of the Swedish fleet (Figure 8). *"With the positive development of SSB between 2009-2011, it is not unlikely that the fishery will become even more fuel efficient. The fishing gear used is the same and no other major changes in the management system have been made the Swedish fishery is today not limited by effort nor by quota and the increase in fuel efficiency hence mainly seems to be related to the improvement of the stock."* (Ziegler and Hornborg 2012).

Figure 8. Fuel use versus stock biomass of eastern Baltic Cod in Sweden, 2002-2011

Fuel use weighted average of three fleet segments



Source: Ziegler and Hornborg (2012)

35. Driscoll and Tyedmers (2010) study the New England Atlantic Herring fishery, where a ban on mobile gear led to a conversion to purse seine and a resulting significant increase in fuel efficiency. Factors of interest here are that trawling had displaced purse seine before the ban, possibly because of the ease with which trawlers can target multiple fisheries, and that a profitable purse seine fishery was able to arise after the change in regulation.

36. Weninger (1998) develops a model to predict the impact of introducing ITQ systems based on the theory that these systems can improve capital structure and allocative efficiency over time: "*Quota rights provide a mechanism to eliminate redundant capital that may have accumulated under the pre-ITQ management regime and encourage cost-efficient production once industry restructuring is complete. Benefits emerge as retired capital is employed in other more productive uses, and as remaining fishers exploit production economies under the ITQ operating rules. For example, the elimination of input controls and harvest time restrictions can improve (input) allocative efficiency and vessel capacity utilization on fishing vessels that remain active under the ITQ management regime.*"

37. The benefits that accrue from introducing an ITQ system in Weninger's model depend on the initial situation—how much excess capital is in the fishery and how great are the possible efficiency gains. Because restructuring can take time, the full benefits of moving to an ITQ system may not be seen for years. Premature evaluation of the effects of changing management regimes risks therefore underestimating total benefits. Weninger applies his evaluation method to the clam fishery in Maine, USA and predicts that the number of vessels would move from 128 to between 21 and 25 vessels with annual cost savings of between USD 11.1 million and USD 12.8 million (in 1998)[4] Brandt (1999), examining the same fishery, estimated that productivity under the ITQ system increased by 39.8% relative to the prior limited-entry system. While fleet consolidation and productivity improvements are only indirect indicators

4. More recent NOAA data states the size of the combined surf clam and ocean quahog fleet was 43 vessels in 2009 (http://www.nero.noaa.gov/nero/regs/frdoc/10/10SCOQ2011-2013FishingQuotasEA.pdf)

of the energy use in a fishery, such significant changes in industry structure would seem to imply a certain gain in energy efficiency of production.

38. Repetto (2001) used the scallop fishery off the coast of eastern Canada and the United States as a natural experiment on the impact of management regime. The resource is sedentary and harvest techniques are similar in the two countries, so the impact of different management systems should be observable. The Canadian fishery operates under an ITQ system while the US system was based on effort controls limiting days at sea, number of crew, and gear restrictions. The main observed differences are that Canadian fishers supported efforts to rebuild the stock, while US fishers continued to resist them. The Canadian scallop stock successfully rebuilt with a better age structure than the US stock.

39. In terms of the CPUE of the scallop fishery, Repetto observes that the catch-per-day of the Canadian fleet increased by a factor of four over the 1986-1999 study period, being seven times larger than the US catch per day at the end of the study period. Operating costs are seen to be a linear function of days at sea for scallop operations, though energy costs are not explicitly identified in his analysis. Improved stock abundance and significant reduction in the Canadian fleet size are behind the changes.

40. It is an open question as to why some fishing techniques continue to be used when more efficient alternatives exist (Ziegler and Valentinsson 2008, Ziegler and Hansson 2003, Hornborg *et al.* 2012). While part of the answer may have to do with excess capacity in other fisheries being available, there may also be reasons found in the management regime. For example, some quota allocations are made on the basis of fleet segment, with purse seiners and trawlers given explicit shares of the fishery. So long as both segments are profitable, such a fishery will continue to be pursued using mixed gears, regardless of the relative efficiencies of each.

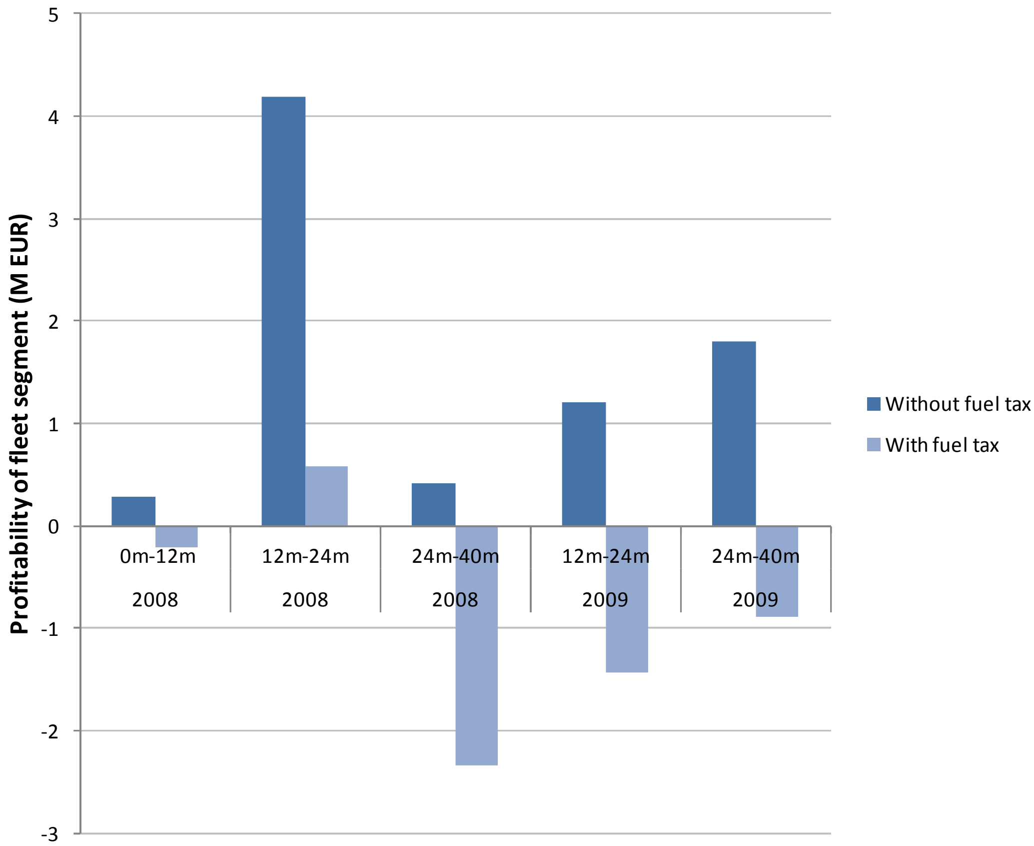
Support Policies

41. Fisheries support policies deliver financial transfers to fishers and many of the support policies will influence decisions regarding costs and hence energy use. Among the most important of these are fuel tax concessions, investment aids for vessels or gear, and capacity reduction schemes In this context, fuel tax concessions have received the most attention as they directly influence the cost of energy (as fuel) for fishers. These policies have also received attention for their potential conflict with broader environmental goals in terms of climate change and resource conservation.

42. Fuel tax concessions can be expected to favour fleet segments with higher fuel use. The more fuel consumed by a vessel, the higher the value of the transfer provided by the credit. In Sweden it was observed that demersal trawlers were highly dependent on tax credits to remain profitable (Ziegler and Hornborg (2012) (Figure 9).

Figure 9. Impact of fuel tax concessions on profitability of demersal trawlers

by vessel size, Million Euros



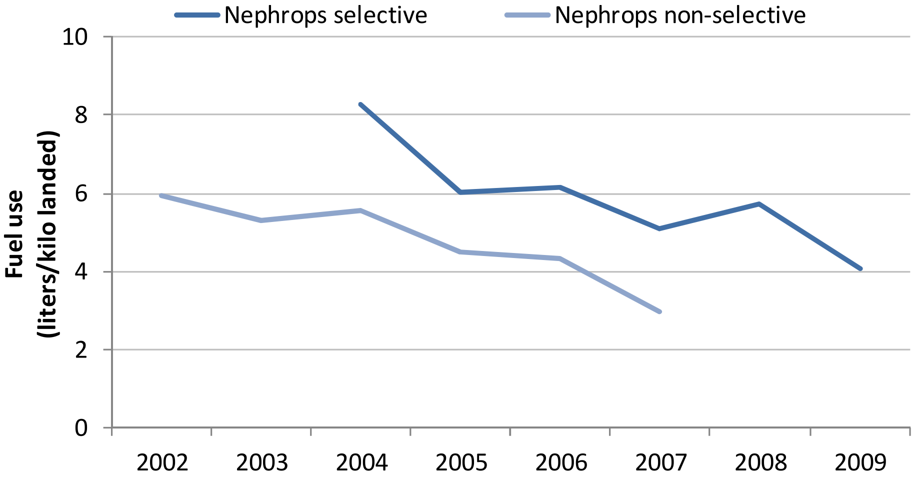
Source: Ziegler and Hornborg (2012)

43. The impact of investment aids and decommissioning schemes are more complicated. Investment aids for re-engining of vessels or other efficiency improvements have been justified on the basis of improved fuel efficiency, but they may also have a confounding expansionary impact on total fishing capacity.

Regulatory restrictions

44. Restrictions on gear use, such as those mandating bycatch reduction devices or similar, can influence the amount of energy required to harvest fish. Bycatch reduction devices can also reduce gear efficiency, so duration of trawls must increase to yield the same quantity of catch. For example, data from Sweden show that more selective gear in the *Nephrops* fishery led to higher fuel use per landed tonne (Ziegler and Hornborg (2012), Hornborg *et al.* 2012) (Figure 10).

Figure 10. Selectivity and fuel use in the Swedish *Nephrops* fishery



Source: Ziegler and Hornborg (2012)

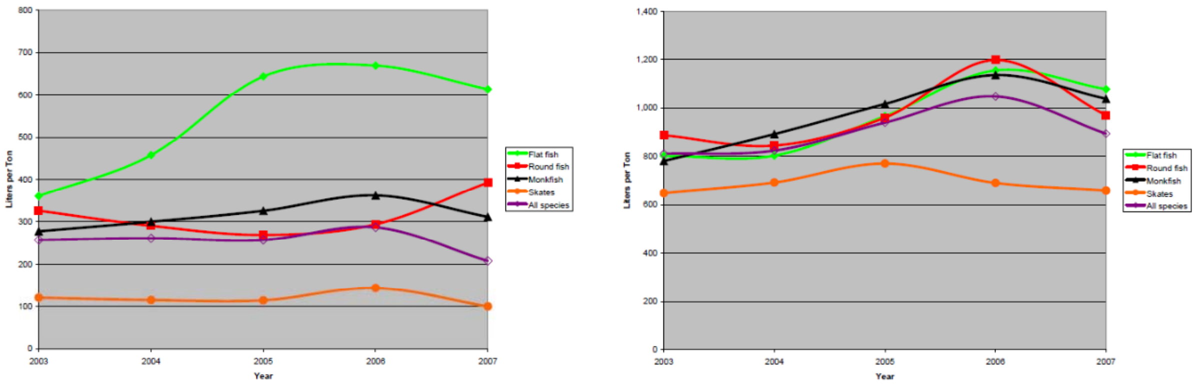
In the Northeast United States groundfish fishery, changes to regulatory restrictions on fishing may have led to higher fuel consumption per tonne landed (Kitts, Schneider and Lent 2008). This effect may also be a result of stock changes (Box 4). The authors found that after the regulatory changes, average days-at-sea for trips increased for all species, but some saw increased landings per trip (groundfish, monkfish) while others did not (flatfish).

Box 4. Trends in the NE USA Groundfish fishery

Northeast Fishery Observer Program (NEFOP) data was used to estimate annual fuel usage rates in the Northeast multispecies groundfish fishery during 2003 through 2007. Over the five-year time period, significant management changes have occurred -- particularly the implementation on 1 May 2004 of Amendment 13 to the Northeast Multispecies Fishery Management Plan. This amendment reduced the amount of fishing days allocated to the groundfish fleet, imposed limits on the amount of fish landed per trip, closed fishing areas, and established sector allocations and day-at-sea trading, among other measures. A number of subsequent management alterations also occurred from 2005 through 2007. Trips with combined landings of round fish, flat fish, monkfish, and skates greater than 50% of total landings were examined as these were most likely to be affected by the days-at-sea restrictions.

For gillnet gear, vessel fuel consumption rates for round fish, monkfish, and skates remained relatively constant during the 5-year period – at about 300 litres of fuel per ton of fish for round fish and monkfish and about 120 litres per ton for skates (see Figure). However, the rate for flat fish species increased from 360 litres per ton in 2003 to a high of 669 litres per ton in 2006 (an increase of 86%). For all four gillnet species categories combined, fuel consumption during 2003-2006 remained rather stable at about 250 litres per ton, but declined to 200 litres in 2007. For otter trawl gear, vessel fuel consumption rates for round fish, flat fish, and monkfish increased from about 800 litres per ton in 2003 to a high of about 1,100 litres per ton in 2006 (an increase of 38%). Fuel consumption rates for skates during 2003-2007 remained constant at about 700 litres per ton. For all species combined, otter trawl vessel fuel consumption increased from 800 litres per ton in 2003 to slightly more than 1,000 litres per ton in 2006, and then declined to about 900 litres in 2007.

Litres per tonne landed, Gillnet and Otter trawl



Source : Kitts, Schneider and Lent (2008)

45. Regulation on length and other vessel characteristics can also impact fuel economy, as more efficient hull shapes can be prohibited by specific effort restrictions (Ferlin and Weber 2010).

Processing and aquaculture

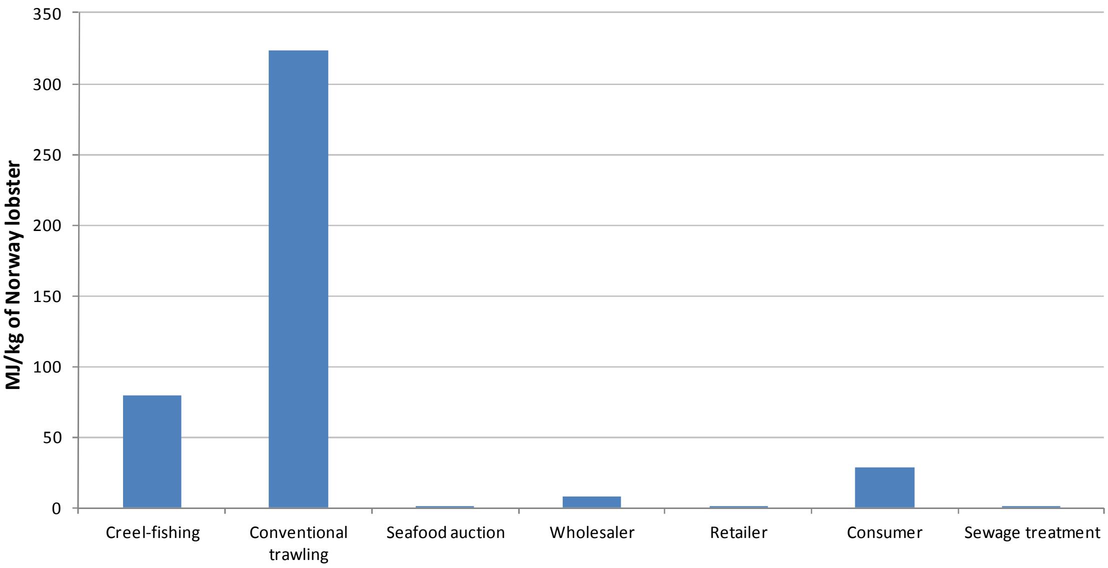
Life cycle analysis

46. Life cycle assessment (LCA) is a process of accounting for the different elements in the production chain of a particular good. LCA is a useful tool for understanding the total impact of a product on specific indicators. In this context, it provides some information on the contribution of processing and transportation to the total energy required to produce a fish product and deliver it to the market.

47. A majority of the energy used in the production of fish products (including aquaculture where wild fish are used as feed) tends to occur at the capture stage, and results from direct fuel inputs to fishing (Eyjólfsdóttir *et al.* 2003, Ziegler *et al.* 2003, Tyedmers 2004, Hospido & Tyedmers 2005, Thrane 2006, Pelletier et al 2009, WorldFish 2011), though there are some exceptions to this when airfreight is involved (Fulton 2010, Winther *et al.* 2009) or when the fishery has a very low energy use (Ziegler *et al.* 2011). While important in specific contexts, energy use by fleets other than direct fuel consumption (vessel construction, maintenance and gear) have not been found to be the crucial factors determining energy use in capture fisheries (Hayman *et al.* 2000, Huse *et al*. 2002, Ziegler *et al.* 2003, Tyedmers, 2004). For example, energy inputs into Salmon aquaculture are more than 90% from feed inputs (Pelletier *et al.* 2009). Tilapia production systems have had a reputation for being more efficient as the fish is omnivorous. But, even for pond-grown Tilapia, more than 50% of the energy inputs come from feed (Pelletier and Tydemers 2010). For Tilapia, only about 5% of feed is fish-based, while for salmon the percentage is closer to 40% (Pelletier *et al.* 2009). There are few studies that move beyond the processor to the retail/consumer stage, but energy use further down the consumption chain still appears to be small compared to that of the harvesting stage (Figure 11).

Figure 11. Energy use in the life cycle of 1kg of *Nephrops*; creel vs. trawl

Megajoules (MJ) per kilo



Source: Ziegler and Valentinsson (2008)

48. The long distances that fish products can travel between fishing ground, processing facility and final consumer has raised concerns on energy efficiency grounds. However, most LCA studies confirm that modern containerised transportation of frozen goods contributes a relatively small amount to the total energy used to produce and deliver fish products. This is because of the high fuel efficiency per kilo of this form of transportation. For example, for Tilapia fillets delivered from Indonesia to Rotterdam, transport makes up only about 10% of the total energy budget (Table 10). Transport mode can be an important part of total energy use in some cases, such as air freight for fresh rather than frozen products (Karlsen and Angelfoss 2000, Andersen 2001, Horvath 2006, Fulton 2010, Winther *et al.* 2009).

Table 10. Energy used in production of one tonne of frozen Tilapia fillets in Indonesia

Gigajoules per tonne

Fish Production	18.2
Processing	7.0
Packaging	2.1
Transport	3.9
Total	30.3

Source: Pelletier and Tydemers, 2010

49. Ellingsen *et al.* (2008) find that the energy use implied by different transport modes for export of fish products from Norway can be significant. They find that transport mode, speed and distance are more important than product form for the overall energy consumption. Changing from road and air freight to sea and rail can be more efficient, but replacing whole gutted fish by fish fillets and traditional refrigeration by superchilling would also reduce emissions (Table 11).

Table 11. Energy use of selected product and transport mode combinations

Chain	MJ/kg
Superchilled salmon fillets to Paris by ship/truck	2.9
Frozen salmon fillets to Paris by truck/train	3.3
Frozen salmon fillets to Paris by truck	5.3
Superchilled salmon fillets to Paris by truck	5.3
Frozen whitefish fillets to Paris by truck	6.4
Fresh salmon fillets in MAP to Paris by truck	6.8
Fresh low-processed salmon fillets to Paris by truck	8
Fresh gutted salmon to Paris by truck	10.1
Fresh gutted salmon to Poland and fillets to Paris by truck	13.3
Frozen gutted whitefish to Paris via filleting in China by ship	35.6
Superchilled gutted salmon to the US by high-speed vessel	52.8
Fresh salmon fillets to the US by plane	83.3
Fresh gutted salmon to Tokyo by plane	168.7

Source: Ellingsen *et al.* 2008

50. In processing, capital goods do not appear to be important relative to the impacts made by direct energy inputs to processing, though some types of packaging can be energy intensive (Thrane, 2006) (Box 5.). Other factors include product yield from processing and product loss between capture and market (Ziegler & Hansson, 2003; Boyd, 2008).

51. Winther *et al.* (2009) provide detailed calculations of the greenhouse emissions from capture fisheries and aquaculture, which is a close analogue to energy use, the main difference being the impact of refrigerants with a large greenhouse effect and biogenic emissions from aquaculture. They find a relatively

more important impact from transportation when compared with Pelletier and Tyedmers, but the conclusion that most of the energy is from fish or other inputs into feed production is supported by their research. They break down the energy inputs in some of the steps in processing salmon from aquaculture, showing that filleting is the largest component but a total much less than reported for Tilapia by Pelletier and Tyedmers (Table 12).

Table 12. Energy use in selected components of processing salmon from Aquaculture in Norway

	GJ/tonne
Slaughter	0.29
Filleting	2.69
Freezing	0.48
Drying	0.77
	Kj/Kg/day
Cold Storage	0.44
Frozen Storage	2.60

Source: Winther *et al.* (2009)

52. LCA considers the energy used in the production and use of inputs and at different processing stages. The scope of the analysis depends on the objectives and interests of the researcher, but typically covers the main inputs into capture plus an accounting of processing and transportation (Figure 12). When transportation is part of the analysis, specification of the origin and destination of the product is required, as is the mode of transportation.

Box 5. A closer look: Canned tuna

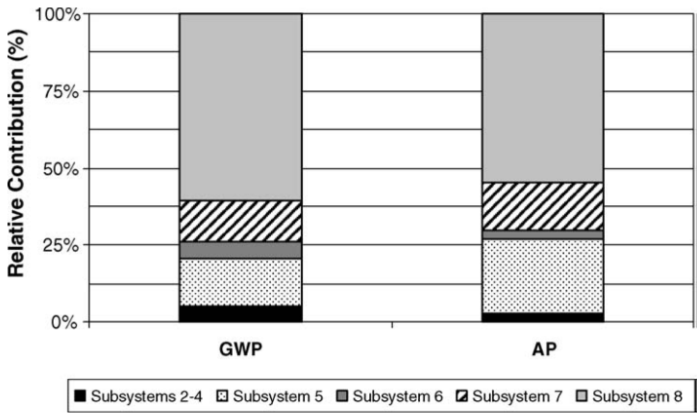
Hospido *et al.* (2006) examine the environmental impact of canned tuna manufacture. Unlike most LCA work in fish products, they exclude the catching sector to focus on processing. They divide the process into several subsystems as follows:

1. Transport of frozen tuna carcasses from port to factory
2. Reception, thawing and cutting
3. Cooking
4. Manual cleaning
5. Liquid dosage and filling
6. Sterilisation
7. Quality control and packaging
8. Ancillary activities.

They find the largest impact on global warming potential (a close analogue of energy use) to come from tinplate production for cans under subsystem 8 (ancillary activities) (see figure). That is, 60% of the supply chain energy use for a can of tuna comes from the production of the metal can. They recommend plastic packaging as an alternative, along with increased recycling of tin cans post-consumer.

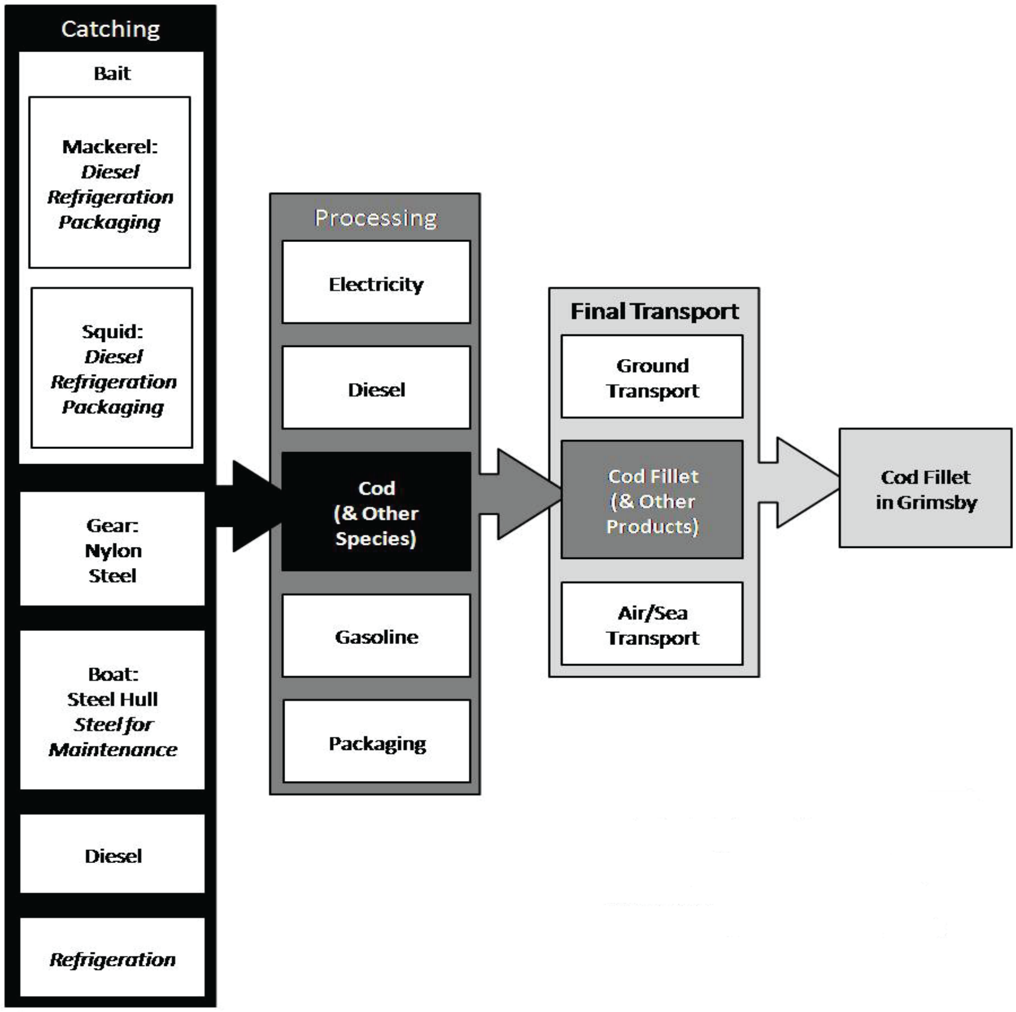
Contribution analysis for canned tuna in Spain

GWP=global warming potential. AP=acidification potential



Source : Hospido *et al.* (2006)

Figure 12. LCA of Icelandic Cod fillet delivered to UK



Source: Adapted from Fulton (2010)

53. Most of the fish products considered in LCA studies are variations of fresh or frozen fillets; market-ready, but without a good deal of value-added. In this context, the conclusion that most energy in their production is expended in the capture of fish is not surprising. But what about products that undergo more significant processing? Parker (2011) carries out a LCA of Antarctic krill products and finds that, for krill meal and oil destined for aquaculture feed, harvesting and vessel steaming to port do indeed account for the majority of energy use. Krill oil capsules, which are used as an Omega-3 supplement, are produced in France using krill meal from the same source. In this case, the total energy consumption is dominated by processing of meal into capsule form, which represents 50% of the total energy budget. Krill meal and oil are directly processed on the harvesting vessel using fuel oil, while additional processing for capsule production uses electricity as the main energy input.

Aquaculture

54. The conclusions of the LCA work described in the preceding section typically apply as well in the case of aquaculture. The production of feed inputs is where most energy is used and this is especially the case for animal inputs such as marine or livestock-derived ingredients which dominate energy use

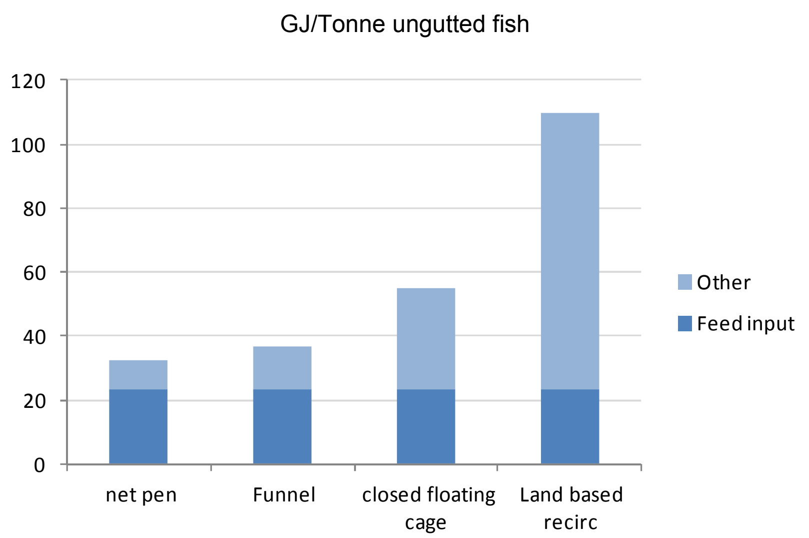
calculations when they constitute a major part of the feed. This seems to be the case for a broad variety of species and production types (Aubin *et al.* 2006, 2009, Pelletier and Tyedmers 2010, Pelletier *et al.* 2009). However, exceptions to this exist for certain types of aquaculture production.

55. Most aquaculture uses open net pens, and these are considered the lowest cost method for aquaculture production. But these are not appropriate everywhere, and alternatives exist. Land-based recirculation systems have been developed in response to a number of factors, of which limited access to coastal zones and control of effluent are the two most important. In many cases, closed recirculation systems are trading capital and energy for scarce or unavailable environmental inputs (coastal access and dilution of effluent). For this reason, these systems are often more energy-intensive than their net-pen equivalents.

56. Different systems respond to the constraints and opportunities offered by specific locations and species of fish produced. Each system will represent a different trade-off between energy and other inputs. For example, Aubin *et al.* (2006) studied a recirculating system for turbot production that used 250 000 MJ of energy per tonne of fish. This was five times the energy use per tonne for flow-through trout production, but used only 8% of the water (Papatryphon *et al.* 2004).

57. Gronroos *et al.* (2006) consider the production of rainbow trout in Finland. They find significant variation in terms of energy use per tonne of production. The variance is found to be mainly due to certain production methods that use additional energy in order to reduce local pollution loading. Systems that are more closed in order to collect effluent must do so via increased energy used in pumping (Figure 13). For the basic net-pen system, energy inputs into feed production dominate the total, but are only a fifth of total energy use for a land-based recirculating system.

Figure 13. Energy input in Rainbow Trout production in Finland



Source: Gronroos *et al.* (2006)

Comparison with terrestrial agriculture

58. The wide differences in energy use by the different fish production systems considered here complicate simple comparisons with terrestrial production systems. Agriculture itself is not a monolith; across countries and regions different systems are in place with different energy inputs. Perhaps more

importantly, the composition of energy inputs can also vary, whereas in fisheries and aquaculture consumption of diesel or fuel oil for vessel propulsion dominates the energy use profile. Pelletier *et al.* (2011) provide a good overview of energy use for a broad set of foods, and conclude that the situation is both complex and that consumer choice is likely to be a key determinant of overall energy use (Box 6.

Box 6. Key points with respect to energy use in agriculture and food systems

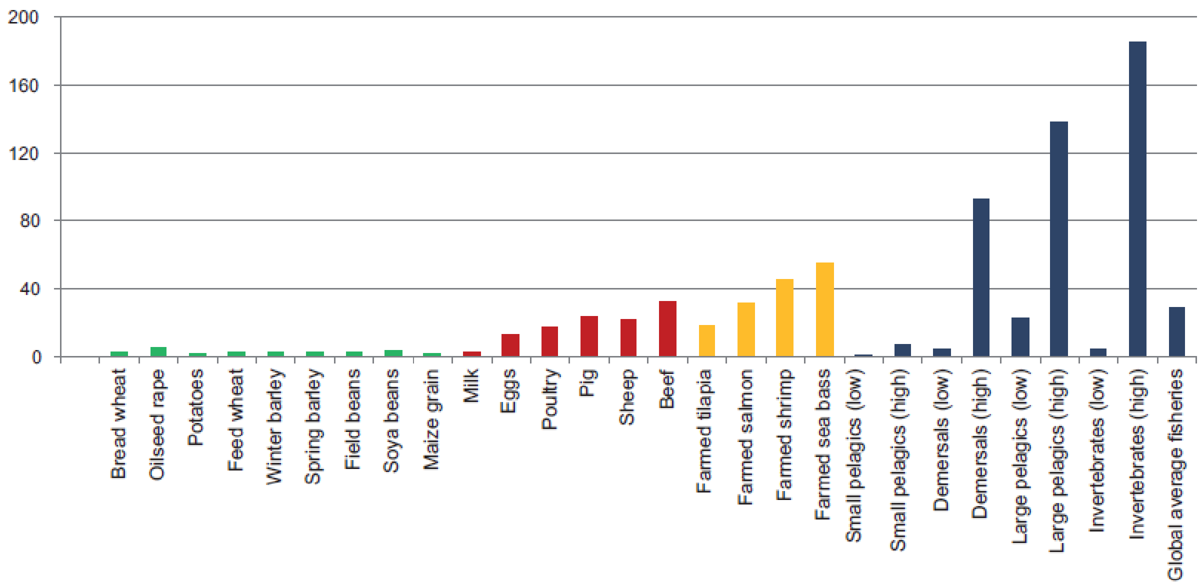
- Contemporary food systems are heavily reliant on non-renewable energy resources, including both direct and indirect life cycle inputs.
- Relationships between energy-dependent inputs and food system productivity are complex and nonlinear. In some cases, diminishing returns are obvious, whereas in others, increased energy use is warranted to improve energy return on (energy) investment ratios.
- In industrialized economies, food production, processing, and household-level activities, such as refrigeration and cooking, account for the largest proportions of total energy use in the food system. Food miles do not contribute as much to the energy intensity of food products as is commonly assumed, with certain exceptions such as air-freighted products.
- Energy use per unit of caloric output in intensive livestock and aquaculture production is typically much higher than for agricultural crops. Energy associated with feed inputs has been estimated to account for 53% to 86% of the total energy intensity of livestock products.
- Given the wide variation in energy intensity within and between crop and livestock products, dietary choice is a key determinant of food system energy use.
- Considerable opportunities exist for improving energy efficiencies, but the scale of food system energy use will likely continue to increase due to population growth and changing consumption patterns. Social and political drivers must be considered alongside appropriate technologies.
- Energy efficiency must be considered from a variety of perspectives, including both anthropocentric and ecological perspectives. Whereas the majority of research regarding energy use in food systems has focused on non-renewable energy resources, biotic energy use efficiency demands increased attention, in particular, with respect to biodiversity objectives.
- In light of the volatility of energy prices and uncertainties with respect to long-term fossil energy availabilities, the energy intensity of food systems has important implications for food security. Risks are unevenly distributed.

Source : Pelletier *et al.* (2011)

59. A comparative analysis of energy inputs shows that, on average, fish products use a comparable amount of energy as terrestrial forms of protein production (Pelletier *et al.* 2011). As noted earlier, within the fisheries sector there are large variations, with some segments such as shrimp trawling using many times more energy per tonne produced than alternatives (Figure 14). On the other hand, production of small pelagic species such as herring can be one of the most energy-efficient ways to produce protein. However, the most energy efficient fish products tend to be those that are not directly intended for human consumption.

Figure 14. Energy inputs of different foods

Gigajoules per tonne



Source: Pelletier *et al.*, 2011

Discussion

60. It is clear that the determinants of energy use in fisheries are complex. The wide variation in energy intensity across fisheries and gear types indicates that fuel costs alone are not the prime determinant of fishing behaviour, even though fuel is the largest single costs in many fisheries. Moreover, fisheries objectives seldom target fuel efficiency directly. Stock management and the economic health of the sector are by and large the first priority of fisheries policy and management, and energy efficiency policy should not lose sight of this.

61. There remains a role for better policy coherence. Energy use in fisheries is an important issue not just because of recent increases in fuel prices, though this has had a significant impact on fisheries in many countries. It is also important because countries have goals and objectives with regard to climate change, renewable energy, and energy independence and security. The vast majority of energy used in fisheries and the entire fish marketing chain is in the form of fossil fuels, mainly diesel. Reducing the amount of fossil fuels used by the sector can contribute to reaching those objectives that lie outside the fisheries sector, as well as potentially improving the economics of fishing for the sector. For OECD countries, the GHG contribution of the sector is relatively small, but for some nations, such as small island states, emissions of the fishing fleet can be the largest single source of emissions and as much as half of the total (Thomsen *et al.* 2012)[5].

5. Even if the share of GHG emissions from fisheries is small, this typically does not eliminate the obligation of the sector to reduce emissions as part of national plans.

62. The challenge is for governments to find the means by which energy efficiency in fisheries can be improved in the context of broader sector and social objectives. In particular, these improvements must not compromise the objective of competitive, profitable, well-managed fisheries. Fortunately, there seems to be considerable opportunity to do this. Fossil fuel subsidies have been singled out by the G20 as inefficient and counterproductive in light of climate change objectives. The fisheries sector in most countries enjoys exemptions from fuel taxes that can impact fuel efficiency in important ways.

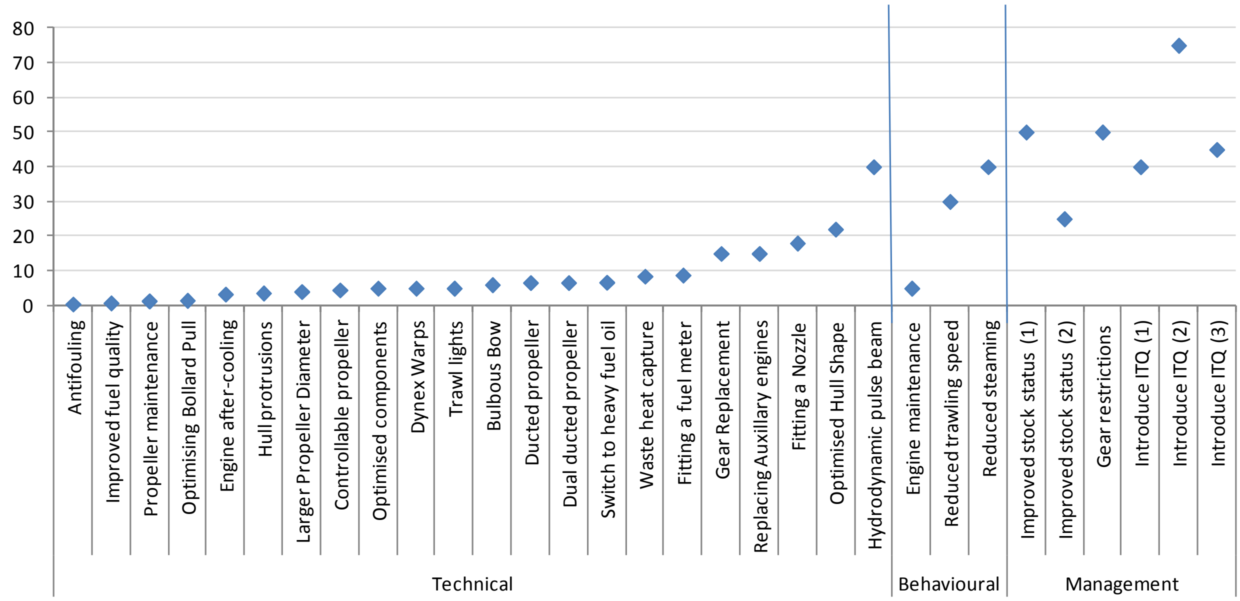
63. Even more potential seems to exist in simply doing fisheries management better. Maintaining a healthy stock has been identified as a key way to increase the efficiency of fishing in general, with concomitant reductions in fuel use, in particular when fleet capacity is matched to available resources. The behaviour of skippers also seems to be more important than the characteristics of the vessels they operate. Reduced steaming and trawling speed and travelling shorter distances have good potential to reduce fuel consumption and improve profitability. Several technical aids have also been identified to help fishers optimize their strategies. However, in many cases, these behavioural decisions are strongly influenced by the nature of the management regime, leaving scope again for a well-designed management system to give proper incentives to maximise profits and efficiency.

64. In particular, market-based approaches to fisheries management seem to provide opportunities for fishers to minimise their costs and to change fishing tactics in a way that increases fuel efficiency while fostering growth. Better matching fleet capacity to resources also helps to reduce energy consumption, in addition to its other benefits. The OECD Green Growth Strategy points out the need to find ways to increase economic output without increasing pressure on the resource base. The degree to which this occurs is called “decoupling” and the OECD had developed indicators to measure progress.

65. This report considered energy use in fisheries from three main perspectives: Technical efficiency having to do with the nature of the vessel and the gear it uses, the impact of behaviour and the choices made by fishers, and the role of the management system in influencing fuel use. While much interest and research has been conducted into technical improvements, the potential of changes in behaviour and management systems stand out (Figure 15).

66. Most of the research presented in this report shares the result that the energy use in the capture fisheries stage of production represents the most important share of the total. This is true also in many cases for aquaculture, where feed is derived in part from fish meal and oil produced from wild harvested stocks. While there are exceptions to this, the largest gains in energy efficiency and reduced greenhouse gas emissions will likely come from improvements in the way wild stocks are managed and harvested.

Figure 15. Potential improvements in energy efficiency by type



Note: improvements from technical efficiency as shown in Table 7 show improvements for specific elements of vessel efficiency only. Those values are converted to changes in overall vessel efficiency here. Results for different management improvements come from multiple studies.

Source: See Table 7, Wilson 1999, Driscoll and Tyedmers 2010, Sigler and Lunsford 2001, Arnason 2010, Brandt (1999), Repetto (2001), IMARES (2006).

67. While research into potential technical improvements holds lots of potential - theoretical improvements of 40% or more are claimed for certain gear improvements - available technologies offer improvements that are much more modest. Moreover, those technical changes that yield large gains also tend to require larger investments to implement. Governments can help by providing the necessary incentives and infrastructure for research and development, a role many governments are already playing.

Next steps

68. This document sets the stage for work to come in the 2013-14 Programme of Work of the Fisheries Committee. The next phase of the project studying energy use in fisheries and aquaculture is to consider the policy implications of the information presented here, and develop specific recommendations based on analysis of this information. This study concludes that the largest potential gains and therefore the most policy attention should be paid to capture fisheries, which is by-in-large the major energy user in the fisheries production chain. In particular, the role of the fisheries management system will be discussed, and green-growth-compatible recommendations for improvements made. This encompasses both stock management and regulatory aspects of the fishery. The role of support in fisheries with respect to energy use will be investigated, covering both potential positive incentives for improvement and the impact of existing policies such as fuel tax concessions.

69. Once the policy-focussed work is completed, it is anticipated that a full report including this document will be produced.

REFERENCES

Andersen, O. (2001), "Transport of fish from Norway: energy analysis using industrial ecology as the framework", *Journal of Cleaner Production*, vol. 10 no. 6, pp. 581-588.

Arnason, Ragnar (2010), "Saving Fuel in Fisheries the Painless Way", Plenary presentation to NOAA Symposium "Energy use in Fisheries: Improving Efficiency and Technological Innovations from a Global Perspective", Seattle.

Aubin, J, E. Papatryphon, H. Van der Werf, S. Chatzifotis (2009), "Assessment of the environmental impact of carnivorous finfish production systems using life cycle assessment", *Journal of Cleaner Production*, vol. 17, pp. 354-361.

Aubin, J, E. Papatryphon, H. Van der Werf, J. Petit and Y. Morvan (2006), "Characterisation of the environmental impact of a turbot (*Scophathalmus maximus*) re-circulating production system using Life Cycle Assessment", *Aquaculture*, vol. 261, pp. 1259-1268.

Ayers, Nathan and Peter Tyedmers (2009), "Assessing alternative aquaculture technologies: life cycle assessment of salmonid culture systems in Canada", *Journal of Cleaner Production*, vol. 17, pp. 362-373.

Bjorshol, Nils Harald (2007), *Design concept for low energy fishing vessel*, ICES CM 2007/M:07.

Boyd, C. (2008). *From ocean to market: The life cycle biophysical impacts of the southwest Nova Scotia live lobster industry*. Masters Thesis, Dalhousie University, Halifax, Nova Scotia.

Brandt, S. (1999), *Productivity and Industrial Structure Under Market Incentives and Traditional Regulation; A Case Study of Tradable Property Rights in the Middle Atlantic Surf Clam Fishery Working Paper No. 900*, Department of Agricultural and Resource Economics and Policy, University of California at Berkeley.

Brown, S., and A. E. Lugo. 1981. *Management and Status of U.S. Commercial Marine Fisheries*. A report published by the Council on Environmental Quality, Washington, D.C.

Deacon, Robert, D. Parker and C. Costello (2008) "Improving Efficiency by Assigning harvest rights to Fishery Cooperatives: Evidence from the Chignik Salmon Co-op", *Departmental Working Papers,* UC Santa Barbara.

Driscoll, John and Peter Tyedmers (2010), "Fuel use and greenhouse gas emission implications of fisheries management: the case of the new England Atlantic herring fishery", *Marine Policy*, vol. 34 pp. 353-359.

Dupont, D and R. Grafton (2001), "Multi-Species Individual Transferable Quotas: The Scotia-Fundy Mobile Gear Groundfishery", *Marine Resource Economics*, vol. 15, pp. 205-220.

Ellingsen, H and S. Aanondsen (2006), “Environmental Impacts of Wild caught Cod and Farmed Salmon—A comparison with Chicken”, *International Journal of Life Cycle Analysis*, vol. 1, pp. 60-65.

Ellingsen, H., A. Emanuelsson, E. Skontorp Hognes, F. Ziegler and U. Winter (2008), “Carbon footprint and energy use in export of Norwegian seafood products”, *SINTEF Report SFH80 F096026*, Trondheim, Norway.

FAO (2006), *The State of the World’s Fisheries and Aquaculture*, FAO, Rome.

Ferlin, Philippe and P. Weber (2010) *Rapport: Pêche et Energie*, CGAAER report number 10137, France.

Fulton, Sarah (2010), *Fish and Fuel: Life Cycle Greenhouse Gas Emissions Associated with Icelandic Cod, Alaskan Pollock, And Alaskan Pink Salmon Fillets Delivered to the United Kingdom*, Masters Thesis, Dalhousie University, Halifax.

Gaston, Troy, Giles Thomas, David Maynard and Rowan Frost (2012), “Energy Efficiency through bycatch reduction—a radical approach”, *Second International Symposium on Fishing Vessel Energy Efficiency*, Vigo, Spain.

Grafton, Quentin, D. Squires and T. Fox (2000) “Private Property and Economic Efficiency: A study of a Common-Pool Resource”, *Journal of Law and Economics*, vol. 43 no. 2 pp. 679-714.

Gronroos, Juha, Jyri Seppälä, Frans Silvenius and Timo Mäkinen (2006), “Life cycle assessment of Finnish cultivated rainbow trout”, *Boreal Environment Research*, vol. 11, pp. 410-414.

Hall, Stephen, Anne Delaporte, Michael J. Philips, Malcolm Beveridge and Mark O’Keefe (2011), *Blue Frontiers: Managing the Environmental Costs of Aquaculture*, The WorldFish Center, Penang, Malaysia.

Hayman, B., M. Dogliani, I. Kvale, and A. M. Fet, (2000), *Technologies for reduced environmental impact from ships - ship building, maintenance and dismantling aspects,* ENSUS-2000, Newcastle upon Tyne, UK.

Hornborg, S., P. Nilsson, D. Valentinsson and F. Ziegler and Hornborg (2012), “Integrated environmental assessment of fisheries management: Swedish *Nephrops* trawl fisheries evaluated using a life cycle approach”, *Marine Policy*, vol. 36, pp. 1193-1201.

Hospido, Almudena and Peter Tyedmers (2005), “Life cycle environmental impacts of Spanish tuna fisheries”, *Fisheries Research*, vol. 76, pp. 174-86.

Hospido, A., M.E. Vazquez, A. Cuevas, G. Feijoo and M.T. Moreira (2006), “Environmental assessment of canned tuna manufacture with a life-cycle perspective”, *Resources, Conservation and Recycling*, vol. 47, pp. 56-72.

Horvath, A. (2006), “Environmental assessment of freight transportation in the U.S.” *The International Journal of Life Cycle Assessment*, vol. 11, no. 4, pp. 229-239.

Huse, I., S. Aanondsen, H. Ellingsen, A. Engas, D. Furevik, N. Graham, N., *et al.* (2002). *A desk-study of diverse methods of fishing when considered in perpective of responsible fishing, and the effect on the ecosystem caused by fishing activity*. Institute of Marine Research and SINTEF, Bergen, Norway:.

IMARES (2006), *Energy Saving in Fisheries*, (ESIF) FISH/2006/17 LOT3-Final Report. Wageningen IMARES, IJmuiden.

Ishikawa, Masanobu, K. Sato, H. Akizawa, Y. Sakai and H. Watanabe (1987), "A Cases Study of Energy Analysis of Long Distance Squid Angling", *Nippon Suisan Gakkaishi*, vol. 53, no. 9, pp. 1525-1531.

Karlsen, H. and A. Angelfoss (2000), *Transport of frozen fish between Alesund and Paris- a case study* (No. HiA 20/B101/R-00/020/00), Aalesund College, Norway.

Kitts, Andrew, Greg Schneider and Rebecca Lent (2008), *Carbon Footprint of Commercial Fishing in the Northeast United States*, IFFET 2008 Vietnam Proceedings.

Matsushita, Yoshiki, Toru Azuno and Yukiko Yamashita (2012), "Fuel Reduction in coastal squid jigging boats equipped with various combinations of conventional metal halide lamps and low-energy LED panels", *Fisheries Research*, vol. 125, pp. 14-19.

Messina, Geatano (2006) "Some technological contributions to fuel savings in trawlers" in *Conference on Energy Efficiency in Fisheries*, EC.

Mitchell, Catherine and Cutler Cleveland (1993) "Resource Scarcity, Energy Use and Environmental Impact: A Case Study of the New Bedford, Mass, Fisheries", *Environmental Management*, vol. 17 no. 3 pp 305-317.

OECD (2010), *Fossil Fuel Subsidies*, [TAD/FI(2010)8/FINAL].

Papatryphone, E., J. Petit, H. Van der Werf, S. Kaushik and S. Kanyarushoki (2005), "Nutrient balance modelling as a tool for environmental management in aquaculture: the case of trout farming in France" *Environmental Management*, vol. 35 no. 2, pp. 161-174.

Parker, Robert (2011), *Measuring and Characterizing the Ecological Footprint and Life Cycle Environmental costs of Antarctic Krill*, MS Thesis, Dalhousie University, Halifax.

Pelletier, Nathan and Peter Tyedmers (2010), "Life Cycle Assessment of Frozen Tilapia Fillets From Indonesian Lake-Based and Pond-Based Intensive Aquaculture Systems", *Journal of Industrial Ecology*, vol. 14, no. 3 pp. 467-481.

Pelletier, Nathan, Peter Tyedmers, Ulf Sonesson, Astrid Flysio, Sarah Kruse, Beatriz Cancino and Howard Silverman (2009), "Not All Salmon Are Created Equal: Life Cycle Assessment (LCA) of Global Salmon Farming Systems", *Environmental Science and Technology*, vol. 43, pp. 8730-8736.

Pelletier, N., E. Audsley, S. Brodt, T. Garnett, P. Henriksson, A. Kendall, K.J. Kramer, D. Murphy, T. Nemecek, and M. Troell (2011), "Energy Intensity of Agriculture and Food Systems", *Annual Review of Environmental Resources*, vol. 36, pp 223-46.

Polet, Hans, Jochen Depestele, Hendrik Stouten and Els Vanderperren (2006), "Moving from beam trawls towards multi-rig ottertrawls—and further... in *Conference on Energy Efficiency in Fisheries*, EC.

Repetto, R. (2001), "A natural experiment in fisheries management", *Marine Policy*, vol. 25, pp. 251-264.

Rossiter, Tom (2006), "Adapting fishing techniques in UK fisheries", in *Conference on Energy Efficiency in Fisheries*, EC.

Sigler, M. and C. Lunsford (2001), "Effects of individual quotas on catching efficiency and spawning potential in the Alaska sablefish fishery", *Canadian Journal of Fisheries*, vol.58 pp. 1300-1312.

Smith, A. (2007). *A study into the effect of energy costs in fisheries*. FAO Fisheries Circular 1022. Rome, FAO.

Sterling, David and Kim Klaka (2007), *Energy Efficient Fishing: A 2006 review. Part B—Hull characteristics and efficiency*, Australian Fisheries Research and Development Corporation Project No. 2005/239.

Suuronen, Petri, Francis Chopin, Christopher Glass, Svein Lokkeborg, Yoshiki Matsushita, Dante Queirolo and Dominic Rihan (2012), "Low impact and fuel efficient fishing—Looking beyond the horizon", *Fisheries Research*, in press.

Scientific, Technical and Economic Committee for Fisheries (STECF) (2008) *The Annual Economic Report (AER) 2008 on the Profitability of European Fleets (SGECA 08-02)* (ed. Anderson J and J. Nord), 21-25 April 2008, Copenhagen.

Swedish International Development Authority/FAO (1986). *Reducing the fuel costs of small fishing vessels*, by Gulbrandsen, Ø. Bay of Bengal Programme. Ref. BOBP/WP/27. Madras, India.

Swedish International Development Authority/FAO (1987), *Fishing trials with beach landing craft at Uppada, Andhra Pradesh, India*. By L. Nyberg. Bay of Bengal Programme. Ref. BOBP/WP/56. Madras, India.

Thomas, Giles, David Sterling, Daniel O'Doherty and Christopher Chin, (2010) "Where is all the energy going? An energy audit system for Australian fishing vessels", *First International Symposium on Fishing Vessel Energy Efficiency*, E-Fishing, Vigo, Spain May 2010.

Thomsen, B., K. Zachariassen, M. Eliasen, P. Hansen and S. Heinesen (2010), "Fuel optimisation in the Faroese fishing fleet", *First International Symposium on Fishing Vessel Energy Efficiency E-Fishing,* Vigo, Spain.

Thrane, Mikkel (2004), "Energy Consumption in the Danish Fishery: Identification of Key Factors", *Journal of Industrial Ecology*, Vol. 8, Nos. 1-2, pp. 223-239.

Tyedmers, Peter (2010), "Energy and Seafood: Challenges and Opportunities" Plenary presentation to NOAA Symposium "Energy use in Fisheries: Improving Efficiency and Technological Innovations from a Global Perspective", Seattle.

Tydemers, Peter (2004), "Fisheries and Energy Use", *Encyclopaedia of Energy, Volume 2*, Elsever.

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.

Van Balsfoort, Gerard and Jean-Pierre Grandidier (2006) "Fuel saving expectations from experiments conducted on towed gears by French and Dutch Fleet" *Conference on Energy Efficiency in Fisheries*, EC.

Van Marlen, B and P. Salz (2010) "Energy Saving in Fisheries – EU project ESIF", First International Symposium on Fishing Vessel Energy Efficiency E-Fishing, Vigo, Spain, May 2010

Vasquez-Rowe, Ian, M. Teresa Moreira and Gumersindo Feijoo (2010), "Life-cycle assessment of horse mackerel fisheries in Galicia (NW Spain): Comparative analysis of two major fishing methods", *Fisheries Research*, vol. 106, pp. 517-527.

Watanabe, Hisahiko and Motohiro Okubo (1989), "Energy Input in Marine Fisheries of Japan", *Nippon Suisan Gakkaishi*, vol. 55, no. 1, pp. 25-33.

Weninger, Quinn (1998), "Assessing Efficiency Gains from Individual Transferable Quotas: An Application to the Mid-Atlantic Surf Clam and Ocean Quahog Fishery", *American Journal of Agricultural Economics*, vol. 80, no. 4, pp. 750-764.

Wilson, J.D.K. (1999), *Fuel and financial savings for operators of small fishing vessels*, FAO Fisheries Technical Paper 383, FAO, Rome.

Winther, Ulf, *et al*. (2009), "Carbon footprint and energy use of Norwegian seafood products", SINTEF Fisheries and Aquaculture, Sintef, Norway.

World Bank (2009), *The Sunken Billions,* World Bank, Washington.

Ziegler, Friederike and Per-Anders Hansson (2003), "Emissions from fuel combustion in Swedish cod fishery", *Journal of Cleaner Production*, vol. 11 pp. 303-314.

Ziegler, Friederike 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.

Ziegler, F., A. Emanuelsson, J.L. Eichelsheim, A. Flysjö, V. Ndiaye and M. Thrane (2011) "Extended Life Cycle Assessment of Southern Pink Shrimp Products Originating in Senegealese Artisanal and Industrial Fisheries for Export to Europe", *Journal of Industrial* Ecology, vol. 15, no. 4 pp. 527-538.

Ziegler, Friederike and Sara Hornborg (2012), *The energy use of Swedish demersal fisheries between 2002-2009 in relation to management, stock status, fuel price and technology*, Consultant report prepared for the OECD, The Swedish Institute for Food and Biotechnology, Göteborg, Sweden.

附件 2 綠色成長議題報告：

2-3 養殖漁業與綠色成長： TAD/FI(2012)11

For Official Use **TAD/FI(2012)11**

Organisation de Coopération et de Développement Économiques
Organisation for Economic Co-operation and Development **01-Oct-2012**

English - Or. English

TRADE AND AGRICULTURE DIRECTORATE
FISHERIES COMMITTEE

TAD/FI(2012)11
For Official Use

A GREEN GROWTH PERSPECTIVE ON AQUACULTURE

Paris, 29-31 October 2012

This document is presented to the 110th session of the Committee for Fisheries under Draft Agenda item 3 iv) for DISCUSSION and GUIDANCE.

Contact: Dongsik Woo (email: dongsik.woo@oecd.org)

JT03327449

English - Or. English

TABLE OF CONTENTS

A GREEN GROWTH PERSPECTIVE ON AQUACULTURE

1. Introduction

1. The COFI approved the revised scoping paper "Green Growth Perspective on Aquaculture" [TAD/FI(2011)8/PART4/REV] at its 109th Session and asked the Secretariat to present a progress report to the 110th Session. Following extensive review of the available literature and analysis of case studies from a number of delegations (distributed as TAD/FI(2012)11), this progress report is submitted for discussion and guidance.

2. This progress report seeks to identify the challenges for green growth in aquaculture[1], the policies that can ensure its further growth in a sustainable manner, as well as to understand the factors necessary for successful aquaculture development in participating economies. This analysis can help develop advice and best practices that can be used as a roadmap for national aquaculture planning.

3. This progress report will also discuss the effects on competitiveness of incorporating green growth principles into aquaculture policy.

1.1 Overview

4. Global demand for fish products has increased over the last decades and this trend is expected to continue due to the growing population and increasing wealth, as well as a growing preference for healthy foods (Garcia and Rosenberg, 2010). When taking into account stagnating capture fisheries production (Figure 1), it is clear that aquaculture will have to meet most of the future increase in demand for fish[2] (Bostock *et al*., 2010).

5. 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, it 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).

6. Aquaculture has a major potential role in helping to reduce poverty and increase foreign currency earnings. Increased production, together with innovation[3] in aquaculture, has lowered production prices significantly and has provided benefits to consumers and producers. For example, shrimp production increased 43 times (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).

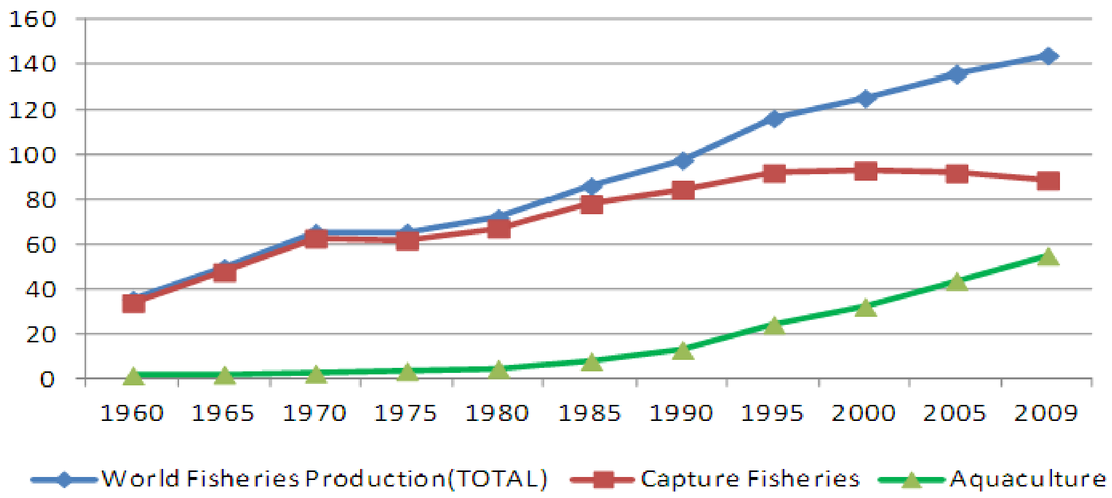
---

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).

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.

3 The characteristic of "production controllability" coupled with a demand from global markets provide incentives for innovation.

Figure 1. World fisheries production



1. Aquatic plants are excluded.

Source: FAO Fisheries and Aquaculture Information and Statistics Service.

7. Aquaculture takes on many different forms in different parts of the world: inland water vs. marine; cage culture vs. ponds; carnivorous vs. herbivorous species; extensive vs. intensive; etc. Some emerging economies are important export-oriented producers, e.g. Viet Nam, of fish from aquaculture, while others supply mainly domestic markets, e.g. China. This situation, together with the poor or lacking reporting from aquaculture producing economies, makes it challenging therefore to identify common features that make aquaculture green. Incorporating green growth principles in aquaculture calls for 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.

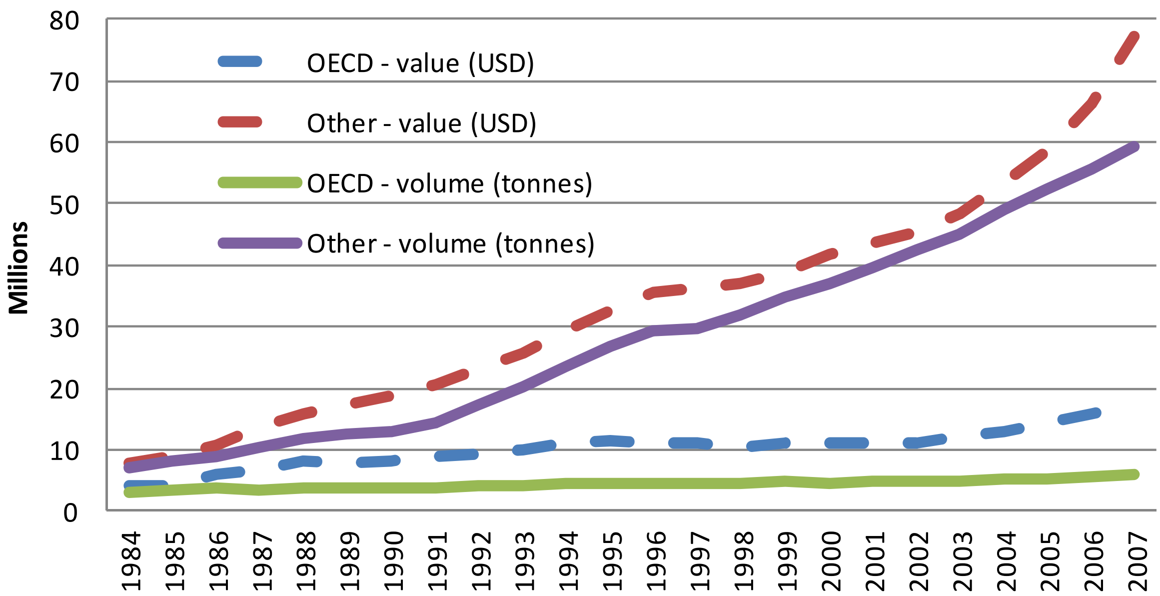
8. While aquaculture production has increased substantially, there are concerns about the sustainability of aquaculture production due to environmental externalities (e.g. pollution, fish diseases and escapees), supply of feed resources (e.g. fishmeal trap), and competition for space. For example, many shrimp aquaculture farms in Southeast Asia have been 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).

9. This has led to a tendency to focus on the negative externalities of aquaculture and it has been difficult in many developed countries for fish farming to establish itself as a growth sector. After the rapid growth of the 1980s-1990s, aquaculture in Europe and North America has stagnated, mainly due to regulatory restrictions on site and other inputs (Bostock *et al.* 2010). The result is that contrary to the rapid expansion of aquaculture production in emerging economies, 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 total aquaculture production in 1984, but only 18% and 9%, respectively, in 2007 (Figure 2).

10. With increasing concerns of food security, this situation has called for a rethink of aquaculture policies, national development plans, and governance of the aquaculture industry. The aquaculture sector also needs to consider adopting 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). Against this background, the aquaculture industry must find a way to provide more seafood to meet increasing demand while mitigating the environmentally negative effects of production.

Figure 2. Total aquaculture production: Volume and value



Source: OECD (2010).

11. The COFI workshop on *Advancing the Aquaculture Agenda – Policies to Ensure a Sustainable Aquaculture Sector* aquaculture held in April 2010 in France concluded that aquaculture has a high potential to contribute to green growth and food security because good management practices make it possible to limit and reduce environmental harmful effects while increasing food production. Indeed, compared to the rearing of terrestrial animals, aquaculture offers much better feed conversion ratios (OECD, 2010).

12. 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-OECD 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. 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 the 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).

2. Green Growth issues in aquaculture

13. The green growth strategy is relevant for sectors interacting with the surrounding environment and which produce externalities (Nielsen *et al.*, 2012). Aquaculture fits well into the overall OECD green growth agenda. This encompasses significant growth potential, an important contribution to food security

and poverty reduction. At the same time, however, the sector requires that government play role in creating a stable and predictable governance framework, while ensuring policy coherence and innovation in production and environmental prevention and mitigation.

14. For aquaculture to grow sustainably it must address the externalities it causes. As aquaculture competes for space with other users, both recreational and commercial, the path towards green growth in aquaculture must include issues related to the use of space, i.e. planning (including user conflicts), sanitary issues, licence system, site allocation and importantly cooperation among the various stakeholders in aquaculture, e.g. farmers, consumers, authorities, etc. Within such a framework a number of green growth challenges and their associated policy framework can be identified (Box 1).

Box 1. Green growth challenges and aquaculture

Green Growth challenges	Variables to control	Policy framework	Measures (examples)
Discharges	Feed, feed conversion, feed components	Regulations, innovation, good management practices	Feed quotas, fallowing, cleaning, transferable discharging permits, taxes, IMTA, reuse, zoning
Feed resources	Feed	Innovation	Grains and vegetables, Use of wastes
Diseases	Density	Regulations, innovation, good management practices	Distance, vaccine, fallowing, zoning
Escapees	Storms, accidents	Regulations, good management practices, Innovation	Stronger cages, sterilisation, paying local fishermen to catch escapees
Space	User conflicts / conflicting uses	Coastal zone/ocean management, regulations	Reserved areas(zoning)
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
Development	Capital, skills	Education and training, labour standards	Continuing education for local populations

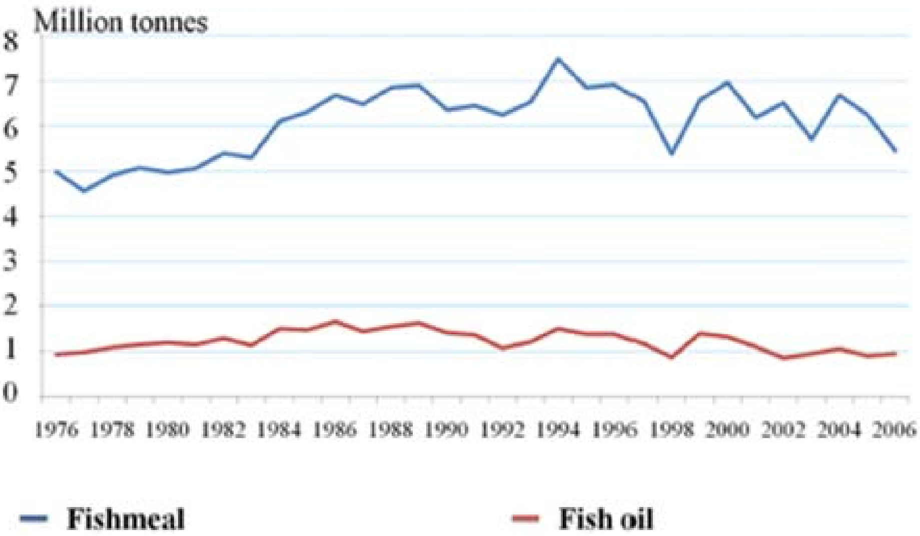
2.1. Feed resources

15. 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 aquaculture production (19.3 Mt) in the world relied on small pelagic fisheries for its feed (Tacon and Metian, 2009). As aquaculture has grown fast and is expected to continue to increase in the future, this may drive many small pelagic fisheries into extinction and endanger the sustainable growth of the aquaculture industry, which means that aquaculture may not be sustainable in the absence of proper management and conservation of stocks from which feed (fishmeal and fish oil) is produced. It also raises

food security and ethical issues in that more fish is used for fishmeal and fish oil. The potential existence of a fishmeal trap[4] is a major concern, especially where carnivorous species such as salmon are concerned. 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 sources of feed (whether terrestrial or marine) that are managed sustainably.

16. However, the total amount of wild capture fish used for reduction[5] 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). The use of fish meal in compound aquafeeds has been lower than predicted between 1997 and 2007 (Welch *et al*., 2010).

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

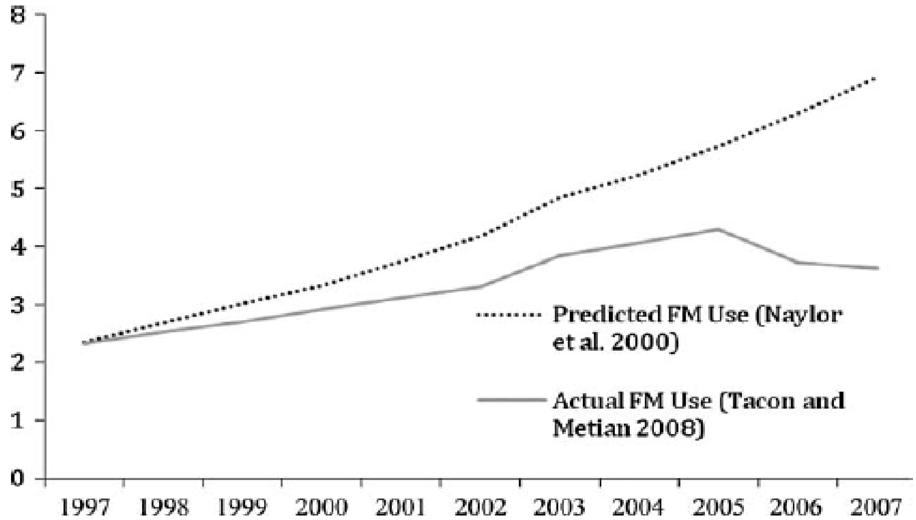


Source: Tacon and Metian (2009).

4 The fish meal trap is that 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.

5 Reduction means that fish caught in wild are reduced **or** turned into fishmeal and fish oil. Most of the fish for reduction is from pelagic species.

Figure 4. Fishmeal use: past projections and current trends



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

17. As the aquaculture industry grows, the pressure on fishmeal and fish oil may increase and thus alternatives to fishmeal/oil need to be developed. Ingredient substitution and improved feeding systems may be part of the solution. More research and innovation are required in this field (Bostock *et al*., 2010). As can be seen in Table 1, "fish-in fish-out ratios" for nearly all species fell between 1995 and 2006. While transfer efficiency in energy move between trophic levels of fish is 10%, in general, in natural environments, all farmed species cited in the table have a greater transfer efficiency than their counterparts in the wild. In case of salmon, the ratio fell further after 2006, as seen in Figure 5.

Table 1. 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

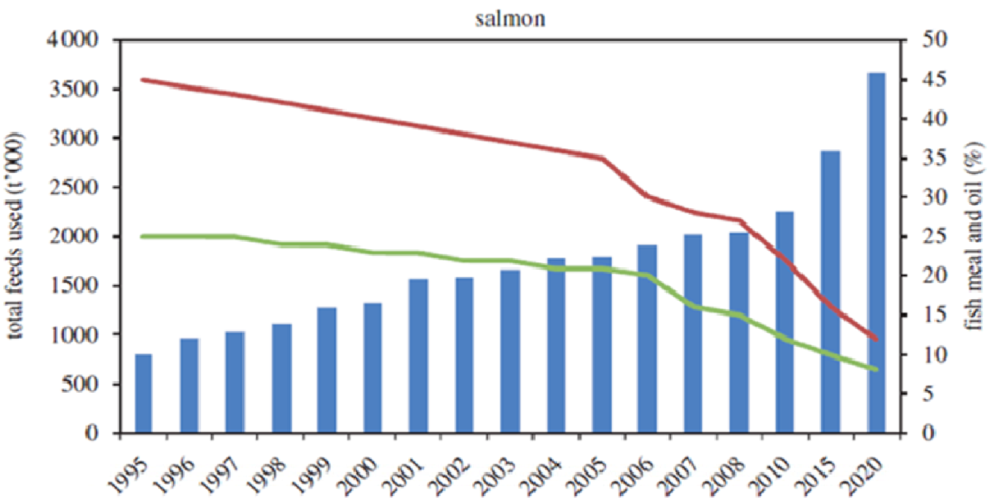
Source: Tacon & Metian, 2008.

18. The decreased use of fish meal and fish oil has resulted mainly from the industry's keen interest and investment to find substitutes due to rising prices and social pressure for improved sustainability, which in turn will probably continue to drive down inclusion levels in the future (Welch *et al*., 2010). There have been major achievements in feed use in the salmon industry. Figure 5 demonstrates that the relative importance in feed compounds has decreased considerably over the past decades as fishmeal and

oil are seen as expensive ingredients (Bostock *et al.* 2010). In addition, about 25% of fish meal and oil sources are at present provided by processing waste (Jackson, 2010).

19. So far, a fishmeal trap has not developed and this will probably not be a limiting factor for the immediate future aquaculture growth. As the aquaculture industry grows, however, the pressure on fishmeal and fish oil may increase, so alternatives to fishmeal/oil need to be further developed. In the meantime, more research and innovation are required in this field.

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

20. Aquaculture activities interact with the surrounding environment. As aquaculture continues to intensify and expand, aquaculture production discharges more organic wastes, nitrogen and phosphorous, this may result in environmental degradation, and particularly water pollution. For example, feeds provided to farmed species are not usually consumed entirely and are 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 are needed or that can be assimilated by the surrounding environment. As a result, poor water quality, eutrophication[6] or dead zones may appear. Eutrophication may lead to reduced dissolved oxygen and hypoxic[7] or dead zones which often result in fish kills, excessive phytoplankton and macroalgal growth which can reduce light penetration which are harmful to submerged aquatic vegetation, harmful algal blooms which may result in mass fish kills, and decrease in biodiversity due to changes in nutrient composition (Selman *et al*., 2008).

21. This is one of the main reasons why aquaculture has been criticized and why strict restrictions on aquaculture expansion have been in place in many countries.

22. The use of antibiotics is also a concern because it may harm humans and the environment since those which are not consumed dissipate in surrounding water and are consumed by other aquatic species.

---

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

7 Hypoxic refers the condition of low oxygen level that will sustain animal life.

23. In order to control discharges from aquaculture operation, many countries have implemented command and control measures such as feed quota and maximum discharge load. For example, Denmark introduced strict environmental regulations to control water pollution from aquaculture activities, which requires a maximum allowable feeding, statistical standard for N, P, 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 are more efficient ways of dealing with problems due to their flexibility and increased incentives for innovation.

24. Fallowing, cleaning, allocating suitable spaces, integrated multi-trophic aquaculture such as farming filter feeders (mussels, sea cucumber) or aquatic plants (algae and kelp) are also possible policy options. Since phosphorous and sludge from aquaculture are valuable resources, capture and re-use of phosphorous and sludge is a new area for technology and regulation development (Nordic Council, 2012). The important message is that there are solutions, some of which may be expensive (e.g. fully re-circulated systems in which water outflow is not polluted to more extensive production systems like multi-trophic aquaculture). Identifying a maximum load on the environment (e.g. nitrogen, phosphor etc) and make such emission permits transferable between farms and among industries may also allow for a more efficient allocation of resources. It would be useful if countries with experience in this regard submit specific case studies to underpin the evidence-based analysis.

2.3. Escapees

25. The environmental effect of escapees is an important issue 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 and become dominant species, which in turn changes and/or reduces biodiversity. If farmed fish are not indigenous to the area of production, the escaped fish becomes an invasive species which may disturb the ecosystem. The escapees may also spread diseases or pathogens to the wild stocks.

26. While reliable and complete escapee data worldwide are not available, Norway has collected comprehensive data on escapees. Fredheim *et al*. (2010) state that there are over 325 million Atlantic salmon held in sea-cage in Norway, which is far greater than the wild salmon population which is 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. There may be a big indirect cost to the industry and society, however, because escapees undermine the industry's reputation and can be detrimental to ecosystems (Fredheim *et al*., 2010); this calls for government intervention. As part of the regulatory reforms that have been developed in the recent years in Chile, there progress is noted, from preventive measures to mitigation measures. Particularly, escapee has been dealt through the regulation of the security of farming structures.

27. Based on the data from the sea-cage salmon farming case in Norway, the causes of the escapes 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 large escapements. In contrast, operational failures usually lead to small incidents and are more frequent. Thus, structural failures are the area to be addressed first in preventing escapes (Fredheim *et al*., 2010). Over the last two years escapes due to structural equipment failure has been reduced leaving operational/human failure as the main cause for escapes.

28. Norway introduced in 2004 a technical standard for marine fish farms, including regulations for design, dimensioning, production, installation and operation. Following a revision of the regulations in 2011, they have been strengthened further. In addition, the Norwegian government has imposed an upper limit on the number of fish to be kept in each net pen. In combination, these two measures effectively

reduced the overall risk of escapes both in terms of the numbers and as a proportion of number of fish in sea-cages (Fredheim *et al*., 2010).

29. There are some policy lessons to be learned from the Norwegian experience, including: (1) establish mandatory reporting system of all escapes; (2) establish a mechanism to collect, analyse and learn from the mandatory reporting; (3) conduct mandatory, technical assessments on the cause of large-scale escape incidents; (4) introduce a technical standard for sea-cage aquaculture equipments; (5) conduct mandatory training of fish farm staff; (6) pay local fishermen to catch the escapees; and (7) conduct R&D for better equipment, sterilisation and on species behaviour (Jensen *et al*., 2010, and Fredheim *et al*., 2010). It would be interesting if other countries with major marine cage aquaculture (for example Turkey for sea bream and bass, France for sea bass, and Canada, the United Kingdom and Ireland for salmon) could provide case material that would help inform of approaches taken to address problems associated with escapees.

2.4. Diseases and parasites

30. Aquaculture activities may transfer diseases and parasites to other farms and to wild species through various ways, such as eggs and fingering transactions, equipment, fish-to-fish contact, or currents. This often leads to a decrease in production, and sometimes significant economic losses, and pose a threat to wild fish populations.

31. Asche *et al*. (2010) argued that disease is always present in any animal husbandry industry so disease control should be an essential part of animal farming, including in aquaculture. The Chilean case can happen elsewhere; that is, where aquaculture expands fast while appropriate regulatory frameworks are not implemented mainly due to short-term economic interest. Thus good governance is very important in controlling disease. Addressing individual cases only when problems appear has led to allopathic measures, such as a heavy reliance on the use of antibiotics in Chile without initially implementing precautionary measures (OECD, 2010).

32. Spatial planning to make periodical fallowing and relocation of farming sites, regulations to keep a certain distance among farms, limit on stocking density, vaccinating smolts, and reducing the use of antibiotics are several policy measures to be taken in order to address the disease issue. After the crisis of ISA, Chile has been innovative in the design and implementation of all of these measures (Box 2).

33. The Chilean case of ISA outbreak in 2007 wreaked havoc on the aquaculture industry (Box 2) and inflicted major economic losses on the sector and jobs in both farming and processing. The Chilean case study on how the Chilean Government, in co-operation with industry, addressed the issues of disease outbreak is an important contribution to show the need for a long term collaborative approach to establish aquaculture. Other countries with similar experiences in addressing disease outbreaks (pre or post to actual outbreaks) are encouraged to share their messages on how they have dealt with this issue.

Box 2. 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, it is the second largest producer in the world. However, the development of the aquaculture sector was not accompanied by an appropriate regulatory framework that addressed biological risks and other social, economic and environmental issues. The industry's priority was on production, sales, and overall economic benefits from aquaculture growth: an appropriate regulatory framework was not put in place.

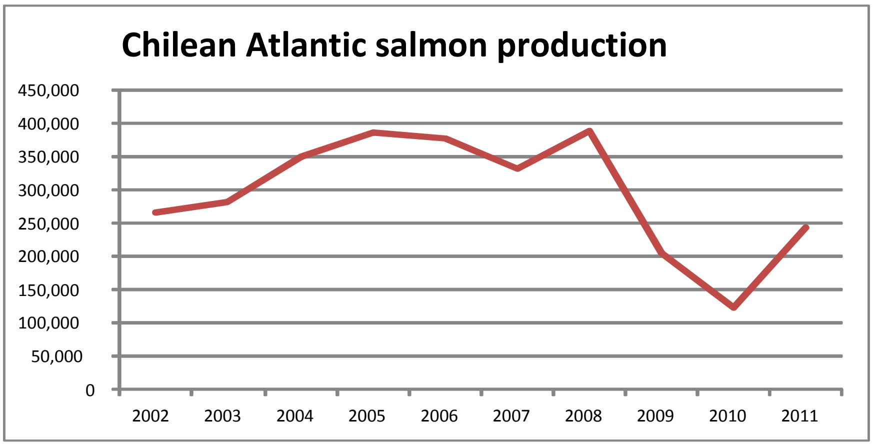
Once the virus (infectious salmon anaemia: ISA) outbreak occurred in 2007, this imbalance impaired the industry's ability to respond. The Atlantic salmon industry was hard hit by ISA, with a production decrease of 67% (from 376 476 tonnes in 2006 to 123 233 tonnes in 2010), a significant fall in the 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).

Overall, the biosecurity measures and regulatory framework at the time were insufficient to control diseases. 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 and comprehensive government regulations.

With a fast public-private co-ordinated effort, basic infectious disease control measures were implemented to intensify biosecurity on farms, and quality assurance of diagnostic laboratories and mandatory reporting were introduced. 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 been adopted include spatial planning to make periodical fallowing and relocation of farming sites, regulations to keep distance among farms, limit on stocking density, vaccinating 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 level is expected to be restored to 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 government.

Source : Chilean Government, Undersecretariat for Fisheries and Aquaculture

2.5. Space competition

34. Aquaculture essentially requires space on land and in marine waters to operate. As aquaculture expands, suitable sites have become scarcer and in many regions this has become one of the constraints for further growth. There are also other economic sectors, such as fisheries, recreation, transportation and energy production, which compete for the same 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 has been exhausted. For example, there are cases reported in China where inland water aquaculture has reached its physical limit of expansion.

35. When allocating space among competing users, all sectors and stakeholders should be considered in order to co-ordinate and minimise conflicts. Integrated coastal zone management is one tool to consider in addressing conflicting uses.

36. To address competing uses, aquaculture should be considered as a part of coastal and marine spatial planning. Designated suitable zones for aquaculture and other sectors under spatial planning can be a reasonable solution to avoid conflicts (Díaz, 2010).

37. As long as aquaculture produces negative impacts on the environment and loss to society as a whole with unsustainable operations, strict environmental regulations measures can be justified. However, 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).

38. With growing pressure on land and marine resources, in part due to increasing population and food security concerns, the challenges to deal with space will augment. Policy makers need to address the problems associated with space use, user conflicts, and how best to deal with it. There are models for the economically most efficient allocation to consider. The report *Integrated Ocean Management and the Fisheries Sector: Interactions, Economic Tools and Governance Structures*, submitted to the 107th Session of COFI, considered how some of these issues might be addressed (Charles, 2011). Case study material that participating economies could be shared with the Secretariat and COFI in this regard is most welcome.

Box 3. 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 tons, a doubling only since 2002. With expanded production have 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, ultimately needed to help bring the industry on the path to green growth. In addition, competition for space from different user groups such as recreation, fishing and the petroleum industry has made it increasingly difficult for salmon farming companies to get access to new sites.

In order to ensure industry optimization 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 gap for establishing suitable production zones, 2) challenges for small farm owners located in only one or two zones, and 3) the municipalities’ ownership to spatial planning processes in coastal waters.

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

2.6. Externalities from other sectors

39. Aquaculture may also suffer from externalities induced by other sectors. Since water is of utmost importance for aquaculture activities, other activities that deteriorate water quality 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).

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

41. Since multiple externalities are involved, it is not possible to correct environmental externality by addressing aquaculture only, which leads to a sub-optimal solution. In this case, where multiple externalities exist, co-ordinated regulation of externalities among different sectors can make green growth possible by making different players internalise externalities in their management decision and by allowing the best welfare producer to operate on the market (Nielsen *et al*., 2012). This calls for policy makers to address issues of coherence and a willingness to co-operate among a wide variety of stakeholders who have an economic interest in this shared resource.

42. Agricultural and aquaculture externalities may be best addressed at the same time to correct a total environmental externality. If authorities implement an incentive-based policy, for example transferable discharge permits, both in the aquaculture and agriculture sectors, an optimal solution may be achieved and thus green growth can be possible. Conflict among competing users can be avoided by introducing spatial planning.

43. The complexity of legal and institutional responsibilities (institutional set up) is another challenge to tackle the multiple externalities issue, and the one-stop shop found in Norway and Michigan in the United States can be a good way to deal with this problem (OECD, 2010a).

3. Policy framework

44. Green growth can be achieved by increasing production while managing and reducing externalities. It can be achieved through technological developments (innovation) or better management practices and improved regulations.

45. Command and control policies are prevalent in dealing with the negative impacts from aquaculture in many countries. Compared to incentive-based policies, such as transferable discharge permits, these policies are, in general, inefficient because they do not provide much incentive to innovate or much flexibility for fish farmers to adjust, in addition to requiring more information for authorities (and raises questions of information deficiencies). However, what measures to choose and to what extent the chosen measures should be implemented is a challenging task for policy makers.

3.1. Optimal regulations

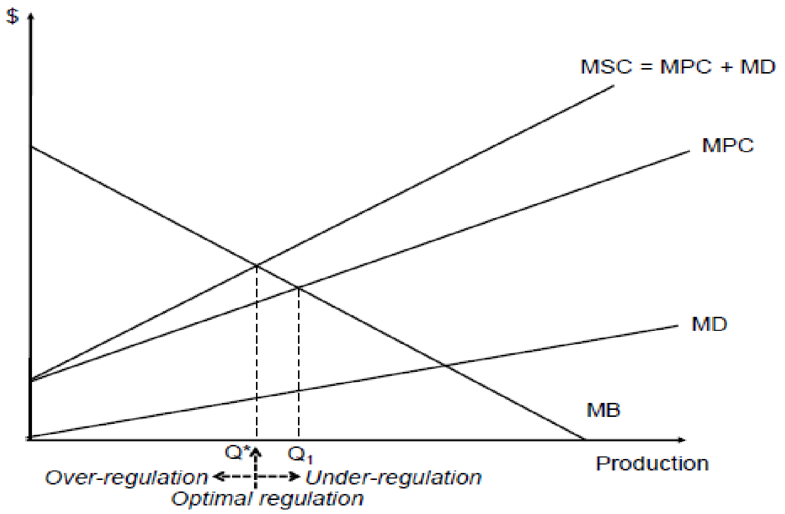
46. Theoretically, externalities can be solved between actors in a market if there are no transaction costs (Coase, 1960). In practice, however, where there are many players involved with lots of transaction costs, the market will not correct the externalities. Aquaculture is an example in that it produces

externalities which affect many players such as other farmers, fishers, other water users, and recreational users. This is why government regulation is required.

47. Green growth is possible through improved regulation, moving from command and control regulations (e.g. aquaculture extension moratorium and feed quotas) to incentive-based regulations (e.g. pollution taxes or individual transferable pollution quotas), which ensures that the costs and benefits of an extra unit of activity/production are equal (Box 4, Nielsen *et al*., 2012). It should also be taken into consideration that a regulatory approach does not always benefit society due to information deficiencies.

48. If aquaculture growth in many OECD countries is low because of strict environment regulations, such as feed quota or aquaculture extension moratorium, green growth is possible by adopting an incentive-based policy, e.g. taxes or transferable pollution quotas (Nielsen *et al*., 2012).

Box 4. Optimal regulation and optimal pollution level



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

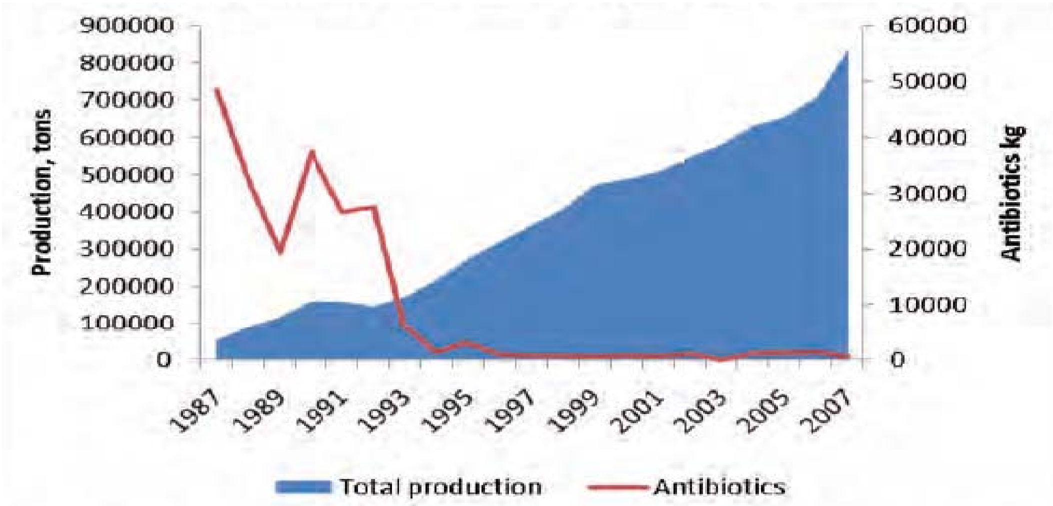
The optimal level of production is Q^* where the marginal social costs equal to marginal benefits. To the left of Q*, regulation is stricter than needed, i.e. over-regulation. To the right of Q*, regulation is weaker or absent than needed i.e. under-regulation There is room for green growth by moving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

Source: Nielsen *et al*., 2012.

3.2. The role of innovations in green growth aquaculture

49. An important aspect of the green growth strategy is innovation. Innovation fosters better use of natural resources and a reduction in negative impacts on the environment (OECD 2011b). This can be achieved by changing the regulatory framework or increased investment in research and development. Technological innovations has 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 Industr,2009.*

50. As of 2010, about half of Danish trout farms adopted new recirculation systems. The most widespread model fish farm re-circulates at least 95% of water, reduces water intake about 15-25 times, and reduces discharge of total nitrogen, total phosphor, and organic material by respectively 36%, 62% and 94% compared to the traditional farms (Jarlbæk and Børresen, 2011). The main reasons for changing to this innovative system are strict environmental regulations combined with strict regulations of using weirs, which requires a maximum allowable feeding, statistical standard for N, P, organic matter, minimum level of oxygen in the outlet water, and a limit of 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 this sector.

51. The Norwegian salmon industry has sought to reduce production costs in many ways. Optimisation of holding facilities, and handling and feeding equipments have their share of success in reducing costs, but the Norwegian selective breeding program[8] for salmon starting in the 1970s and a lowering of the fish conversion ratio combined with a lower use of fishmeal and fish oil in the feed has been one of the most important contribution to this success (OECD, 2010). The supply industries and government have played the most important roles in this process, while most farms, which are small family-owned companies with little resources for R&D, have been dependent on their suppliers (Box 5).

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

- 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;

Box 5. 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, which in turn leads to productivity growth (Asche *et.al*, 2012). The supply industry and the government have played 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.

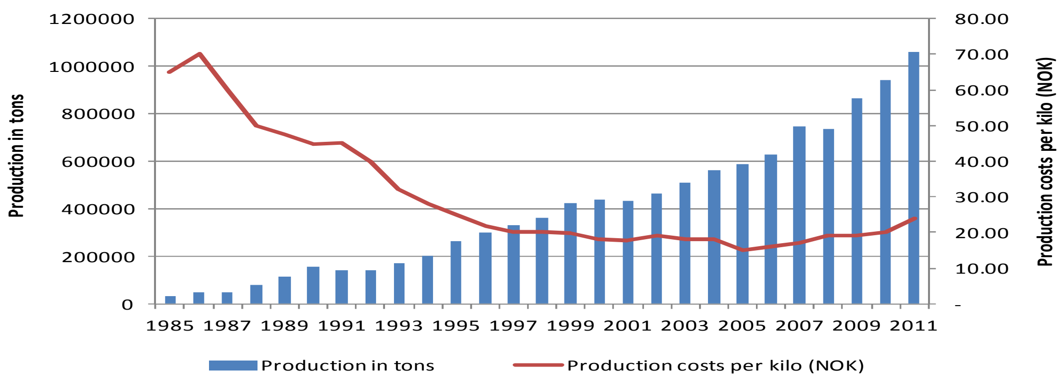
(3) Research-based entrepreneurs control parts of the value chain that require continuous R&D, pursue radical innovations, and are happy to share their innovations with other companies in the cluster.

(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 against its competitors.

Historically, most salmon farming companies in Norway have been small family-run firms with limited resources and capacity for R&D. They have been dependent on their suppliers, such as feed producers and pharmaceutical companies, for innovations and new technologies. While there are currently a few companies that can be categorised as research-based entrepreneurs or part of the science-based process industry, quite a few 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 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. While it is unrealistic for R&D-intensity to return to previous levels, Asche et al. (2012) holds 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.

Production cost per kilo and production of salmon, tons.



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

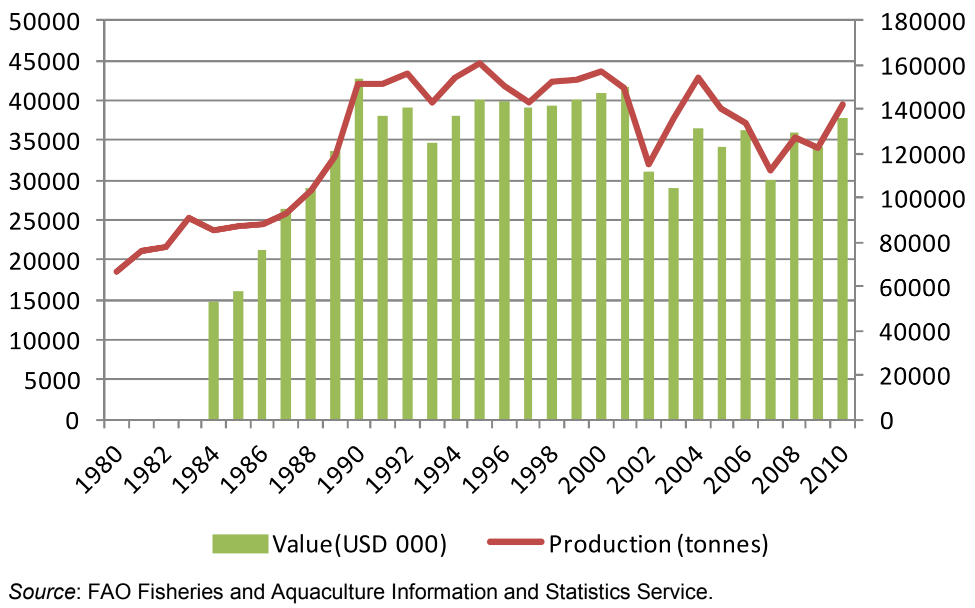
4. Effects of adopting green growth policies

52. Many countries have already incorporated some green growth components in their regulatory frameworks to respond to sustainability requirements. However, little is known about the effects of adopting green growth components 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 40% of fish and fish products in the world are traded, the impact on competitiveness can have important implications.

53. While there is not much information available for in-depth analysis, there are several cases that provide some effects on competitiveness on whether to adopt or not green growth policies in aquaculture development.

54. 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 7). 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). As seen in Figure 7, there was a rapid growth in production until 1990; since then, the production has stagnated and later decreased. Recently, 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.*

Figure 7. Danish aquaculture production between 1980 and 2010



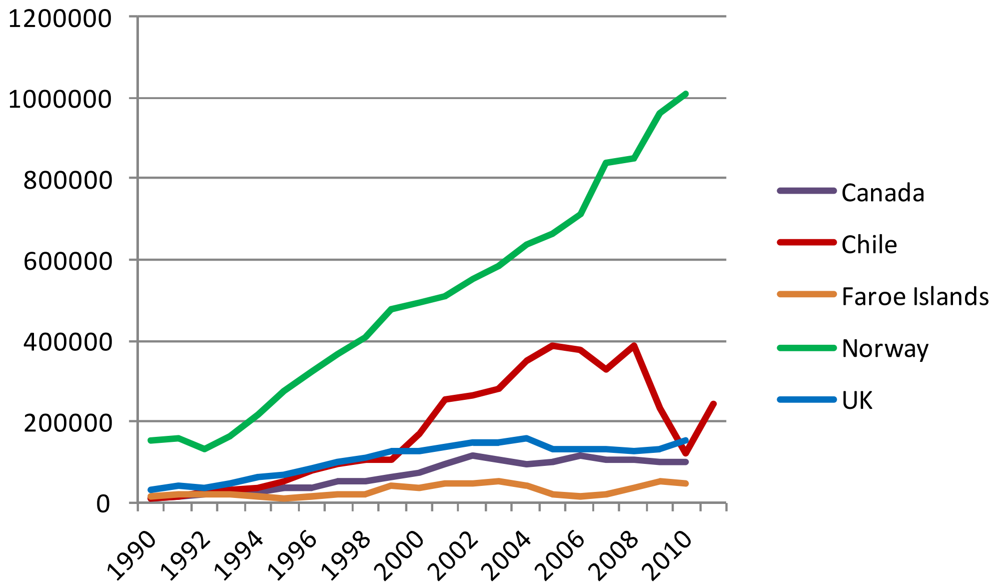
Source: FAO Fisheries and Aquaculture Information and Statistics Service.

55. From the Chilean ISA crisis, some preliminary results of green growth policies can be drawn. From 2001 to 2009, Chile was the second largest Atlantic salmon producer and exporter in the world, but lost this status in 2010 due to the ISA crisis (Figure 8). As a result, there was a substantial decrease in the production of Atlantic salmon, a significant fall in the number of Atlantic salmon, and a significant loss in direct and indirect jobs (Chile, 2012). This outcome can be interpreted as the cost resulting from not having adopted a green growth policy, including appropriate biosecurity measures. 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). It will be an interesting exercise to further analyse this case.

56. While Chile is not the only case that have experienced a crisis in the aquaculture sector in recent decades, the Chilean case provides particular insights on the effects of having green growth policy in place. Voluntary submissions of similar case studies from other economies are welcome. They may serve to further lessons which will be reported in the next stage.

Figure 8. Atlantic salmon production among major countries



Source: FAO Fisheries and Aquaculture Information and Statistics Service.

5. Conclusion and next steps

57. Several preliminary conclusions can be drawn from the discussion above, although further case study material needs to be analysed before final conclusions can be drawn.

- Environmental externalities and space competition are key issues to be addressed for aquaculture to grow sustainably.
- Improved regulation, moving from command and control regulations to incentive-based mechanisms can produce green growth in aquaculture.
- Innovation can help green growth both at the production level and to address the environmental challenges.
- Adopting green growth policies affects economic, social and environmental outcomes as well as the competitiveness of aquaculture sector.
- Governments play an important role in green growth for aquaculture.

58. In the meantime, at the 110th Session of COFI, a number of issues highlighted in this preliminary report would benefit from additional case study material. This concerns in particular national experiences in dealing with escapees, disease, space allocation among competing industries, externalities from other sectors impacting on aquaculture and innovation. Such additional national experience will allow for a more

solid analysis of the success factors in moving to a green growth path in aquaculture. Cases having analysed the competitive impact of green aquaculture are also welcome. Countries that on a voluntary basis are able to contribute case study material on these issues are urged to do so.

59. At the 110th Session it would be useful to explore further:

- Have the externalities been correctly identified in the paper (i.e. escapements, discharges, use of medicines, use of space) and what are their relative importance in OECD aquaculture?
- What are the particular issues that aquaculture in developing country context gives rise to and to what extent do COFI wish to also incorporate those aspects into the present study?
- How can the analysis be extended to also include the linkages (and competitive issues) between products from capture fisheries vs. from aquaculture origins?

60. The Secretariat will explore further cases and the literature to draw lessons, and to identify common barriers, and as well as factors of success. The effects of adopting green growth policies in the aquaculture industry will be further analysed. A revised version of this report, to be presented at the April 2013 COFI, will, *inter alia*, be based on material presented at the Workshop in Yeosu, Korea to be held 12-13 December 2012. Voluntary submission of national cases and relevant data are welcome as this will underpin the relevance and quality of the next progress report.

REFERENCES

Allison, E.H. (2011), *Aquaculture, Fisheries, Poverty and Food Security*, OECD, TAD/FI(2011)2.

Asche, F. (2008), *Farming the Sea*. Marine Resource Economics 23(4): 507-527.

Asche, F., H. Hansen, and R. Tveteras (2010), "Thalassorama-The Salmon Disease Crisis in Chile", *Marine Resource Economics.* Vol. 24, pp. 405-411.

Asche, F. (2011), *Green Growth in Fisheries and Aquaculture*, OECD, TAD/FI(2011)6.

Bostock, J., B. McAndrew, R. Richards, K. Jauncey, T. Telfer, K. Lorenzen, D. Little D, L. Ross, N. Handisyde, I. Gatward, and R. Corner (2010), "Aquaculture: Global Status and Trends", *Philosophical transactions of the royal society,* B 365, 2897-2912(doi: 10.1098/rstb.2010.0170).

Charles, A., (2011), *Integrated Ocean Management and the Fisheries Sector: Interactions, Economic Tools and Governance Structures*, TAD/FI(2011)4, Consultancy paper, OECD, Paris.

Chilean Government, Undersecretariat for Fisheries and Aquaculture (2012), *The Recovery of the Chilean Salmon Industry*, OECD TAD/FI/RD(2012)4, a case study submitted to the OECD Fisheries Committee.

Coase, R. (1960), "The Problem of Social Cost", *Journal of Law and Economics*, 3, 1-44.

Díaz. R., (2010a), "Agriculture's impact on Aquaculture: Hypoxia and Eutrophication in Marine Waters", Advancing the Aquaculture Agenda – Workshop proceedings, OECD (2010a), Paris.

FAO (2008), *Glossary of Aquaculture* (accessed on 1 June 2011), Rome. http://www.fao.org/fi/glossary/aquaculture/default.asp)

FAO (2010), *The State of World Fisheries and Aquaculture* 2010, Rome. (http://www.fao.org/docrep/013/i1820e/i1820e00.htm)

FAO (2011), Global Statistical Collections, Rome. http://www.fao.org/fishery/topic/16140/en

Fredheim, A., O. Jensen and T. Demster (2010), "Norway: Escapes of Fish from Aquaculture", *Advancing the Aquaculture Agenda – Workshop proceedings*, OECD (2010a), Paris.

Garcia, S. M. and A. A. Rosenberg (2010), " Food Security and Marine Capture Fisheries: Characteristics, Trends, Drivers and Future Perspectives", *Philosophical transactions of the royal society,* B 365, 2869-2880 (doi: 10.1098/rstb.2010.0171)

Hall, J. S., A. Delaporte, M.J. Phillips, M. Beveridge and M. O'Keefe (2011), *Blue Frontiers: Managing the Environmental Costs of Aquaculture.* The WorldFish Center, Penang, Malaysia

Hasan, M., and M. Halwart (2009), *Fish as Feed Inputs for Aquaculture-Practice,Ssustainability and Implications.* FAO Fisheries and aquaculture technical paper No. 518, Rome.

Jarlbæk, H., and T. Børresen. (2012), "Innovation in Fisheries and Aquaculture Technology as Contributor to a Green Growth Strategy", OECD consultant paper, forthcoming, OECD, Paris.

Jensen, O., T. Dempster, E.B.Thorstad, I.Ulem, A.Fredheim (2010), "Escapes of Fishes from Norwegian Sea-cage Aquaculture: Causes, Consequences and Prevention", *Aquaculture Environment Interactions,* Vol. 1:71-83.

Nielsen, M., L. Ravensbeck, and R. Nielsen (2012), "*Achieving Green Growth through Improved Regulation of Fisheries and Aquaculture*", OECD consultancy paper, forthcoming, OECD, Paris..

Nielsen, R. (2012), *Barriers to Sustainable Growth in the Aquaculture Sector: an Economic Analysis*, Ph.D. Thesis, University of Copenhagen, Denmark.

Norwegian Ministry of Fisheries and Coastal Affairs (2009), Strategy for an Environmentally Sustainable Norwegian Aquaculture Industry.

Norwegian Ministry of Fisheries and Coastal Affairs (2012a), *Moving towards a Zoning Structure in the Norwegian Aquaculture?*, TAD/FI/RD(2012)3, a case study submitted to the OECD Fisheries Committee.

Norwegian Ministry of Fisheries and Coastal Affairs (2012b), *Innovations Strategies and Green Growth-Norwegian Salmon Farming Case*, TAD/FI/RD(2012)2, a case study submitted to the OECD Fisheries Committee.

Nordic Council (2012), *Draft Summary*.

OECD (2010a), *Advancing the Aquaculture Agenda*- Workshop proceedings, Paris.

OECD (2010b), *Conditions for Establishing Aquaculture Production Sites in OECD Countries*, TAD/FI(2010)1/REV1.

OECD (2011a), Towards Green Growth: Green Growth Strategy Synthesis Report. OECD C/MIN(2011)4.

OECD (2011b), Green Growth Strategy Synthesis Report. OECD C(2011)29.

OECD (2011c), Summary Record of the 108th Session of the Committee for Fisheries. OECD TAD/FI/M(2011)2.

Selman, M., S. Greenhalgh, R. Díaz and Z. Sugg (2008), "Eutrophication and Hypoxia in Coastal Areas: A Global Assessment of the State of Knowledge", *World Resources Institute Policy Note*, No.1. Washington D.C., pp. 1-6.

Tacon, A.G.J., and Metian, M. (2008), "Global Overview on the Use of Fish meal and Fish oil in Industrially Compounded Aquafeeds: Trends and Future Prospects", *Aquaculture*, Vol. 285, pp 146-158.

Tacon, A.G.J., and Metian, M. (2009), "Fishing for Aquaculture: Non-food use of Small Pelagic Forage Fish-a Global Perspective", *Reviews of Fisheries Science*, 17: 305-317.

附件 2 綠色成長議題報告：

2-4 漁業課徵能源稅之可行性：TAD/FI(2012)10

For Official Use **TAD/FI(2012)10**

Organisation de Coopération et de Développement Économiques
Organisation for Economic Co-operation and Development **02-Oct-2012**

English text only

TRADE AND AGRICULTURE DIRECTORATE
FISHERIES COMMITTEE

TAD/FI(2012)10
For Official Use

FEASIBILITY STUDY - FUEL TAX CONCESSIONS IN FISHERIES

Paris, 29-31 October 2012

This document is presented to the 110th session of the Committee for Fisheries under Draft Agenda item 3 ii). It is presented for INFORMATION

Roger Martini (roger.martini@oecd.org)

JT03327488

Complete document available on OLIS in its original format

English text only

NOTE BY THE SECRETARIAT

At the 109th session of the COFI Agenda, item 7 dealt with the potential for quantitative modelling work for fuel tax concessions. At the meeting, the following concerns were raised:

- The objectives and outcomes of such a study need to be clarified. That is, whether the purpose is to evaluate impacts of Fuel Tax Concessions (FTCs) on fish stocks, profitability of fishers, or other indicators such as social impacts?

- Are the level of resources required and the capacity of the Secretariat sufficient to effectively carry out this work?

- Are data available, in particular is the existing FTC data suitable to support cross-country analysis?

On the basis of the discussion, the COFI agreed that the Secretariat would prepare a feasibility study discussing the following

- The relevance and possible application of existing models, such as the FISHRENT model;

- To decide whether outcomes of simulations of such models are likely to contribute to the understanding of the effects of a phasing out of tax concessions on inter alia catches, income, profitability, capacity and employment; and

- To decide whether or not to pay attention to other aspects such as stocks, social factors and green house gas emissions.

TABLE OF CONTENTS

Tables

Figures

FEASIBILTIY STUDY: FUEL TAX CONCESSIONS IN FISHERIES

Introduction

1. At the 109th session of the COFI, a discussion paper was presented regarding the potential for quantitative modelling work to be done on the subject of the impact of fuel tax concessions (FTCs) in fisheries [TAD/FI(2012)1]. That paper provided several cautions regarding the feasibility of quantitative analysis. Specifically:

- The broad set of indicators initially envisaged for this analysis cannot be treated in a single modelling exercise.
- The cost of carrying out such work is potentially high, both in terms of staff resources and financing of consultancies.
- Modelling of fish markets is newly available in AGLINK, which forms the basis of one of TAD's flagship publications (The OECD-FAO Agricultural Outlook), and will compete for scarce resources for quantitative work.
- The data collected in the recent document "Fuel Tax Concessions in Fisheries" [TAD/FI(2010)8/FINAL] was not compatible and so would not support this analysis in its current form.

2. Given these cautions, the paper suggested that, if the COFI was interested in pursuing this work, the first preference of the Secretariat was an analytical rather than a quantitative model. Other options presented were the FISHRENT model, developed by LEI and Framian and considered in more detail in a following section of this study, and working with the Environment Directorate as part of their work on this subject.

3. The discussion of this item during the 109th session raised several issues. Some of the main issues were:

- The objectives and outcomes of such a study. That is, whether the purpose is to evaluate impacts of Fuel Tax Concessions (FTCs) on fish stocks, profitability of fishers, or other indicators such as social impacts.
- The level of resources required and the capacity of the Secretariat to effectively carry out this work.
- The availability of data, in particular the suitability of the existing FTC data to support cross-country analysis.

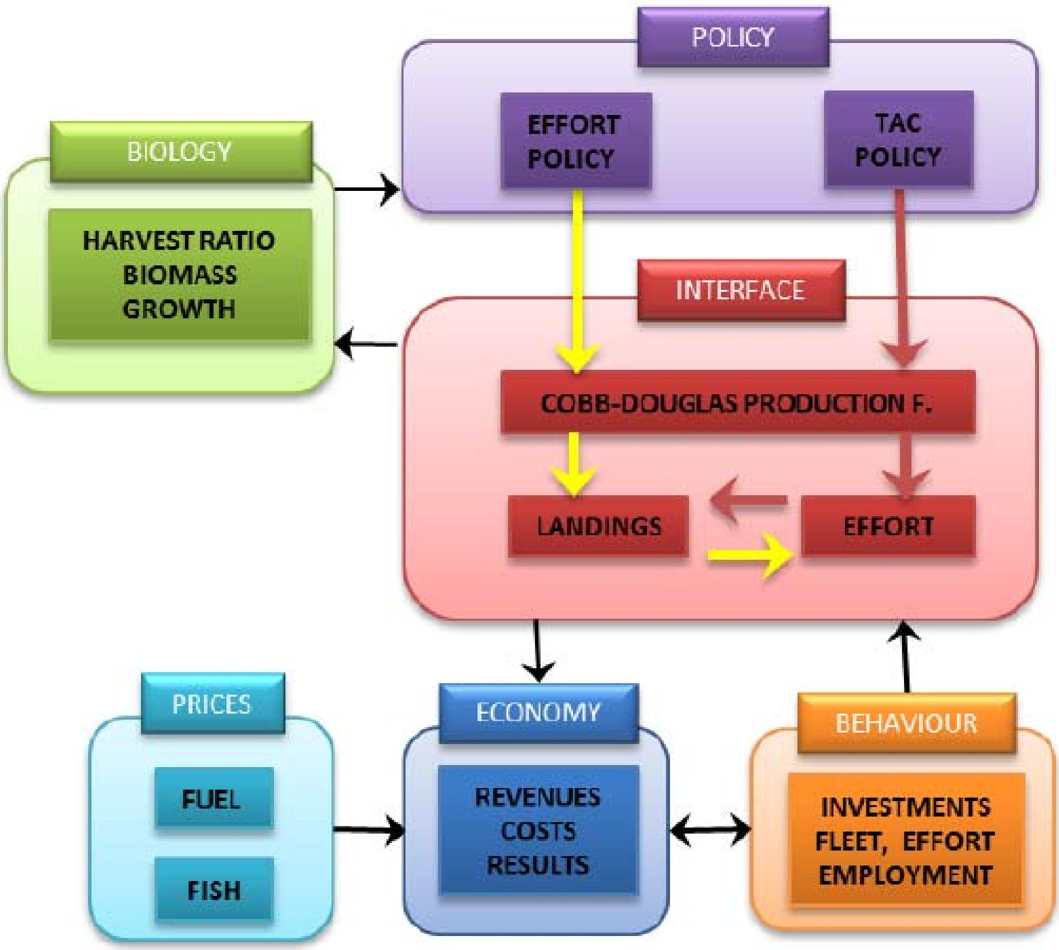
Item 1: The relevance and possible application of existing models, such as FISHRENT

4. A number of different models have already been discussed in [TAD/FI(2012)1]. This section will focus specifically on the FISHRENT model. The design, use, and some results from the model are presented.

Structure

5. The FISHRENT model was developed for the EU-funded project "Remuneration of spawning stock biomass" (Contract MARE/2008/11-Lot3). It is composed of five modules - biological, economic, management system, investment and prices (Figure 1). The authors note that "while these form a complete set of mathematical relations, [the model] also contains a number of important assumptions, which remain to be tested empirically" What this means is that where estimates are unavailable, the parameters of the model have simply been chosen by the authors as round figures. The structure of the model allows it to be run iteratively, producing output results as a time series path of adjustment with a selectable time horizon.

Figure 1. Structure of FISHRENT model



6. All discussion of the FISHRENT model and all simulations produced in this report are on the basis of the 2-sector demonstration model that is freely available for download from LEI (http://www.lei.dlo.nl/Wever.Internet/Applications/LeiRapporten/images/SPR/Fishrentdemo2x2.xlsm. The

version of the model used by its authors is more complicated, having a representation of a larger number of species and fleets, and perhaps other differences that have not been identified in publicly available documents.

Model Operation

7. The FISHRENT demonstration model is a two-fleet, two-species model. The fleets are labelled as trawls of 12-24m and trawls of 24-40m and the species are labelled as cod and plaice. The actual data used is notional and identical for both species and both fleet segments.

8. In operation, the model provides for six management alternatives (Table 1). These define either restrictive or lose TAC or effort-based controls, taking into account harvest interactions between the two species. In addition, there is a "Policy intensity" parameter that relates the extent to which TAC setting conforms to scientific advice. A value of one for this parameter sets the TAC at the advised level, a value greater than one sets the TAC at a higher level than that scientifically advised.

Table 1. Management options in FISHRENT

TAC MIN	The most restrictive TAC is used to determine the effort level which the fleet can exert. This may lead to underutilisation of other species
Effort MIN	Most restrictive effort level is allowed, which leads to realtively low catches
TAC MAX	The least restrictive TAC is used to determine the level of effort which the fleet can exert. This may lead to overfishing of other species.
Effort MAX	Least restrictive effort level is allowed, which leads to relatively high catches.
Open Access	Fishery is driven by economic incentives. Neither TAC nor effort constraints are imposed
MIN MIN	This is the most restrictive policy. In this option, the minimum effort level is compared with the minimum TAC and the lower of the two is selected. This choice is made for each year separately, which means that througout the simulation period, different species and different types of policies determine the outcomes.

Source: FRAMIAN (2011)

9. There are a number of settable parameters in the model aside from the management settings (Figure 2). Most important of these is the fuel price, which can be modified as a one-time shock or as a change over time (as in a phase-out of an FTC policy). The actual treatment of fuel in the cost function is simple; fuel use is proportional to output. A change in the price of fuel does not change fuel intensity of fishing; it only has an impact on overall fishing effort.

10. Other parameters have to do with the growth function of the stock, the operation of the fleet, and the investment response to profits. This last item shapes the dynamic evolution of the model, as it relates current year profit to investment, which impacts future fleet size and effort. Investment is a fixed percentage of profits, which may be set to any percentage, the default being 20%.

Figure 2. FISHRENT Parameter input table

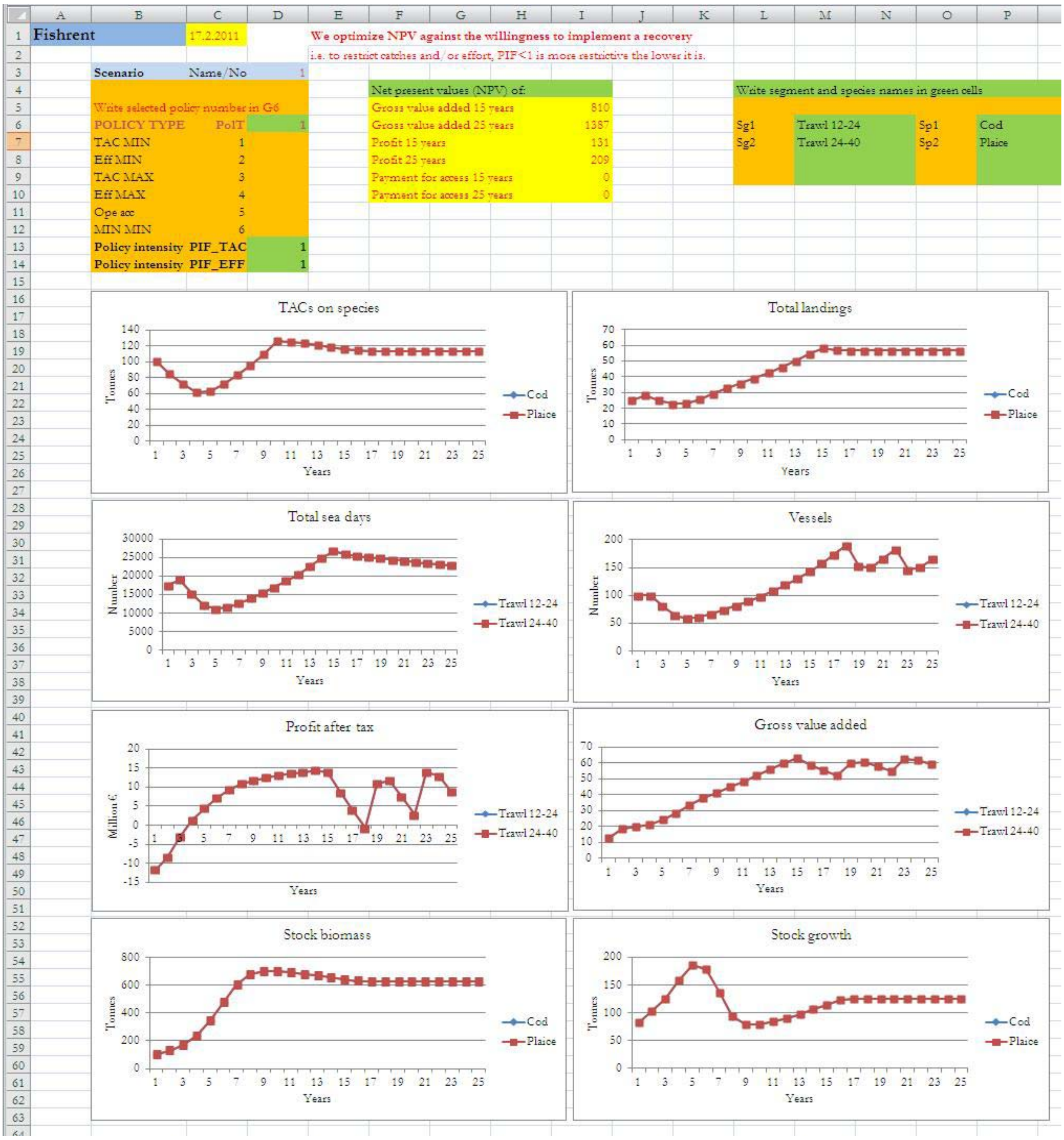
	A	B	C	D	E	F	G	H	I	J	K
1	**Fishrent**										
2	**Parameter values**	Insert values in the white cells after the parameter name. Do not touch other cells									
3											base
4											
5	Text	Formula, constraint, start value	Dimensions	Variable names	Base year values	Parameters		Expalnation in column T			
6	TAC/landings	Bio Constr	Tonnes	TAC_a1	100	Ftarget_a10	0.500	M_a10	0.2	Tac_a10	
7	TAC/landings	Bio Constr	Tonnes	TAC_a2	100	Ftarget_a20	0.200	M_a20	0.2	Tac_a20	0
8	Payment for access	Policy constr	1,000 €	PfAcc_1a	0	PfAcc_1a0	0	PfEff_1a0	0	ProTax_1a0	
9	Payment for access	Policy constr	1,000 €	PfAcc_2a	0	PfAcc_2a0	0	PfEff_2a0	0	ProTax_2a0	
10	Payment for fish	Policy constr	1,000 €	PfFish_a1	0	PfFish_a10	0				
11	Payment for fish	Policy constr	1,000 €	PfFish_a2	0	PfFish_a20	0				
12	Fleet (number of vessels)	Start value	Number	Fle_1a	100						
13	Days at sea/vessel - operational	Start value	Sea days/year	DASope_1a	175						
14	Days at sea/vessel - maximum	Constr	Sea days/year	DASmax_1a	190	DASmax_1a0	190	DASmax_1a1	0%		
15	Investment price vessel	Start value	1,000 €	InvPrice_1a	1	InvPrice_1a0	0%				
16	Investment (number of vessels)	Formula	Number	Inv_1a	-20	PrfShare_1a0	1	InvLimu_1a1	10%	InvLimd_1a2	20%
17	Nominal employment	Formula	Number / vessel	NoEmp_1a	2						
18	Full time employment (FTE)	Formula	Number / vessel	FTEmp_1a	2						
19	Fleet (number of vessels)	Start value	Number	Fle_2a	100						
20	Days at sea/vessel - operational	Start value	Sea days/year	DASope_2a	175						
21	Days at sea/vessel - maximum	Constr	Sea days/year	DASmax_2a	190	DASmax_2a0	190	DASmax_2a1	0%		
22	Investment price vessel	Start value	1000	InvPrice_2a	1	InvPrice_2a0	0%				
23	Investment (number of vessels)	Formula	Number	Inv_2a	-20	PrfShare_2a0	1	InvLimu_2a1	10%	InvLimd_2a2	20%
24	Nominal employment	Formula	Number / vessel	NoEmp_2a	2						
25	Full time employment (FTE)	Formula	Number / vessel	FTEmp_2a	2						
26	Target landing	Constr	Tonnes	LandT_11	25.0	TACsh_110	0.25				
27	Target landing	Constr	Tonnes	LandT_12	25.0	TACsh_120	0.25				
28	Target landing	Constr	Tonnes	LandT_21	25.0	TACsh_210	0.25				
29	Target landing	Constr	Tonnes	LandT_22	25.0	TACsh_220	0.25				
30	Catchable biomass	Start value	Tonnes	CB_a1	100.0						
31	Recruitment	Formula	Number fish	Rec_a1	83	Rec_a10	0	Rec_a11	0.95	Rec_a12	0.0
32	Catchable biomass	Start value	Tonnes	CB_a2	100.0						
33	Recruitment	Formula	Number fish	Rec_a2	83	Rec_a20	0	Rec_a21	0.95	Rec_a22	0.0
34	Catch	Formula	Tonnes	Catch_11	12.5	Catch_110	0.002	Catch_111	0.8	Catch_112	
35	Discards	Start value	Tonnes	Disc_11	0	Disc_110	10%	Disc_111	1		
36	Catch	Formula	Tonnes	Catch_12	12.5	Catch_120	0.002	Catch_121	0.8	Catch_122	
37	Discards	Start value	Tonnes	Disc_12	0	Disc_120	10%	Disc_121	1		
38	Catch	Formula	Tonnes	Catch_21	12.5	Catch_210	0.002	Catch_211	0.8	Catch_212	
39	Discards	Start value	Tonnes	Disc_21	0	Disc_210	10%	Disc_211	1		
40	Catch	Formula	Tonnes	Catch_22	12.5	Catch_220	0.002	Catch_221	0.8	Catch_222	
41	Discards	Start value	Tonnes	Disc_22	0	Disc_220	10%	Disc_221	1		
42	Fuel price	Start value	Coefficient	FuelPr_1a	1.00	FuelPr_1a0	0%	FuelPr_xa adjust the price LEVEL			
43	Fuel price	Start value	Coefficient	FuelPr_2a	1.00	FuelPr_2a0	0%	FuelPr_xa= adjust the price GROWTH			
44	Fish prices	Start value	€/kg	FishPr_a1	2.39	FishPr_a10	2.39	PrEl_a11	0.0000	PrSeg_110	
45	Fish prices	Start value	€/kg	FishPr_a2	2.39	FishPr_a20	2.39	PrEl_a21	0.0000	PrSeg_120	
46	Revenues	Formula	1,000 €	Rev_1a	59.6	OtSpR_1a0	0%	OtSpF_1a0	0.0000	OthSpK_1a0	0.0
47	Fuel costs	Formula	1,000 €	FuC_1a	17.5	FuC_1a0	0.001				
48	Crew costs	Formula	1,000 €	CrC_1a	14.9	CrC_1a0	0.25	CrC_1a1	0.0	CrC_1a2	0.0
49	Variable costs	Formula	1,000 €	VaC_1a	8.9	VaC_1a0	0.15				
50	Fixed costs	Formula	1000 € per vessel	FxC_1a	20.0	FxC_1a0	0.2				
51	Capital costs	Formula	1000 € per vessel	CaC_1a	10.0	CaC_1a0	0.1				
52	Profit discounted	Formula	1,000 €	PrfDis_1a	-11.4	Dis_1a0	3.5%	Inserted in "Drivers"			
53	Fuel use	Formula	1000 litres	FuU_1a	35.0	FuU_1a0	0.002				
54	Revenues	Formula	Coefficient	Rev_2a	59.6	OtSpR_2a0	0%	OtSpF_2a0	0.0000	OthSpK_2a0	0.0
55	Fuel costs	Formula	1,000 €	FuC_2a	17.5	FuC_2a0	0.001				
56	Crew costs	Formula	1,000 €	CrC_2a	14.9	CrC_2a0	0.25	CrC_2a1	0	CrC_2a2	0.0
57	Variable costs	Formula	1,000 €	VaC_2a	8.9	VaC_2a0	0.15				
58	Fixed costs	Formula	1000 € per vessel	FxC_2a	20.0	FxC_2a0	0.2				

Source: Framian (2011) FISHRENT Demonstration model

Model Output

11. The first thing that becomes apparent when opening the model is that the fishery is not in equilibrium in its initial state (Figure 3). The stock starts at a relatively low level, grows strongly, overshoots the equilibrium amount, then converges to a stable equilibrium. But not all variables behave smoothly. The share of profits that is reinvested in capacity can trigger oscillations in profits and number of vessels. The model shows discontinuous adjustment in many other elements as well—the TAC has a break point at year 10, while other fleet variables exhibit a break point at year 15.

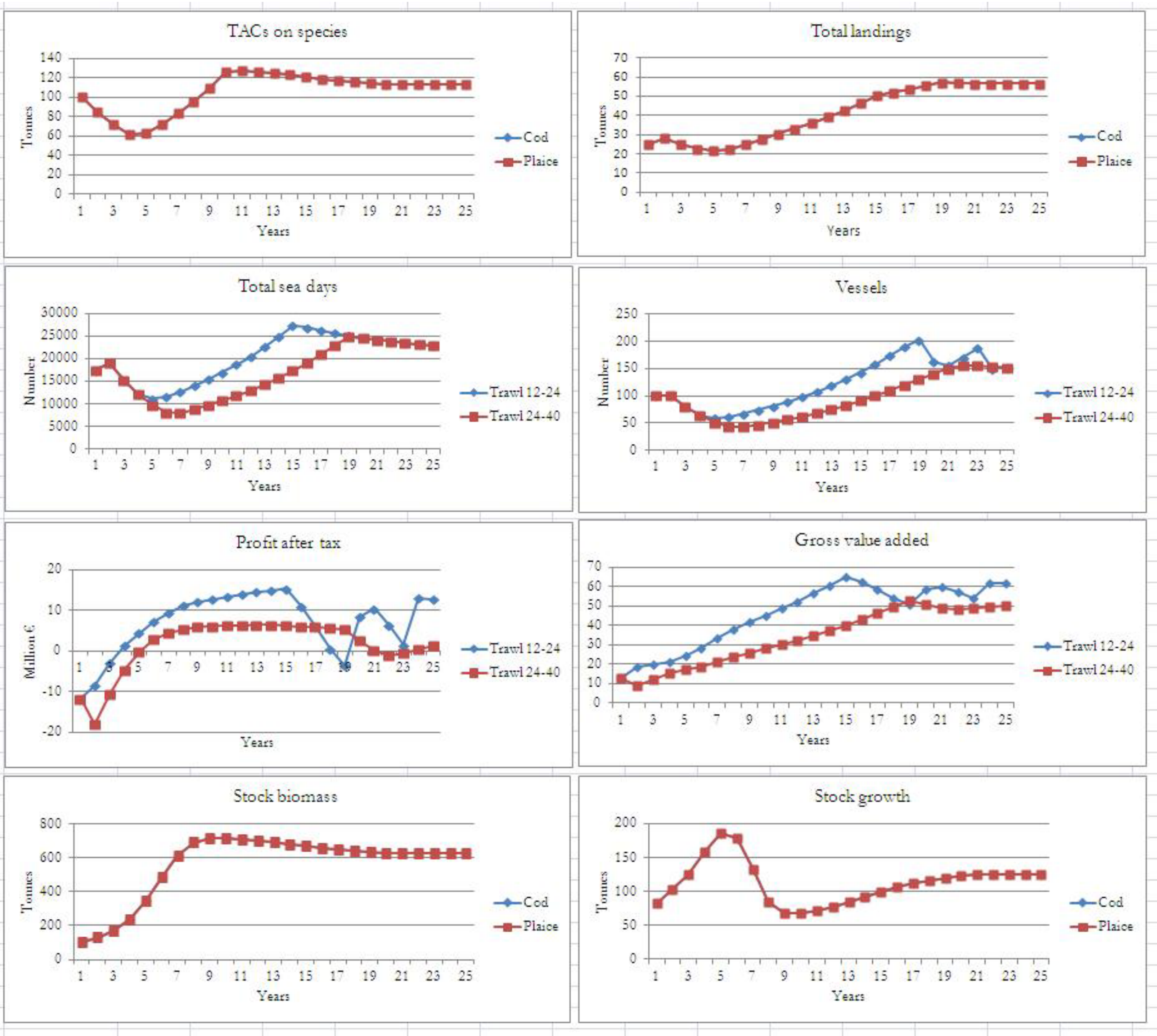
Figure 3. FISHRENT Output Charts



Source: Framian (2011) FISHRENT Demonstration Model

12. In the graphs in Figure 3, the two time series overlap because all the model elements are identical for the two species and fleet segments. Introducing a shock to fuel price of 50% to the 24-40m trawl segment causes the two to diverge (Figure 4). In particular, the profit of the higher fuel cost fleet is generally lower, and the number of vessels fewer.

Figure 4. Introducing a fuel shock to 24-40m trawl segment



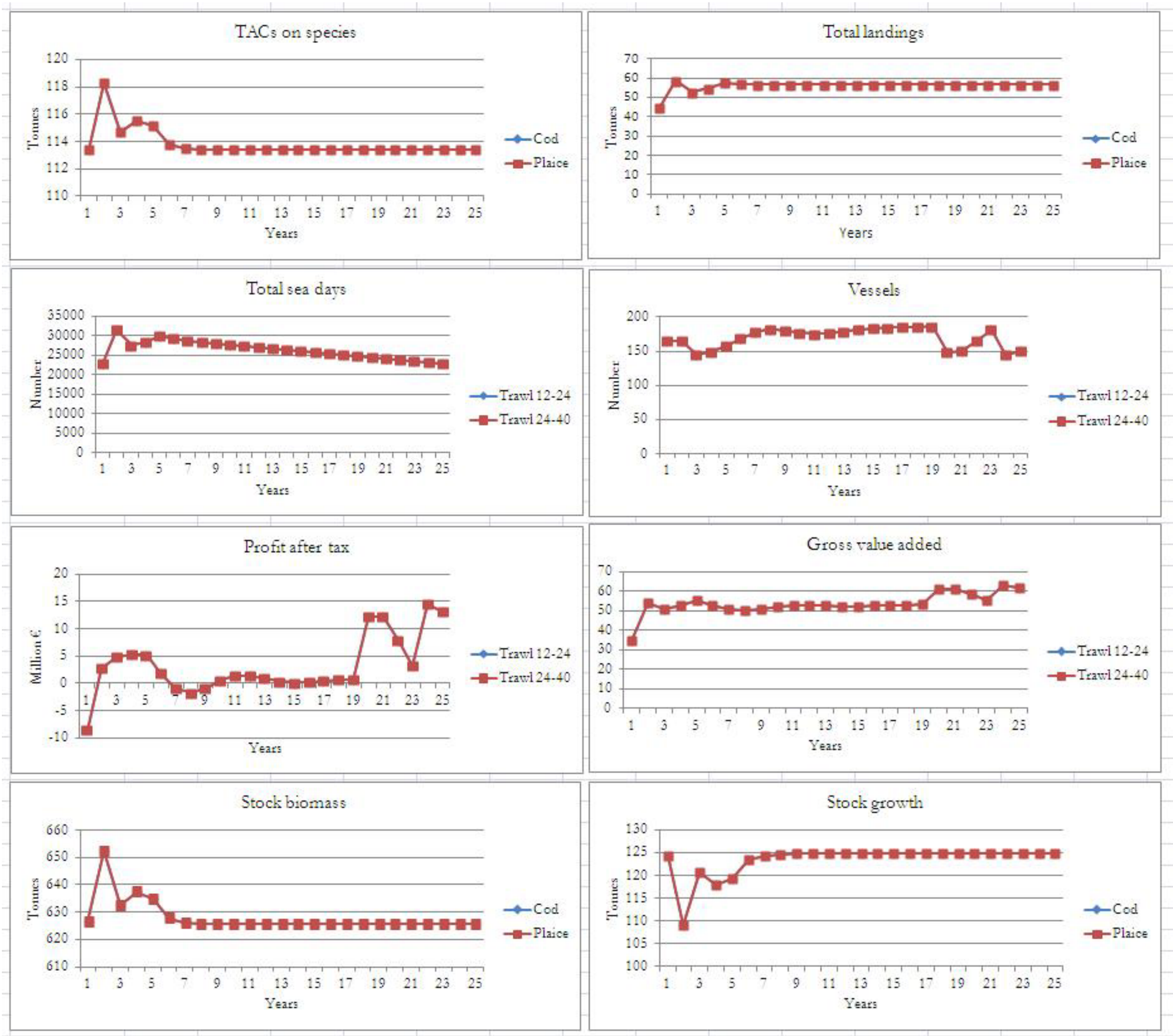
Source: FRAMIAN (2011) FISHRENT Demonstration model

13. Notice that the TAC is almost double landings in most years, and is not binding on either species. It should play no role in the equilibrium as a result, but changing the management regime to open access (not shown) results in significant changes, in particular in later years of the simulation, so the TAC has to be doing something in the model. The increased fuel price for 24-40m trawlers has affected profit, sea days and fleet size, but not harvest (even though effort as measured by total sea days is lower).

14. What happens if the model starts with an initial equilibrium? By setting the starting biomass, fleet size, TAC and days at sea equal to their final values from the simulation, the model should start near the

steady state. This works, but the expected straight lines in the graphs do not appear; there is some adjustment happening that follows no obvious pattern (Figure 5).

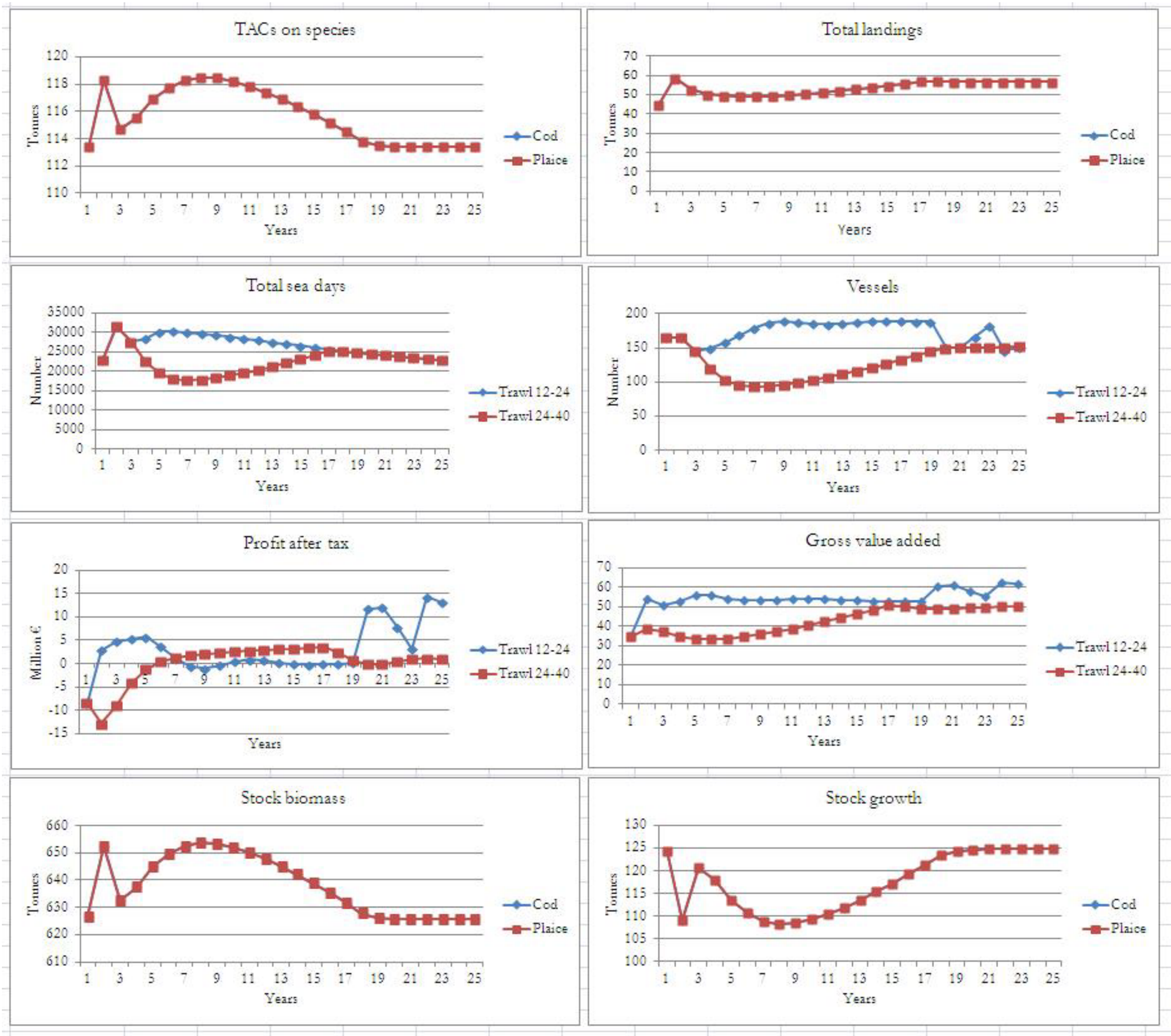
Figure 5. Attempting to find a steady-state



Source: Framian (2011) FISHRENT Demonstration model

15. Ignoring the inter-year variation in the simulation and re-introducing the 50% fuel price increase for 24-40m trawlers results in very similar steady-state outcomes (initial and final years are similar), but with a change in the evolution of the output variables along the time paths (Figure 6).

Figure 6. Fuel price shock with initial steady-state



Source: Framian (2011) FISHRENT Demonstration model

16. The fleet with the higher fuel cost starts the simulation with negative profits, leading to disinvestment and reduced fleet size. This eventually returns profits to a positive level. Profits for the higher fuel-cost fleet start out lower than the low-cost fleet, then are higher over the middle period before declining again. Profits of the low-cost fleet oscillate in the final years at a higher level than the high fuel cost fleet.[1]

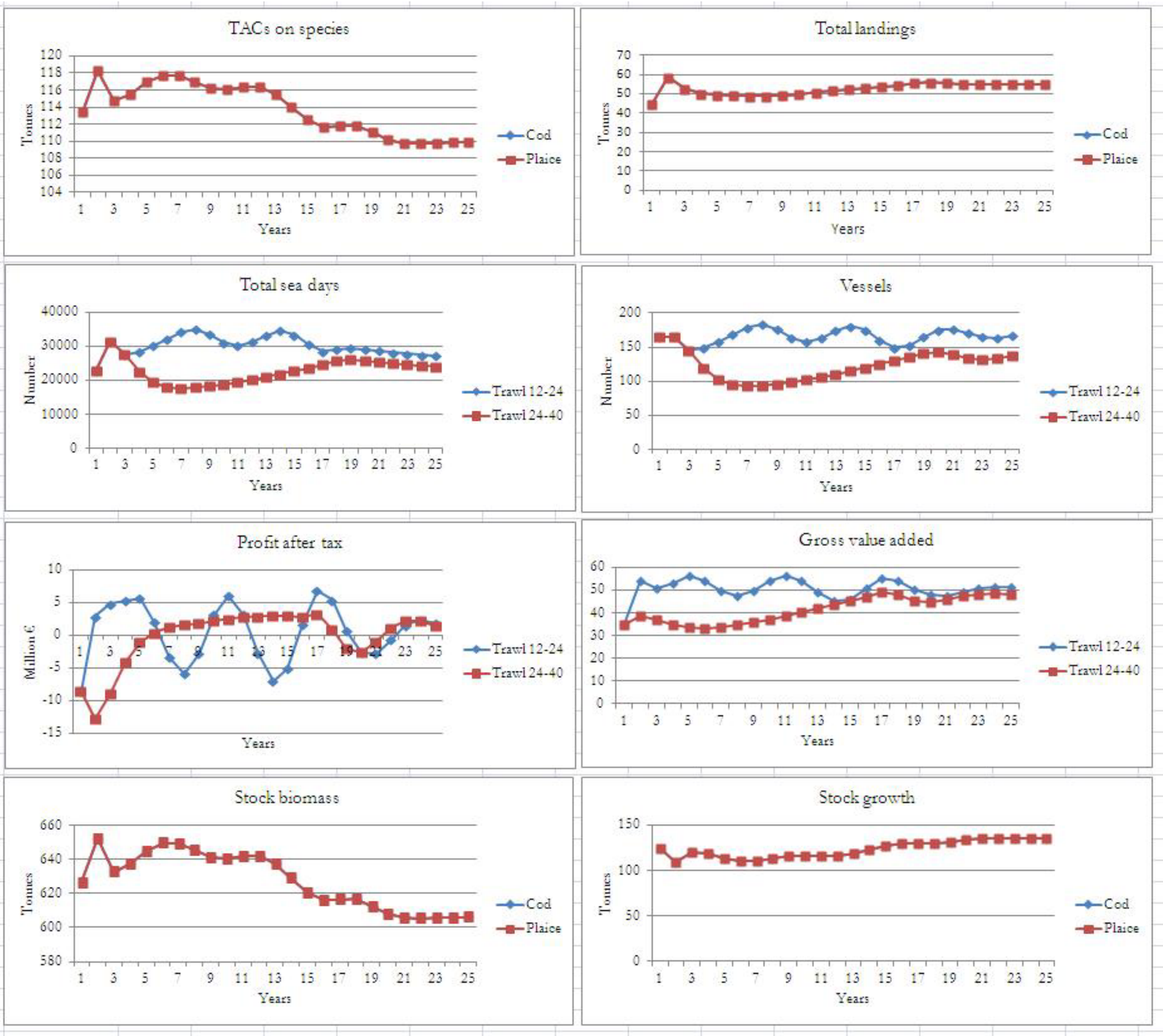
17. Changing the management regime from the TAC-based to effort-based has a significant impact on the results (Figure 7).[2] The low-fuel-cost fleet shows significant oscillations in profits and number of

1. The profit oscillations are probably driven by the fixed investment-profit relationship that leads to over- and under-shooting of the ideal fleet size.

2. The MIN and MAX settings for TAC and Effort do not change the results. This is because both fleets and stocks are identical, so MAX and MIN are also identical.

vessels, while the high-fuel cost fleet has a more steady pattern, with an initial reduction in number of vessels followed by steady growth and finally the beginnings of an oscillation pattern. Again, different fuel costs have no impact on the stock biomass or harvest levels, despite changing total days at sea.

Figure 7. Steady state with effort controls and 50% fuel price shock for 24-40m fleet



Source: Framian (2011) FISHRENT Demonstration model

18. There are several open questions about the operation of the model. The stock growth rate usually exceeds the TAC which in turn exceeds total landings. The reason for this is unclear[3]. The relationship between stock growth, landings and biomass is unclear, as Figure 7 demonstrates. Further, the relationship between effort and landings is not clear, as reduced effort (as measured by total days at sea) does not lead to reduced landings, either under a TAC or an effort-based management regime. Finally, there are several instabilities and oscillations in the model that hinder understanding of the results.

3. Discards are always zero in the model, so this cannot be part of the answer.

19. It should be pointed out that this is just a demonstration version of the model, and some of the problems identified likely stem from inappropriate parameter choices rather than a fundamental problem with the model. At the same time, this is the only version of the model that is publically available and so is the only one that could be used by the OECD. The more sophisticated version of the model could be used only as a consultancy with the developers.

Conclusions

- Even though all the elements of the FISHRENT model are very simply defined, when all are taken together along with the dynamic feedbacks in the model, it remains quite complicated and understanding the output is not straightforward.

- FISHRENT is composed of many very simple elements, but the management system dominates very strongly, and the dynamic nature of the outputs significantly complicates interpretation. What was at first view a simple model is in fact challenging to understand and interpret. The Secretariat does not currently have the expertise to understand and describe the results in a way that produces a useful output. For this reason, if it is decided to carry out work using FISHRENT, this is best done by the model authors as part of a consultancy using voluntary contributions.

- Fisheries modelling is very heavily conditioned on the assumptions surrounding the management regime in place. That is, there is not an "objective" impact of fuel tax concessions that can be separated from the specifics of the management regime. This is also likely the case for the biological specifics of individual fisheries. This speaks again to the importance of expert rather than casual use of a model. In the case of FISHRENT, which is designed as a policy-comparison model, it is difficult to unpack the effects of management settings in the model from changes in the price of fuel (due to FTCs), especially because of the dynamic effects.

Item 2: Are outcomes of simulations of such models likely to contribute to the understanding of effects of a phasing out of tax concessions on inter alia catches, income, profitability, capacity and employment

20. While in principle it is possible for a quantitative model to investigate the effect of FTCs on catches, income, profits, capacity, employment or other indicators, in practice there is no model that can cover all these issues at once. Moreover, such modelling exercises will depend on the specific features of the fishery represented in the model and the management system in place. For this reason, it is unlikely that the OECD could undertake a quantitative modelling exercise whose insights could not be achieved more simply through analytical work.

21. This does not mean that quantitative work is impossible. There are other modelling exercises underway, most notably but not limited to the work being carried out under the auspices of the Nordic Council of Ministers. These exercises benefit from the larger commitment of resources that is required to produce useful results. The OECD has worked very fruitfully in the past with other international organisations or academics to take on board the results of their analysis. For example, the FAO and World Bank have produced analysis that has informed and aided OECD work.

22. There is no potential for the OECD to itself produce meaningful and timely quantitative estimates of the impact of FTCs on the indicators that have been identified by the COFI. Secretariat resources are simply too limited to take on such an ambitious task. Moreover, there is no model that is both general enough to be useful to an OECD audience and specific enough to provide realistic results, and no possibility for the Secretariat to develop such a model on its own.

Item 3: Whether or not to pay attention to other aspects such as stocks, social factors and green house emissions.

23. Broader indicators such as social factors or greenhouse emissions add another layer of difficulty, calling for models with a broader scope. Such models omit fisheries-specific detail and are better suited to considering general energy taxation rather than fisheries-specific policy. There will always be a number of projects underway to evaluate the global economic and environmental impact of policies. For example, the ENV/LINKAGES model is used for this on an ongoing basis. Quantitative data on broader indicators, if desired, should be sought from existing projects, keeping in mind the absence of fisheries-specific detail.

Discussion and Recommendations

24. Over the last year the OECD COFI Secretariat has been considering whether it is possible for it to produce quantitative modelling work regarding FTCs in fisheries. The answer at this point is a clear and definitive “no”. The lack of specific in-house expertise, the considerable resource requirements implied, and the sustained long-term effort required to produce useful results of this kind go beyond what is currently possible. The FISHRENT model was thought to provide a relatively low-cost way for the Secretariat to produce quantitative estimates, but further investigation has shown that this model is both more complicated and its output less useful for FTC modelling than previously thought.

25. Moreover, the COFI has pointed out that the objectives motivating such an undertaking are unclear, and there is currently no consensus on the part of the member countries as to the objectives of this work. The clearest rationale proposed so far has been that such quantitative results could support WTO negotiations in this area, but these negotiations are currently dormant.

26. It was mentioned several times during the 109th session that the Nordic Council of Ministers has been funding work on the impacts of FTCs. The Secretariat has been following the progress of this work and notes that the scale of resources dedicated to that effort is both more appropriate to the task and far beyond what the Secretariat has at its disposal. Inasmuch as this work will produce estimates of the type sought by Member Countries, it should serve to fill the demand for such output.

27. This does not mean that the OECD has nothing to say on this subject. The OECD’s comparative advantage and mandate is to produce evidence-based economic analysis guided by the agreed principles of the Organisation. The Green Growth Strategy of the Organisation provides a set of guiding principles and practical advice to help address the issues raised by the use of FTCs. Work as been proposed and approved in the 2013-14 Programme of Work and Budget of the COFI that will investigate policies related to energy use in fisheries, including FTCs. In the Summary Record of the 109th Session it was agreed that “the work under the title, ‘A Green Growth Perspective on Energy Use in Fisheries and Aquaculture’, would continue, producing a document that is focused on policy analysis and recommendations that builds upon the current work…”.

28. Moreover, broad interest in FTCs as a form of support to fossil fuels remains high. In September 2009, G20 Leaders agreed to rationalise and phase out, over the medium term, inefficient fossil fuel subsidies. Previous OECD work [TAD/FI(2010)8/FINAL] has helped to quantify the scale and extent of FTCs, an important step. Broader OECD work on this subject is ongoing (see [ENV/EPOC/EAP(2012)2] for example), and the COFI can play a role by sharing the data it has collected and helping to identify policy solutions that work for the sector.

29. Given the considerable overlap between the ongoing work on energy use in fisheries and the question of the impacts of FTCs, it would be most efficient to consider the impact of FTCs as part of the work on energy use in fisheries and aquaculture, using analytical approaches that are more feasible and that will be more likely to produce policy recommendations that are useful to member states.

ANNEX 1: SUMMARY RECORD OF ITEM 7 OF THE 109TH COFI

7. Programme of Work 2013-14: Further discussion of deliverables in 2012, 2013 and 2014, adoption of template *[TAD/FI(2012)9 TAD/FI(2012)9/ANN]*

The Secretariat presented document TAD/FI(2012)1, "An Evaluation of Alternative Methods for Analysis of Fuel Tax Concessions in Fisheries", as was requested at the previous meeting. Several delegates appreciated the documents as an important contribution to a discussion on a subject of highest policy relevance, *inter alia* in OECD, WTO and G20. Others expressed concern with three issues. First, some delegates asked for more clarity regarding the objectives and outcomes of such a study. That is, whether the purpose is to evaluate impacts of Fuel Tax Concessions (FTCs) on fish stocks, profitability of fishers, or other indicators such as social impacts. The second issue was the level of resources required and the capacity of the Secretariat to effectively carry out this work. The third issue was the availability of data, in particular the suitability of the existing FTC data to support cross-country analysis. The COFI agreed to request a feasibility study for its next meeting in order to firstly, find out the relevance and possible application of existing models, such as the FISHRENT model, secondly to decide whether outcomes of simulations of such models are likely to contribute to the understanding of effects of a phasing out of tax concessions on *inter alia* catches, income, profitability, capacity and employment, and thirdly to decide whether or not to pay attention to other aspects such as stocks, social factors and green house emissions. All these relevant points would be discussed and agreed at the 110th Session of COFI.

Several delegates informed the committee on the work being undertaken by the Nordic Council of Ministers in this area. This work would be considered for presentation to COFI with a view to seeing how this work could contribute to OECD work in this area.

附件 3

漁業管理手冊草案：TAD/FI(2012)7/REV1

For Official Use **TAD/FI(2012)7/REV1**

Organisation de Coopération et de Développement Économiques
Organisation for Economic Co-operation and Development **25-Sep-2012**

English - Or. English

TRADE AND AGRICULTURE DIRECTORATE
FISHERIES COMMITTEE

TAD/FI(2012)7/REV1
For Official Use

The OECD Handbook for Fisheries Managers

Principles and Practice of Policy Design

Paris, 29-31 October 2012

This document is presented to the 110th session of the Committee for Fisheries under Draft Agenda item 4 for DISCUSSION and APPROVAL

Roger Martini (roger.martini@oecd.org)

JT03326840

English - Or. English

Note by the Secretariat

This report draws upon past OECD publications to provide advice to fisheries managers and other policy makers on the principles and practice of good policy design in fisheries. It is intended to be a comprehensive review of OECD COFI document spanning approximately the last ten years. A partial version titled “Fisheries Managers’ Handbook” was presented to the 109th Session of the COFI. This version is the complete text of the report and is presented to the 110th session of COFI for discussion and approval.

Data provided in this report come from OECD publications. Data from older publications have not been updated for this report and so may not fully reflect the current situation.

This document was edited by Romy de Courtay.

TABLE OF CONTENTS

Tables

Figures

Boxes

ACRONYMS

DEFRA	Department for Environment, Food and Rural Affairs (United Kingdom)
EEZ	Exclusive Economic Zone
FAO	Food and Agriculture Organization of the United Nations
FoS	Friends of the Sea
IEQ	Individual non-transferable effort quotas
IMO	International Maritime Organization
IOC	Intergovernmental Oceanographic Commission
IOM	Integrated ocean management
IQ	Individual non-transferable quotas
ITQ	Individual transferable quota
IVQ	Individual vessel quota
IUU	Illegal, unreported and unregulated
LL	Limited Licence
MEY	Maximum economic yield
MSC	Marine Stewardship Council
MSE	Management Strategy Evaluation
MSY	Maximum sustainable yield
MT	Mega tonne
OA	Open Access
NPV	Net present value
RFMO	Regional fisheries management organisations
TAC	Total allowable catch
TAE	Total allowable effort
TC	Total cost
TR	Total revenue
TURF	Territorial use rights in fisheries
UNDP	United Nations Development Program

THE OECD HANDBOOK FOR FISHERIES MANAGERS: PRINCIPLES AND PRACTICE OF POLICY DESIGN

Foreword

1. Today's fisheries managers face the challenge of trying to conserve increasingly scarce resources using a set of tools that has evolved over the past few decades. Once concerned mainly with devising efficient means and methods to catch more fish and share the seas' abundance, the science of fisheries management now involves better managing the finite "common" fish resources of the world's oceans and the sector's impacts on the environment, as well as on other users and interests. At the same time, consumers are increasingly concerned with the sustainability of the fish products they purchase.

2. Based on work already carried out by the OECD Committee for Fisheries, this handbook intends to present a modern view of fisheries management, in particular with respect to setting objectives and designing effective policy instruments. It highlights the importance of economic incentives and political economy. It demonstrates how fisheries managers can use incentives to deliver effective policies and achieve effective results.

3. The OECD Committee for Fisheries has developed a large body of research over the years investigating fisheries policy and fisheries management. This handbook combines this work into a comprehensive volume designed to help fisheries managers maximise the economic and social value of the fisheries resource while conserving it for the long term.

4. Several existing reference texts target fisheries managers, of which the technical paper *Fishery Manager's Guidebook* (Food and Agriculture Organization of the United Nations [FAO], 2002) is a good example. Rather than replicate the information provided in these publications, the handbook aims to complement them by focusing on the nuts and bolts of good policy design, making it particularly useful to:

- fisheries executives involved in policy design and development;
- fisheries managers at a local, national or regional scale; and
- industry representatives, members of environmental organisations or other NGOs with a more general interest in fisheries policy design.

5. This handbook is based on recent OECD publications on fisheries. It reviews different topics on which the Fisheries Committee has worked and summarises related documents.

- **Chapter 1** provides an introduction to fisheries management's objectives, instruments, benefits and beneficiaries.
- **Chapter 2** reviews the main economic concepts and theories relevant to fisheries management.
- **Chapter 3** explores the problem of and possible solutions to excess fishing capacity.
- **Chapter 4** describes management tools, and in particular market mechanisms such as individual transferable quotas.

- **Chapter 5** covers the economics of and approaches to rebuilding and restoring fisheries to safe biological, economical and social limits.

- **Chapter 6** discusses the human dimension of fisheries management, particularly the problem of fishers adjusting to long-run changes in the fishery.

- **Chapter 7** presents the main issues and some practical applications of policy coherence for fisheries development.

- **Chapter 8** discusses certification in fisheries and aquaculture.

- **Chapter 9** covers the increasingly important topics of aquaculture, recreational fishing and competition among users of aquatic resources.

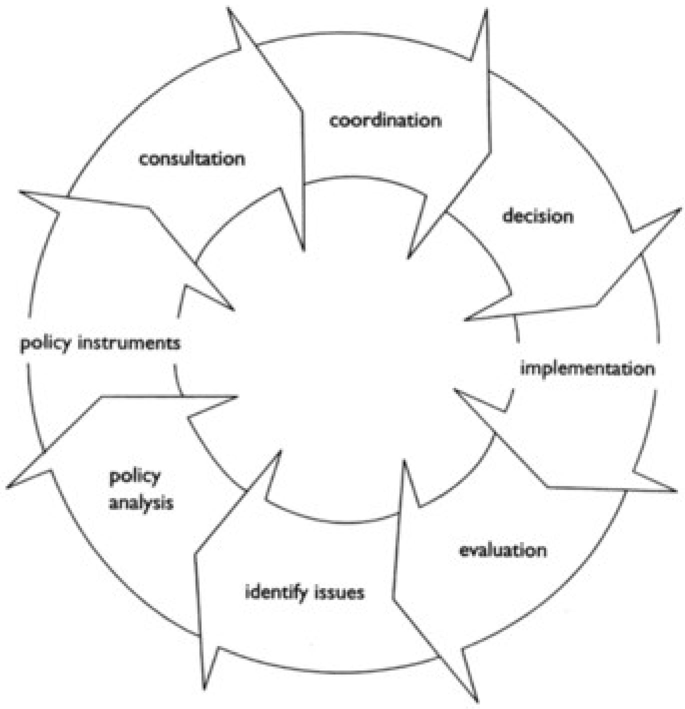
- **Chapter 10** concludes by reviewing the key issues and provides a policy checklist for sound fisheries management.

CHAPTER 1. INTRODUCTION TO FISHERIES MANAGEMENT

6. This chapter introduces the concept of fisheries management and the role of the fisheries manager. It outlines both the prerequisites and requirements of successful fisheries management. It emphasises the importance of good policy design, setting the stage for the specific subjects addressed in subsequent chapters.

7. Policy development is a cyclical, never-ending process – policies always need to be adjusted to conform to emerging needs and developments and their performance can always be improved (Figure 1.1). Thus, policies evolve continuously as policy makers respond to stakeholders, changing circumstances and technological advancements. Figure 1.1 highlights some of the typical elements of policy development and activities in practice.

Figure 1.1. The policy development cycle



8. The policy development process has five main steps, as follows.

1. **Formulate** objectives, identifying policy issues through consultations, feedback, political pressure, and advice from experts and bureaucracies.

2. **Evaluate** the performance of current policies and approaches to achieve the objectives identified in Step 1; this requires tangible information on costs and benefits.

3. **Define** the operational characteristics of new polices and approaches to fisheries management – e.g. using market-based approaches, harvest control rules, and modes of financial transfers.

4. **Implement** new policies, using learning and feedback that may lead to needed adjustments; stakeholder involvement may help in this regard.

5. **Monitor and evaluate** by developing control and information systems to evaluate the fishery's performance with regard to the objectives set out in Step 1; ensure the right data is collected to support evaluation.

9. Good policy design is not enough. For policy reform to be effectively implemented at the ground (or sea) level, the sector must be prepared for reform and obstacles to change removed. Stakeholders must understand the need for the policy process, see a role for themselves in it, and feel that the sacrifices and risks that come with changing to a new and unfamiliar system are balanced by the resulting benefits – for themselves as well as for others (Box 1.1). In some cases, losers will need to be compensated. Those who choose to leave – or remain in – the fisheries sector may receive help through "flanking measures" designed to assist adjustment.

Box 1.1. Principles for Effective Stakeholder Participation

1. **Commitment**: Leadership and strong commitment to open and inclusive policy making is needed at all levels – politicians, senior managers and public officials.

2. **Rights**: Citizens" rights to information, consultation and public participation in policy making and service delivery must be firmly grounded in law or policy. Government obligations to respond to citizens must be clearly stated. Independent oversight arrangements are essential to enforcing these rights.

3. **Clarity**: Objectives for, and limits to, information, consultation and public participation should be well defined from the outset. The roles and responsibilities of all parties must be clear. Government information should be complete, objective, reliable, relevant, and easy to find and understand.

4. **Time**: Public engagement should be undertaken as early in the policy process as possible to allow a greater range of solutions and to raise the chances of successful implementation. Adequate time must be available for consultation and participation to be effective.

5. **Inclusion**: All citizens should have equal opportunities and multiple channels to access information, be consulted and participate. Every reasonable effort should be made to engage with as wide a variety of people as possible.

6. **Resources**: Adequate financial, human and technical resources are needed for effective public information, consultation and participation. Government officials must have access to appropriate skills, guidance and training as well as an organisational culture that supports both traditional and online tools.

7. **Co–ordination**: Initiatives to inform, consult and engage civil society should be coordinated within and across levels of government to ensure policy coherence, avoid duplication and reduce the risk of "consultation fatigue." Co-ordination efforts should not stifle initiative and innovation but should leverage the power of knowledge networks and communities of practice within and beyond government.

8. **Accountability**: Governments have an obligation to inform participants how they use inputs received through public consultation and participation. Measures to ensure that the policy making process is open, transparent and amenable to external scrutiny can help increase accountability of, and trust in, government.

9. **Evaluation**: Governments need to evaluate their own performance. To do so effectively will require efforts to build the demand, capacity, culture and tools for evaluating public participation.

10. **Active citizenship**: Societies benefit from dynamic civil society, and governments can facilitate access to information, encourage participation, raise awareness, strengthen citizens" civic education and skills, as well as to support capacity-building among civil society organisations. Governments need to explore new roles to effectively support autonomous problem-solving by citizens, CSOs and businesses.

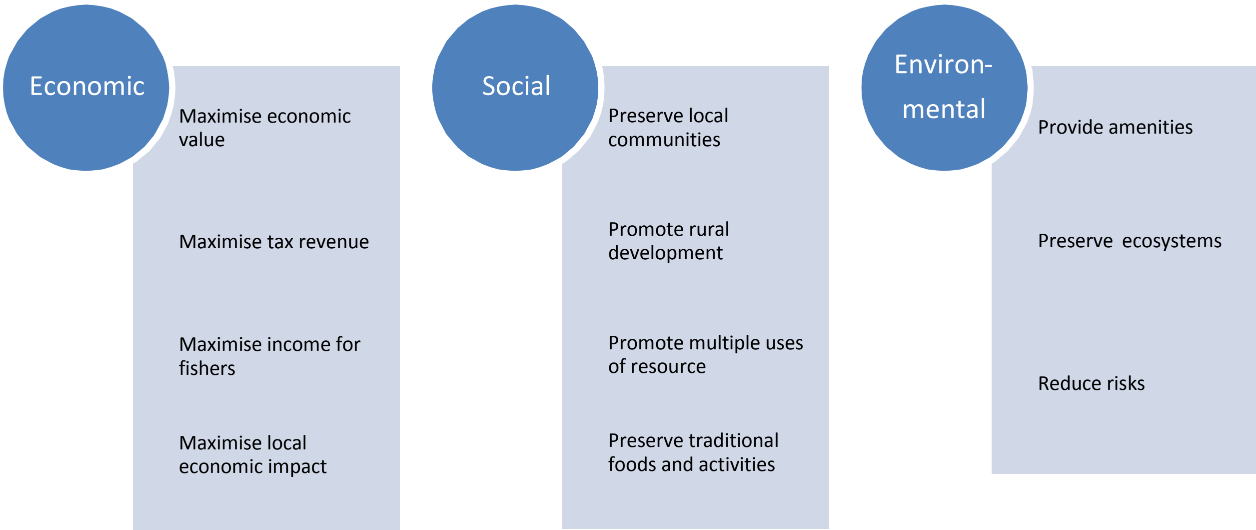
Source : OECD Background Document for meeting "OECD Guiding Principles for Open and Inclusive Policy Making", 2010.

Setting policy objectives

10. Good fisheries policy design begins with clearly defined economic, social, and environmental objectives (Figure 1.2).

11. Fisheries management is generally perceived as management of the stock level as expressed in available fishable biomass. However, the latter is mainly important to ensure meeting more fundamental economic and social objectives. While generally recognised as intrinsic, the value of fish stocks and ecosystems is both subjective and difficult to measure. Moreover, non-market valuation of the resource often relates more to the general health of the ecosystem, of which commercial fish stock size is only a component. For the fisheries manager, the stock's biomass is a means to an end – the end being the ability to deliver on policy objectives.

Figure 1.2. Some possible objectives of fisheries management



12. Nevertheless, stock management is often the fisheries manager's most important task. If the stock is not maintained at a healthy and sustainable level, the fishery will eventually collapse and no longer contribute to government objectives[1]. Responsible policy makers set sustainable, scientifically based, and prudent stock objectives.

13. The objectives of fisheries management policies are often ill-defined, poorly understood by involved parties and stakeholders, or hidden behind other stated objectives. This may be due to a poorly designed policy development process, policy that is developed in response to political pressures, or the persistence of existing policies long after public objectives have changed. The last factor in particular – ***path dependence*** – hinders good policy design. Without clearly stated and transparent objectives, effective policies cannot be designed and the success of fisheries management cannot be gauged.

> ***Path dependence:*** *When past policies strongly influence current or new policy designs. This can be a serious problem when objectives change, but the policy tools do not.*

14. Not all objectives are compatible with one another – which is another reason why good policy thinking starts with clearly defined objectives (Box 1.2). It is not uncommon for policies to express

1. The assumption here is that the fisheries manager would not have the objective of exhausting the resource.

together two frequently conflicting goals, i.e. maximising the fishery's contribution to the economy and preserving small-scale artisanal fishing. This, of course, leaves little room for success. The policy should focus on one or another of these goals; trying to achieve both at once will inevitably lead to failure.

15. Identifying objectives also highlights potential conflicts and areas requiring compromise. This contributes to overall ***policy coherence***, an important characteristic of good policy design.

Box 1.2. Dealing with multiple fisheries management objectives

The necessity of a broad perspective that encompasses the full range of objectives is inherent in the concept of "objectives-based" decision-making in policy and management (not only in fisheries but across many sectors). Objectives-based approaches focus on linking the actions taken to the objectives being pursued, typically within a hierarchy of objectives (see figure below). While this is in a sense simply a logical decision-making arrangement, and reflects a standard approach utilised in planning and operations management, its new-found popularity is useful in reminding us of the importance of having policy and management decisions responsive to societal objectives.

Two realities must be noted in relation to the pursuit of multiple objectives in the fishery. First, with multiple objectives, there will always be some degree of trade-off among them. As Hersoug (2006) notes, "…there are obvious contradictions between the goals, and goal attainment can only be measured as some form of compromise. Greater attention to profitability will for example lead to less employment and most probably to legitimacy problems."

Second, in pursuing a multiple set of objectives…, there is a need for efficiency in policy implementation. To this end, a broad view of efficiency is required, *i.e.* seeking to obtain the greatest benefits (in terms of meeting objectives, within a long-term perspective) at the least cost. Such a perspective can be used to determine the preferred fishery configuration, *i.e.* what the fishery should look like in terms of a desired "mix" among multiple user groups (such as commercial, recreational, and subsistence fishers), scales of operation (notably small-scale *vs.* large-scale, or artisanal *vs.* industrial), and gear types. Also, within any single user group or gear type in the fishery, there is a need to decide on the balance among a variety of inputs that combine to produce fishing effort (labour, capital, technology, management and enforcement activity, etc.). These decisions all depend on the blend of societal objectives pursued, and the capability of the various fishery players to meet those objectives.

Sources: *Charles*, 2007; Hersoug, 2006.

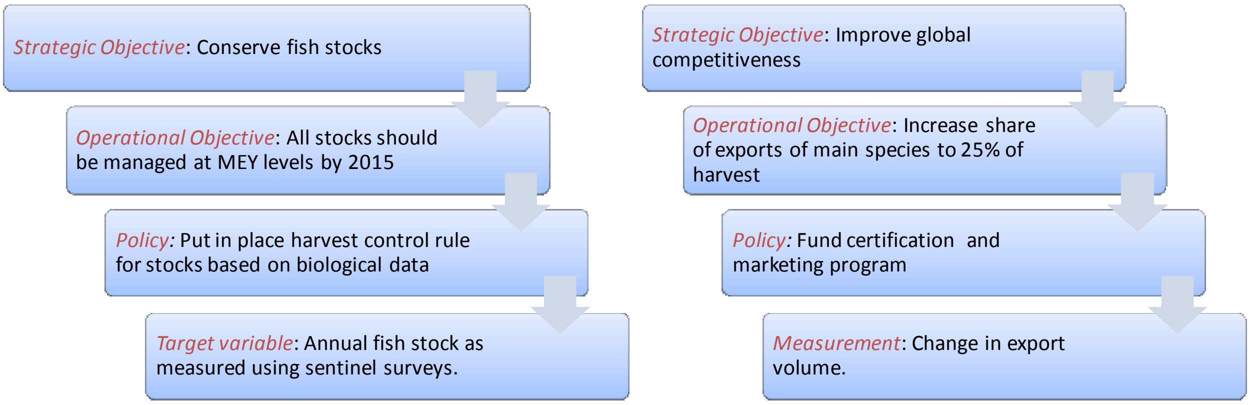
16. The objective-setting process is fundamentally a political one. It is an expression of social choice, which means that elected officials set policy objectives – in consultation with or on the advice of fisheries managers and stakeholders – and fisheries managers devise the best tools to achieve them. While objectives can be evaluated in terms of their practicality and consistency with a set of agreed principles, different governments have different priorities and will choose objectives to suit their purposes. Nevertheless, they should pay due regard to relevant rules of international law, and in particular to the Code of Conduct for Responsible Fisheries. The goal of this handbook is to help fisheries managers meet objectives as efficiently and effectively as possible.

- ***Define objectives*** *clearly from the beginning*
- *Make sure multiple objectives* ***do not conflict***
- ***Set deadlines*** *and measurable criteria for success*

17. Good objectives are explicit, quantifiable and time-bound. They should start with a general statement of principle, reference the related policies and be operational so that their achievement can be evaluated with the relevant measurement tools (Figure 1.3). Broad objectives such as "improving competitiveness" are difficult to quantify, hence the need to define them in more precise terms. Adding a target deadline also signals urgency and ensures effective progress. An objective with no time frame need never be reached.

Figure 1.3. Objective-setting hierarchy

Two hypothetical examples



Targeting and tailoring policies

18. Clear objectives provide measurable targets that aid policy development. Without targets, policies can avoid serious evaluation of their ability to deliver cost-effective benefits. For example, fuel tax concessions are part of fisheries policy of most OECD countries. Is their goal to improve fishers' income, increase fishing effort, to preserve small fishers? Rather than being developed from clear objectives, these concessions are often rooted in the observation that fuel is a major contributor to the overall cost of fishing, and –aided perhaps by sectoral lobbying – leads to the conclusion that something must be done. This gets the policy development process backwards, by reacting to a situation without reflecting on the policy's goals.

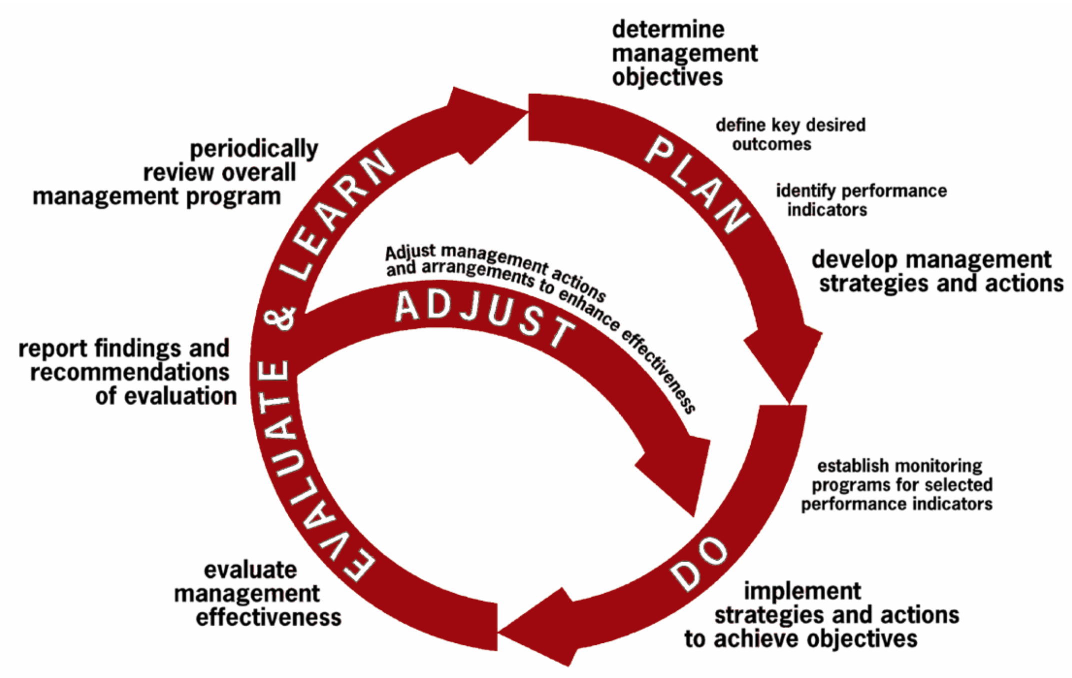
> ***Targeting**: Directing policy at specific recipients to maximise effect and minimise wasteful spending.*
>
> ***Tailoring**: Ensuring that the level of policy effort matches that needed to obtain desired results (don't over-incentivise or over-compensate).*

19. In some cases – such TACs and stock level objectives – the policy and the operational objective are closely related. While preferable, this approach is not always possible. In other cases – e.g. structural adjustment policies such as early retirement schemes or technical restrictions on vessel length or power – policies only indirectly influence the objective and their impact can be hard to measure.

Measuring progress

20. Measuring progress toward objectives is just as critical in the policy design process as establishing those objectives in the first place. Positive reforms are more likely to occur if the results of a set of fisheries management policies have been evaluated and policies seen to be falling short are corrected. This is the core element of **adaptive management** (Figure 1.4).

Figure 1.4. The Adaptive Management cycle



Source: CSIRO http://www.cmar.csiro.au/research/mse/images/adaptive_cycle.gif

Setting priorities and policies

21. As stated earlier, stock management objectives exist to enable more fundamental economic and social objectives. And yet stock management takes up most of the fishery manager's time and effort, because most policy objectives depend on maintaining a healthy and productive fish stock. Without it, none of the other objectives are reachable.

22. The fisheries management system plays a larger role in stock management and will have a greater impact than other fisheries policies, as it sets the context in which they operate. Choosing input- or output-based control as the main tool to regulate harvest has particularly strong implications on the types of incentives provided to the fisher. In particular, the choice of whether to use predominantly input- or output-based controls to regulate a fishery is fundamental to its operation and how fishers respond to the incentives generated by policies (Box 1.3).

Box 1.3. Input or Output Controls?

Choosing input- or output-based control as the main tool to regulate harvest has particularly strong implications on the types of incentives faced by the fisher.

Input controls set limits on how fishers can operate, when they may do so, and the gear and vessel they can use. Input controls reduce effort by limiting fishers to a fixed set of operational strategies. Days-at-sea and seasonal closures of fisheries are important examples. Input controls change the relative rates of return on inputs such as time, energy and capital, changing the choices fishers make as they try to maximize revenue within the system's constraints.

Output controls (such as setting an overall TAC or an individual fisher's quota) are usually more effective at reducing fishing effort and are often used in conjunction with input controls. Output controls tend to introduce fewer constraints on fishers' strategies, leading to higher profits for the same amount landed. Rights-based management (RBM) systems seek to align the fishers' interests with the management system's objectives, thereby making the system more effective and efficient, and so a growing number of output control systems are based on these (see Chapter 4).

By their very nature, input controls will always be chasing technology and fighting fishers' capacity to increase harvest through alternative means. Output controls eliminate this problem by limiting the overall stock harvest to a set TAC. When combined with tradable access permits such as ITQs, they reduce capacity so that technical and economic overcapacity are better balanced.

The benefits of fisheries management

23. Fisheries management exists because fisheries tend to do poorly when left unregulated. This is due to the "tragedy of the commons"– the tendency for common or public resources to be overexploited. Garrett Hardin (1968) famously described this phenomenon in chronically overgrazed communal pastures. In an open-access fishery, fishers have little incentive to conserve the fish stock as the benefits of doing so will likely be enjoyed by others. The tragedy of the commons arises because no one can be assured of benefiting from conservation, no one has an incentive to conserve the resource for the future.

*The **tragedy of the commons** is the tendency for common or public resources to be overexploited.*

24. Unmanaged open-access fisheries generally feature too many fishers and too few fish. Open-access problems are failures of co-operation – fishers cannot co-ordinate to share the benefits of conservation. The role of the fisheries manager is to establish policies that either enable co-operation or replace it with effective controls.

25. The benefits of good fisheries management are clear and few truly open-access fisheries remain in the world. Yet not all regulated fisheries are doing well: according to statistics, more fisheries fail than succeed at stock management (FAO, 2009). Fisheries management is complicated, its difficulty compounded by uncertainty, perverse incentives, incompatible objectives, imperfect enforcement and lack of data and information.

26. Managing fisheries sustainably means ensuring the stock is harvested in a manner that does not damage its long-term availability or its ability to withstand natural environmental variations. This requires good policy design based on sound research, clearly understood objectives and effective administration and enforcement.

Table1.1. Key features of fisheries management frameworks in OECD countries

		Responsibility for delivery of…			
Country	**Policy setting**	**Research services**	**Management services**	**Enforcement services**	**Stakeholder participation**
Predominantly output controls					
Iceland	Ministry of fisheries	Marine Research Institute; Directorate of Fisheries (for Statistics)	Ministry of Fisheries (TAC setting); Directorate of Fisheries	Directorate of Fisheries; Icelandic Coast Guard	Institutionalised consultation with Icelandic Fishermen's Association and Federation of Icelandic Fishing Industry
New Zealand	Ministry of fisheries	Ministry of Fisheries contracts research organisations to carry out research services	Ministry of Fisheries contracts out some management system services (*e.g.* fishing vessel registrations)	Ministry of fisheries	Compulsory consultation with all stakeholders (commercial, recreational, environmental, Maori) on ministry planning, stock assessment and advice to the Minister of Fisheries on management controls. In some cases, stakeholders prepare fisheries plans to be assessed and, if agreed to by the Minister, implemented by the ministry
Norway	Ministry of fisheries	Institute of Marine Research; Norwegian Institute of Marine and Aquaculture Research	Ministry of Fisheries; Directorate of Fisheries	Directorate of Fisheries; Coast Guard; Sales organisations	Institutionalised consultation with Norwegian Fishermen's Association and Federation of Norwegian Fishing Industry
Australia	Central ministry, with advice from Australian Fisheries Management Authority (AFMA)	Independent statutory authority (Fisheries Research and Development Corporation), contracting out research to institutions	Independent statutory authority (AFMA)	Independent statutory authority (AFMA)	Through AFMA Management Advisory Committees and Stock Assessment Groups
Canada	Central government (Dept. of Fisheries and Oceans (DFO))	Government laboratories and universities; priority setting by DFO, with advice from Fisheries and Oceans Science Advisory Council, Fisheries Resource Conservation Councils	DFO	DFO is the primary provider of enforcement services. Industry-sponsored dockside monitoring programmes and cost-sharing of at-sea observers	Industry participation on advisory committees; some Co-management and Joint Project Agreements
European Community	Centrally through European Commission	EC through framework programmes	Rule setting at EC level; Implementation by EU member states	EU member states	Limited at EC level to Advisory Committee on Fisheries (industry and consumers) and Economic and Social Committee. Varies widely between states
United States of America	Broad goals in Magnuson-Stevens Act, objectives set regionally through Regional Fisheries Management Councils (RFMC)	National Marine Fisheries Service (NMFS); Science Centres; universities; RFMCs	NMFS	NMFS for dockside enforcement; US Coast Guard for at-sea enforcement	High degree through RFMCs, Marine Fisheries Commissions
Japan	Centrally through Fisheries Agency	Through Fisheries Research Agency (independent but attached to central government)	Fisheries Agency through regional Fisheries Coordination Offices	Fisheries Agency through regional Fisheries Coordination Offices	Limited, through Fisheries Cooperative Associations
Korea	Centrally through Ministry of Maritime Affairs and Fisheries (MOMAF)	MOMAF through National Fisheries Research and Development Institute	MOMAF through Fisheries Administration Bureau and Fisheries Resource Bureau	MOMAF through Fisheries Resource Bureau; Fishing Vessels Management Office and National Marine Police Agency	None
Mexico	Centrally through Secretariat of Agriculture, Rural Development, Cattle Raising, Fisheries and Food	National Fisheries Institute	Secretariat of Agriculture, Rural Development, Cattle Raising, Fisheries and Food	Federal Bureau for Environmental Protection and National Commission for Aquaculture and Fisheries	National Chamber of Fisheries Industry and Aquaculture; Fisheries Cooperatives
Turkey	Centrally through Ministry of Agriculture and Rural Affairs (MARA)	MARA through four research institutes as well as universities	MARA	MARA	Through producers' organisations

Source: OECD (2003) *The Costs of Managing Fisheries*; OECD country submissions (2003)

27. Sound fisheries management creates benefits for fisheries "stakeholders" – commercial fishers, consumers, recreational fishers and the broader community. A key message of this handbook is that fisheries management systems can only be effective if stakeholders are involved at all stages of the policy development process. Stakeholders resist reforms seen as endangering the benefits they derive from the fishery and will only support reforms that offer increased benefits – and then only if they trust the process.

Effective fisheries management systems involve stakeholders at all stages and build trust in the policy development process

28. Commercial fishers benefit both from the increased output stemming from good stock management and from controls limiting dissipation of the fishery's rent. Optimising fleet and stock size can lower the fishers' costs per unit of effort and increase average fish sizes, which in turn increases harvest value and marketability. Recreational fishers also reap these benefits and the advantages of sharing a well-managed fishery with commercial and sport fishers.

29. As for consumers, they benefit from a larger and more stable supply of fish and potentially lower supermarket prices. They also enjoy better-quality seafood, thanks to post-harvest management measures such as improved quality control, sanitary and phyto-sanitary requirements, and eco-labels and product certification recognising sound management (see Chapter 8).

30. An inclusive approach to fisheries management will lead to broader and more sustainable benefits than one narrowly focussed on the interests of fishers. Management decisions that maximise a fishery's social and economic benefits while protecting its other non-use benefits (for example, recreational or ecological values) are good for fishers because they reduce sources of conflict and enhance the fishery's long-term value. Different groups – such as cultural minorities and indigenous people – also benefit when fisheries management provides for their interests and customs. If the fishery cannot accommodate or reflect broader social goals, the it will not be sustainable in its current form.

31. Chapter 2 deals with the economics of fisheries management and discusses in more detail the benefits of fisheries management to fishers, stakeholders and society at large.

Key Insights

- Effective policies are those that are targeted and tailored to meet clear objectives.
- Evaluations of policy based on measurable outcomes helps drive the policy development cycle upon which effective reform depends.
- A broader perspective on the goals of fisheries management and a more inclusive approach in the policy development process ensures that fisheries deliver maximum benefits to all.

REFERENCES

Charles, A.T. (2001), *Sustainable Fishery Systems,* Blackwell Science, London.

FAO (Food and Agriculture Organization of the United Nations) (2002), *Fishery Manager's Guidebook – Management Measures and Their Application,* K. Cochrane (ed.), Fisheries Technical Paper No. 424. B, FAO, Rome.

FAO (2010), *The State of the World's Fisheries and Aquaculture 2010*, FAO, Rome.

Love, P. (2010), *Fisheries: While Stocks Last?,* OECD Insights, OECD, Paris.

OECD (Organisation for Economic Cooperation and Development) (1997), *Towards Sustainable Fisheries – Economic Aspects of the Management of Living Marine Resources,* OECD, Paris.

OECD (2003) *The Cost of Managing Fisheries*, OECD, Paris.

OECD (2008), *Agricultural Policy Design and Implementation: A Synthesis,* OECD, Paris.

OECD (2010), *Review of Fisheries in OECD Countries 2009: Policies and Summary Statistics*, OECD, Paris.

CHAPTER 2: THE ECONOMICS OF FISHERIES MANAGEMENT

The open-access problem

32. The fisheries management system is a legal and institutional framework for managing the harvest and stock levels of a fishery or fisheries, possibly combined with a set of programmes designed to meet related objectives. As previously discussed, it arose from the tendency of unregulated fisheries to fall prey to the tragedy of the commons, where the commonly available stock is overused and depleted.

33. As a general rule, unmanaged (or "open-access") fisheries run the risk of biological and economic over-exploitation. Fishers have little incentive to conserve the fish stock, since the benefits of doing so are likely to be gained by others. Thus the potential benefits from harvesting the resource optimally are lost.

34. The tragedy of the commons reflects a fundamental feature of public resources. Individuals take actions in their own best interest, leading to sub-optimal results on net welfare. In other words, different ways of using the resource would lead to greater benefits for all involved. Contrast this with the standard neoclassical economic view of market competition, where individual self-interest leads to a welfare-maximising outcome. This view underpins modern market capitalism and the OECD tenet that market mechanisms and discipline are fundamental to sustaining economic growth.

35. This chapter discusses fisheries from an economic perspective – in other words, how fisheries management policies are shaped and what makes them succeed or fail. It covers the basics of the bio-economic fishery model and discusses factors differentiating the fish and fishing market from classical competitive markets – the most obvious one being that fisheries resources are a public good – and how they influence policy. This chapter discusses other important differentiators.

*In the **standard economic model**, individual incentives lead to an optimal outcome. In an **open-access model**, individual incentives lead to over-exploitation and lost benefits.*

Basic assumptions of the standard model:

1. Firms produce identical products and customers are identical; hence, there is no benefit from selling to any particular one.

2. Firms and customers are numerous, hence, sales and purchases of each are small in relation to the total market.

3. Both firms and consumers possess perfect information and act to maximise profits and benefits.

4. Those who wish to enter or exit the market may do so.

36. A quick review of the standard competitive market as described in neoclassical economics[2] will help provide a basis for reference.

The standard neoclassical model

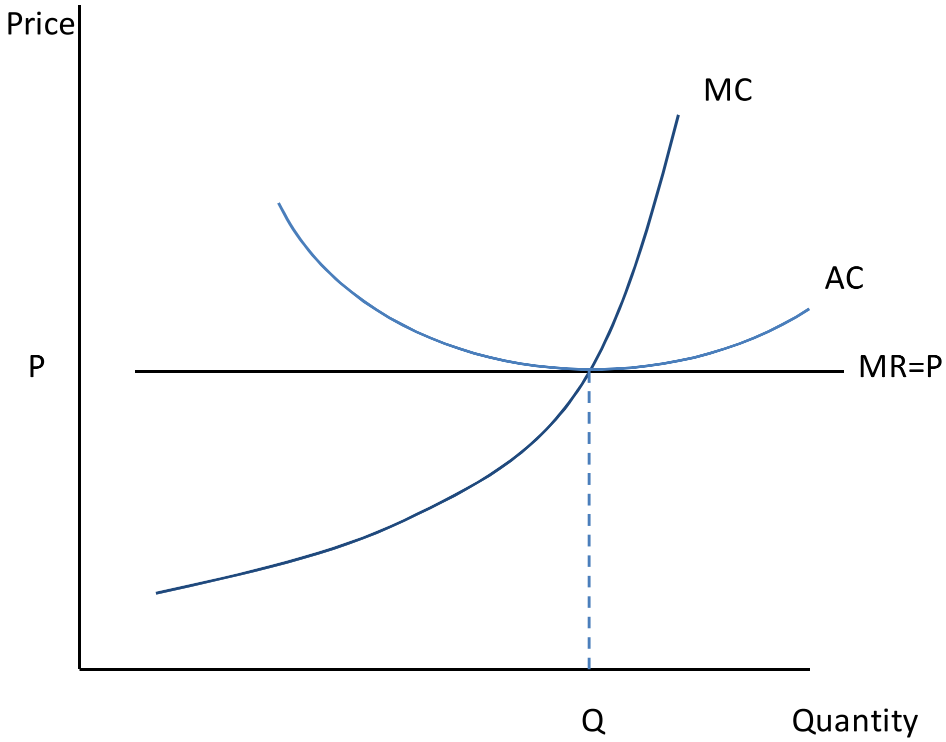
37. The assumptions underlying this model state the conditions that must hold for prices to be "right" and for resources to be used efficiently, leading to maximum profits and benefits to the consumer (Henderson and Quandt, 1980). Equilibrium is defined by the condition where the marginal cost to the

2. These assumptions are often challenged as being unrealistic, and are in fact rarely observed in their strict definition in real life. This has not prevented the ideas derived from this model from proving very useful in practice.

seller is equal to the marginal benefit to the buyer. If this were not the case, it would be possible to increase profits or benefits by changing the price or amount sold in the market (Figure 2.1).

Figure 2.1. Perfect competition

Market equilibrium at MR=MC



38. At the equilibrium point (Q, P), economic profits are zero as average cost equals marginal cost, which also equals marginal benefit. This condition is reached by firms entering (exiting) the market to capture profits (avoid losses), with the resulting change in supply feeding back into the prevailing market price.[3] At equilibrium, everyone is doing as well as possible and the outcome is "optimal" in an economic sense.

The Gordon-Schaefer model of a fishery

39. Compare the neoclassical model to the standard analysis of a fishery: the **Gordon-Schaefer (G-S) model**. This model starts with some assumptions about the growth of the fish stock at different population levels (the growth function) and combines them with the costs facing fishers to define the long-run equilibrium of a single-species fishery. This equilibrium is normally at a point where effort is too high and stocks are too low relative to the economic optimum. Unlike in the competitive market, the optimum and equilibrium points are different.

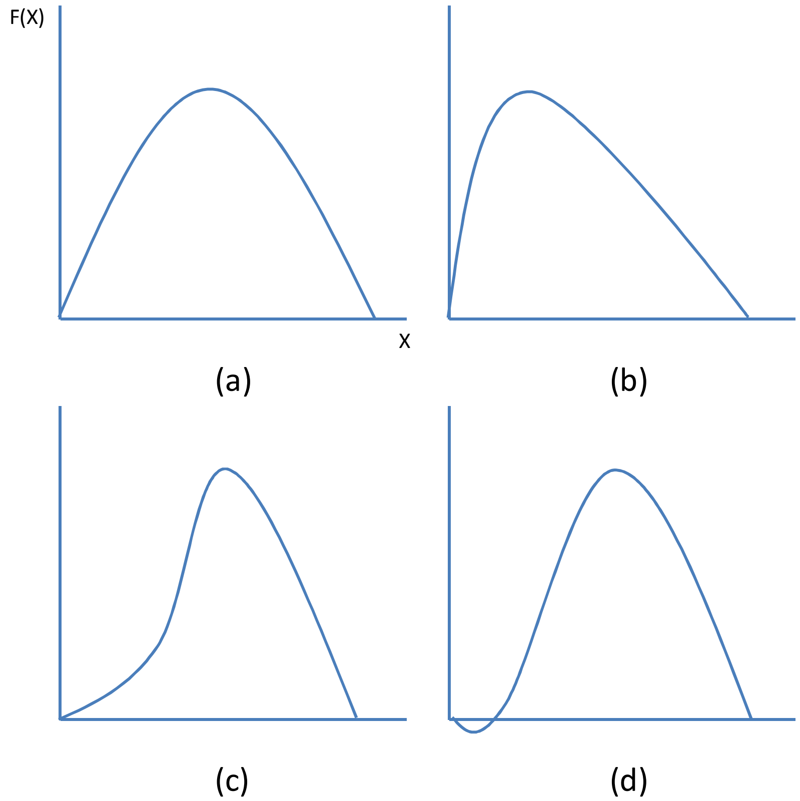
40. The G-S model starts with defining a growth function. Different fish species can exhibit vastly different growth patterns, so many different forms of growth functions are possible (Figure 2.2). The shape of the growth function is important because it determines the response of the stock – whether resilient or fragile, robust or slow-growing – to harvest effort.

3. See Chapter 3 for a fuller discussion of the reasons for zero economic profits in competitive markets.

41. One of the simplest growth functions is the logistic (or compensatory) growth function, depicted in panel (a) in Figure 2.2. This defines a stock which grows quickly at low levels, then more slowly as the stock increases until it reaches maximum stock size. This is a particularly stable growth function as the stock rebounds quickly from low population levels.

Figure 2.2. Different growth functions

(a) compensatory, (b) asymmetrically compensatory, (c) depensatory, (d) critically depensatory



42. The *asymmetrically compensatory* growth function in panel (b) is similar to the logistic (compensatory) one, but exhibits stronger growth rates at lower population levels; the relative growth rate is highest when the population is small, down to the limit of zero population size.[4] *Depensatory* growth functions show impaired growth of the stock at small population sizes, when the stock becomes more vulnerable (e.g. provides easier prey at low densities) or experiences reproductive difficulties. Panel (c) show a *depensatory* growth function where a stock grows relatively slowly at lower population sizes but more strongly beyond a certain point. In panel (d), the stock is *critically depensatory*; below a certain stock size it collapses.

43. Clearly, a fishery's growth function has implications for its management. Fisheries exhibiting compensatory growth can rebound more easily from natural fluctuations or over harvesting, while those with depensatory growth must be managed much more carefully to avoid collapse (Box 2.1). Moreover, a stock exhibiting depensation can still produce good yields with high effort for many years, but will

4. Technically speaking, a compensatory growth function is one that is concave over its entire range. The logistic is a symmetrical growth function defined as $G(X) = rX\left(\frac{1-X}{K}\right)$, where X is the stock size and r and K are parameters representing the resource's intrinsic growth rate and carrying capacity.

collapse dramatically at some critical point. In this case, using yield and effort as indicators of stock health can be dangerously misleading.

Box 2.1. Different growth functions – some real-world examples

Many fisheries have suffered collapses in recent years, but only a few have recovered and become viable commercial fisheries once again. Whether a fishery can recover from overfishing or other natural events depends on many factors – perhaps the most important being the stock's ability to grow from small population levels.

By the early 1970s, the Peruvian anchovetta fishery had seen significant investment in capacity and was poorly managed. This left the stock vulnerable; in 1972, an El Niño event precipitated its collapse. Since then, the fishery has collapsed and recovered several times over the course of capital restructuring, management system changes and several El Niño events. By the 1990s, harvests hovered at the 7.6 MT mark, identified by the Instituto del Mar del Peru (IMARPE) as the fishery's maximum sustainable yield (MSY) capacity.

Anchovetta, a pelagic prey fish, has a remarkably robust growth function that allowed it to recover from severe depletion not once, but several times. This allowed the fishery to withstand the host of problems it faced throughout its industrialisation in the 1960s and 1970s.

By contrast, the cod fishery off the east coast of Canada that collapsed in 1992 has not recovered, despite its near-complete shutdown. Numerous management changes stemming from the collapse of the cod population have led to a persistently low stock equilibrium. The reasons cited are the loss of their ecological niche to crustaceans, permanent alteration of migration patterns, vulnerability to predation, and loss of critical mass for spawning. Regardless of the causes, cod clearly exhibit a depensatory growth function that does not forgive management mistakes.

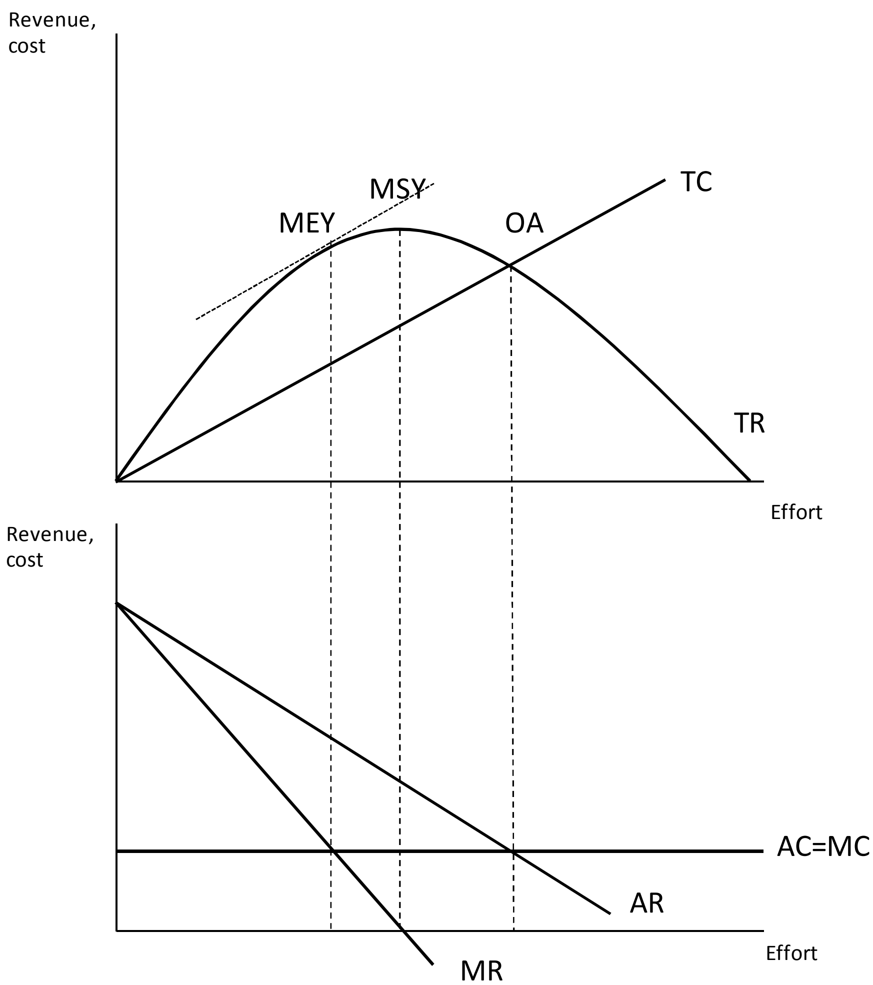
44. Harvesting fish is usually assumed to be expensive when the population is small, but easier and cheaper when it is abundant. This cost assumption is reasonable when the fish (e.g. ground fish) are fairly evenly distributed over an area, but less so in the case of schooling pelagic fish – which are easy to capture even at low populations. In theory, densely schooling species are more likely to be over-harvested. Fortunately, their growth functions usually allow them to recover from low population levels.

The ***Gordon-Schaefer model*** *combines a growth function with a function relating stock size to harvesting cost*

45. Assembling the parts of the G-S model yields the long-run equilibrium of an open-access fishery (Figure 2.3), where its total revenue (TR) equals total cost (TC). At this point, profits are zero, but marginal revenue is not equal to marginal cost—the key condition for optimality in the neoclassical model[5]. MC=MR defines the optimal solution for the fishery, but this isn't where the open-access equilibrium is found.

5. Economic profits equal to zero is a particular economic concept having to do with entry and exit from the sector; it represents the "normal" level of profit just sufficient to keep sector participants from going elsewhere. See Chapter 3 for more details on this.

Figure 2.3. The Gordon-Schaefer model

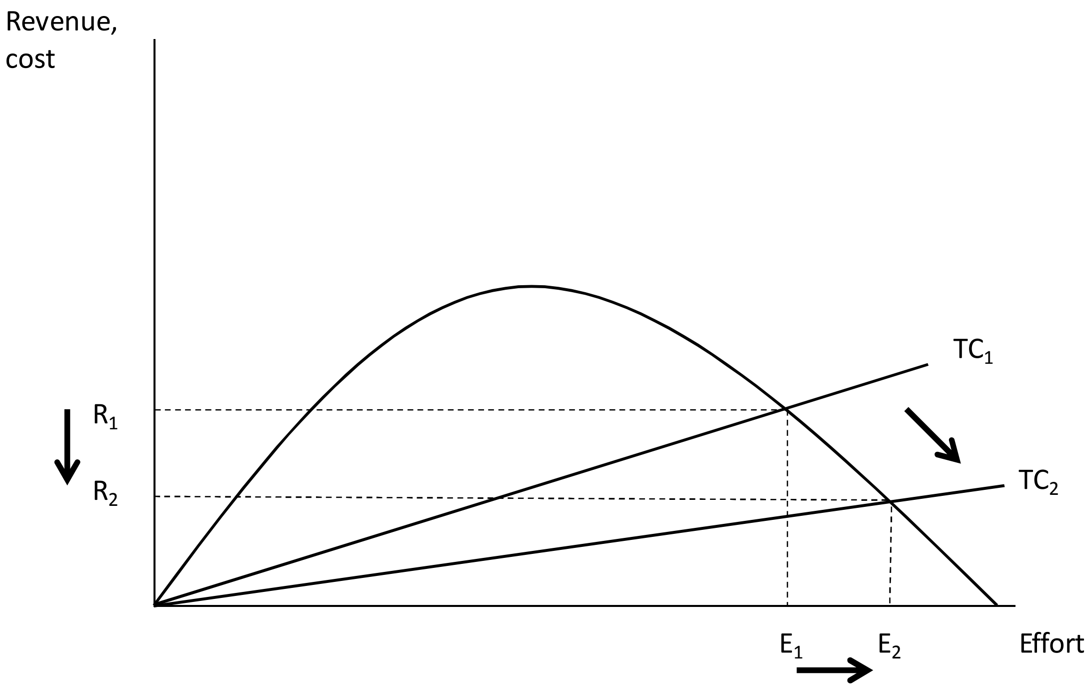


Source: Cunningham, Dunn and Whitmarsh (1985).

46. The open-access (OA) equilibrium, where TR=TC, reflects a long-run situation where stock growth and harvest level are in balance. To visualise this, consider the shape of the TR curve, which shows that after a certain point, increased effort lowers revenue. This is because high levels of effort eventually draw down the stock size and thus harvests at that effort level. Hence, the TR curve is often called the "sustainable yield curve," as it describes the long-term result of a particular effort level. In any given year, the relationship between effort and revenue is more linear – more effort will mean more harvest and revenue in the short run and the short-run TR curve would always slope upward. The open-access equilibrium level of effort is higher (and the stock level lower) than with maximum economic yield (MEY) or maximum sustainable yield (MSY).

47. If the open-access equilibrium is at a low stock level, natural variations due to external factors can also collapse the stock, as lower stock levels tend to be inherently riskier. Technological advances or subsidies that lower the cost of harvesting can exacerbate this problem. In the G-S model, lower fishing costs reduce the equilibrium stock level and revenue at equilibrium (Figure 2.4).

Figure 2.4. Reduction in fishing cost in the Gordon-Schaefer model



Introducing management controls

48. Until now, the G-S model has been used to analyse the “open-access” case, where no active or binding management system is in place. More often, the fisheries management system t is fundamental in determining the equilibrium in the fishery. The G-S model can be used to investigate how some such systems can shape fishery outcomes.

> ***Maximum Sustainable Yield (MSY):*** *Managing the stock so that the annual harvestable amount is as large as possible. This implies keeping the stock at the level where growth is most rapid.*
>
> ***Maximum Economic Yield (MEY):*** *Managing the stock so that the resource rent generated by the stock is as large as possible. This implies choosing the stock level that maximises total profits for the sector*

49. The first step in including the management system in the G-S model is to identify stock-related management objectives – typically MSY or MEY – and the control method applied to reach them.[6] The management objective has traditionally been MSY, as it produces the most yield from the resource, but MEY has become more popular as it produces better economic results.

50. Once managers choose MSY or MEY (or some other stock level) as an objective, they must identify how to achieve it. Input-based controls (for example, restricting the number of days at sea, limiting the length or power of fishing vessels, or the total number of vessels in the fishery) limit fishing effort by restricting the set of allowable techniques or actions. Output-based controls (such as setting a TAC or vessel catch limits) limit overall catch. Chapter 4 discusses management instruments in detail.

6. Because price is constant, revenue in Figures 2.3 and 2.4 also identifies harvest and stock levels. Quantity harvested, being the revenue divided by price, has the same shape as the revenue function. The stock level is implied by the growth function, but in general terms would decline from left to right in the figures. In other words, higher effort means lower equilibrium stock levels.

51. The open-access problem has been identified as a key issue in fisheries management. Avoiding the tragedy of the commons is a common, but not universal, objective of fisheries management. While in economic terms open access poses practical problems of efficiency and sustainability, restricting access to fisheries is often very unpopular. This stems from the different perspectives on the role and nature of the fishery. When viewed as a publicly shared resource, limiting the privilege of fishing to a select few or "privatising" it is hard to accept.

52. As we have seen, initiating input or output controls may or may not address the open-access problem (Table 2.1). While it is possible to manage stock level without significantly limiting fishers' access to the fishery, the outcomes may be quite different than with controls that limit access.

Table 2.1. Examples of management instruments

	Limited entry	Unlimited entry
Input controls	Restricted vessel licences Individual effort quotas	Season limits Vessel power, size or gear restrictions Days-at-sea limits
Output controls	TAC with individual quota or restricted licence Community-based quotas	TAC with unlimited licences Landing taxes Vessel catch limits

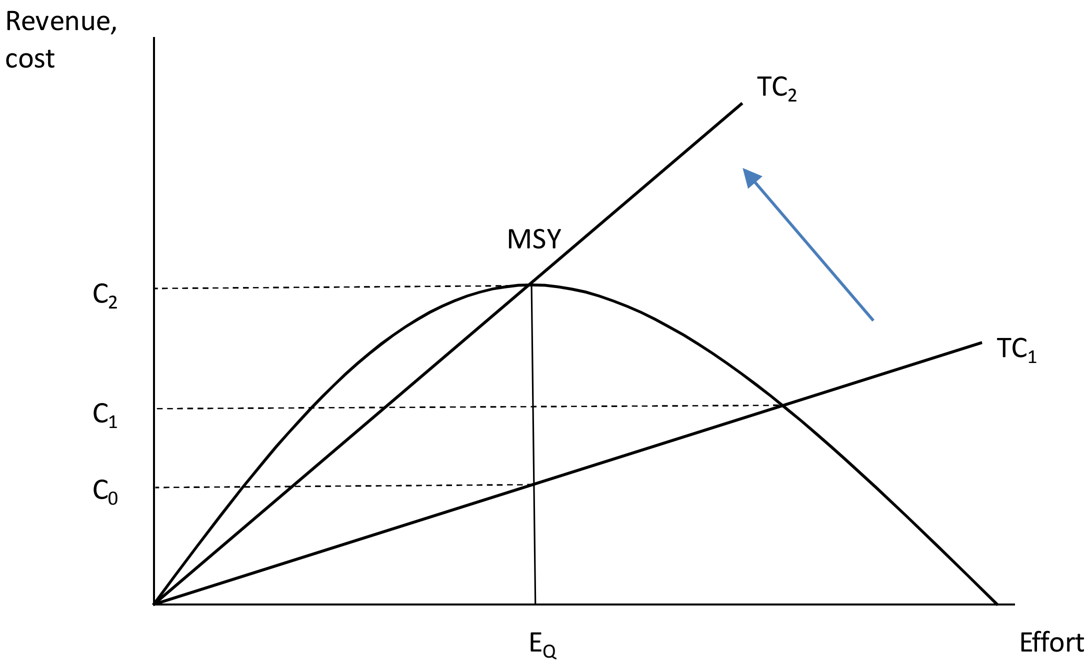
What happens to profits?

53. The key difference in terms of economic outcomes is the preservation or dissipation of **rents**. As demonstrated earlier, the open-access equilibrium (like the competitive equilibrium) occurs at the point of zero economic profit, where participants have no incentive to either leave or enter the fishery. While economic rents may still be dissipated when the management system effectively controls the quantity harvested (output control) or effort invested (input control), the mechanism is slightly different. Conscious of the limits the management system places on effort or harvest, fishers invest in methods that maximise their harvest capacity, accepting higher costs or risks as a result. They may also accept smaller harvests – resulting in a higher fixed cost per fisher as a share of total costs. While not clearly observable in the G-S framework, this adjustment mechanism increases cost-per-unit effort (Figure 2.5).

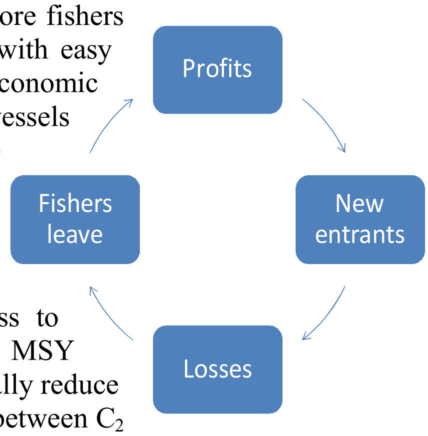
*Economists use "**rents**" and "**economic profits**" interchangeably to mean those profits in excess of the amount required to stay in the industry.*

Figure 2.5. Adjustment after introduction of input or output control

Case 1: Unlimited access



54. If this shift did not occur, fishers would continuously enter the fishery to capture the potential profits. The process is as follows: 1) Profits attract new entrants 2) More fishers reduces profits 3) This continues until profits are gone. Any fishery with easy entry or exit must eventually meet the condition TR=TC with zero economic profits. The result is "**capital stuffing**", where the amount of capital (vessels and gear) in the fishery greatly exceeds that required to harvest the available amount of fish. Thus without effective limits to entry, adjustment policies such as decommissioning schemes cannot be successful.



55. Figure 2.5 illustrates a shift from uncontrolled open access to restricted open access, where overall effort or harvest is limited to the MSY level of output. At this level the increased stock abundance would normally reduce harvesting costs from C_1 to C_0, and enable rents equal to the difference between C_2 and C_0. However, "racing to fish" or other strategies must drive up costs until these rents are gone. The result is a shift of the cost curve from TC_1 to TC_2 and a new equilibrium, with harvest at the MSY level and zero profits.

***Capital stuffing** – the tendency for excessive investment in productive inputs in response to regulations reducing fishing effort.*

56. The fact that rents are possible at the MSY level, but tht entry thwarts this by driving up the cost of fishing, has led fishery policy makers to try preserving these rents by limiting access to the fishery. Preventing entry – for example, by granting licences to existing participants in the fishery—allows rents to persist by eliminating the mechanism that normally reduces them to zero.

Limited-entry and economic rents

57. When entry is limited, economic profits are not dissipated by new investment in the fishery, but what happens to these profits can be complicated to determine. These "excess rents" typically to become capitalised in the input value most fixed or most directly connected to the restriction yielding the rents. In this way, the profits are embodied in the value of a related asset, such as the quota (when ITQs are used) or the value of the vessel (with IVQs are used).

58. For example, if a fisher purchases a licence for a fishery where his or her activities yield an economic profit of USD 1 000, that licence is effectively worth USD 1 000 – the sum the fisher would pay to purchase this licence, and that others would pay to acquire it from the fisher. If the licence is tradable, it quickly acquires this value, so that the cost of obtaining it would cancel out the fishery's available rent. If it is not tradable, the value passes to the vessel or other capital asset whose ownership ensures possession of the licence (Box 2.2).

Box 2.2. The value of licences

Capitalisation is when the value of a future stream of benefits – such as profits – becomes embodied in the price or value of a fixed input. The input could be physical capital – such as a vessel – or a right to do something – such as an assigned quota or licence. The capitalised value of a quota that yields a certain amount of economic rents tends to follow the "net present value (NPV) formula", expressed as follows:

$$NPV = \sum_{t=0}^{N} \frac{R_t}{(1+i)^t}$$

Where R_t is the economic rent available in year t, i is a discounting factor reflecting the rate of time preference (often taken as the prevailing interest rate), and N is the number of years the rents are available. This is a forward-looking formula, as the value of R_t in the future is unknown; the fisher must form an expectation of this value based on the information currently available. It is possible for the NPV to increase or decrease over time as expectations of R_t are updated. The discount rate also takes into account future expectations; if the fishery or quota system is not expected to persist, the discount rate will be higher to reflect this more short-term view of the quota's value.

For example, the value of quota for the Sablefish fishery in western Canada was about CAD 20 per kilo when it was introduced in 1990, reflecting a NPV of the fishery's future profitability of about CAD 0.60 per kilo per year, assuming a 3% discount rate. By 2004, the value of quota had increased to CAD 100 per kilo, equivalent to about CAD 3 per kilo per year (OECD, 2010). The increase stemmed from improved stock expectations under the new system. The annual value of the rent generated by the quota can also be observed when the quota is leasable on an annual basis. For example, in 1993, halibut quota allocations in western Canada were leasing for CAD 3.30 per kilo for a single year (Casey *et al.*, 1995).

59. Economic profits in the fishery can only seldom be expected to turn completely into extra income for sector participants – the licence would have to be non-tradable, assigned to a fisher, and revert to the government upon the latter's retirement or death. This raises a question regarding the objectives of such policies. Is the goal of the fisheries management system to provide maximum profits to current participants, perhaps at the expense of other stakeholders and potential new entrants? Should the distribution of profits among fishers something be controlled? Is this simply a side effect of efforts to optimally manage stocks and beyond the fisheries managers' concern?

Economic profits or rents can only seldom be expected to turn completely into extra income for sector participants.

60. As shown earlier, economic profits or rents are neither desirable nor expected in normal economic situations. Fisheries is a special case because the entry-exit process that leads to zero profits does

not lead to the best result under open access. The management system sets limits because its first goal is to obtain the right harvest level with respect to stock capacity. The rents that are generated as a result can be addressed in a number of ways, from letting rights-holders keep them to taxing resource rents for redistribution.

The management system sets limits because its first goal is to obtain the right harvest level with respect to stock capacity.

61. In the managed open-access situation (Figure 2.5), costs to fishers increased from TC_1 to TC_2, exhausting economic rents. These increased costs constitute revenue for others, such as input suppliers who are able to capture some of the benefits of the increased resource productivity. Thus, to a certain extent the value of the resource is shared elsewhere in the economy and benefit those with some connection to the sector, e.g. vessel builders or gear suppliers. Some of the rents are lost as pure "deadweight" losses that benefit nobody. But the fact that the management system exerts controls on the fishery that generate rents means that the policy maker has to develop a strategy for sharing these benefits.

62. The rents generated by the management system can be distributed in unexpected ways. When tradable quotas are distributed rather than auctioned to sector participants, the initial quota recipients capture the benefits. When purchasing quota, newcomers must pay the present discounted value of the expected future rents in advance – which makes sense, because "normal" profits are still available after deducting the cost of the quota. The purchaser might also have a cost advantage over the seller, and improvements in technology or stock abundance may increase rents over time. When the quotas are initially auctioned to fishers, the government captures the initial economic rents, with later increases accruing to quota holders.

Key insights

- The open-access problem in fisheries leads to a sub-optimal equilibrium outcome: despite high capital and effort, stocks are below the level of highest economic return.

- The fisheries management system corrects the above by imposing controls on overall harvest; these can be based on inputs (effort) or output, and may or may not correct the open-access problem.

- With effort controls – and particularly when the fishery remains substantially open-access – the management system places constraints on fishers, who respond by changing their investment and fishing behaviour. This in turn increases their costs, dissipating the economic benefits of improved stock management.

- A consequence of management-imposed harvest controls is capital stuffing, where fishers incur higher costs by investing more in fishing capacity to avoid effort controls. The problem is compounded when capital is fishery-specific and long-lived.

- Limited-entry output controls are more effective at using economic incentives and tend to improve profitability. In fact, when quota or licences are tradable, costs may actually decrease as more efficient fishers are able to outbid others for quota.

The management system

- *Changes incentives by changing market structure*
- *Constrains fishers by limiting actions through regulation*

- Management controls may also generate economic rents. Depending on the details, various sector participants may capture these as extra income.

- A fishery's resilience is strongly influenced by the nature of the growth function and the changing cost of harvest relative to stock size, particularly at low population levels.

63. The following chapters will expand on the economic aspects of fisheries and fisheries management discussed above. Chapter 3 covers capacity and investment in fisheries, and more explicitly incentives to invest in fisheries and overcapacity as an equilibrium outcome. Chapter 4 addresses management mechanisms, focusing particularly on market-based economic instruments and demonstrating how different systems can work with or against fishers' incentives. Chapter 5 discusses the economics of rebuilding fisheries

REFERENCES

Casey, K., *et al*. (1995), "The Effects of Individual Vessel Quotas in the British Columbia Halibut Fishery", *Marine Resource Economics*, Vol. 10, pp. 211-230.

Conrad, J. and C. Clark (1987), *Natural Resource Economics: Notes and Problems*, Cambridge University Press, London.

Cunningham, S., M. Dunn and D. Whitmarsh (1985), *Fisheries Economics: An Introduction*, St. Martin's Press, New York.

Henderson, J. and R. Quandt (1980), *Microeconomic Theory: A Mathematical Approach*, McGraw-Hill, New York.

OECD (2010), *The Economics of Rebuilding Fisheries: Workshop Proceedings*, OECD, Paris.

CHAPTER 3: DEALING WITH CAPACITY ISSUES IN FISHERIES

64. It would be hard to find a country whose government does not worry about the size and composition of the fishing fleet. Despite ongoing efforts to adjust fleet capacity, overcapacity ranks high in policy makers' concerns. The rapid decline of fish stocks compared with the extended useful life of a fishing vessel, combined with earlier policy efforts to build up capacity and the variable nature of fish stocks, partly account for the problem. However, it is mainly due to individuals deciding to participate and invest in fisheries despite existing **technical overcapacity** relative to allowable harvest levels.

65. Why would people choose to invest in fisheries when the fleet is already more than sufficient to catch the harvestable biomass? The simple answer is that it is profitable. Technical overcapacity is an equilibrium phenomenon. It is not a result of fishers' error and it is not self-correcting. Many policy makers base their determinations of fishery "overcapacity" on low profits, but this conclusion does not fit the facts. While interest groups always aim for higher profits and lobby their government to obtain supportive policies, this does not mean that current profits are inadequate. If they were, the overcapacity problem would resolve itself.

> ***Technical overcapacity*** exists when the potential harvesting capacity of the fishing fleet is larger than the harvestable biomass.
>
> ***Economic overcapacity*** exists when the return on investment in fisheries is less than that of other sectors.

Technical overcapacity is an equilibrium phenomenon. It is not a result of fishers' error and it is not self-correcting.

66. Economic forces, when working properly, move investments around the economy to ensure the most profitable use. In activities where profits are low, labor and capital move elsewhere, leading to higher profits for those who remain. (Box 3.1). This process tends to equalise the profits (in terms of returns to capital and labour) available in different activities. If fisheries investments consistently yielded lower returns than other types of investments, individuals would either run down (depreciate) or sell their invested capital and move on.

Box 3.1. How do economists think about profits?

Economists frequently refer to "zero economic profits". This key indicator of well-functioning markets describes the optimal equilibrium condition of markets and the economy. But the notion of zero profits does not sound very attractive, and more profits are better than less profits – so what makes the idea of "zero economic profits" so attractive?

First of all, the definition of economic profits is fairly particular. Economists call what people normally think of as profits "**accounting profits**"., while "**Economic profits**" add "opportunity costs" – the amount of money one could have made by investing in the next best thing. If one can make USD 100 by investing in activity A and USD 90 by investing in activity B, the accounting profits in activity A are USD 100 but the economic profits are only USD 10 – so by choosing activity A, one gives up the chance to earn USD 90 in activity B.

This way to measure profits is actually very useful, because it compares different investment opportunities by showing how much more accounting profits can be made by investing in the most profitable *vs.* the next most profitable activity. As long as economic profits exist, one can make more money by making better choices (say, by moving from activity B to activity A).

This movement has the effect of equalising the amount of potential profits in any possible activity by balancing the returns on investment in different sectors of the economy. When investment returns are balanced, economic profits are zero and no extra profit is to be made by readjusting investment. That is the optimal economic equilibrium

67. For example, a gas station doing booming business at a busy local intersection might provide incentive for others to get in on the action by opening their own gas station nearby. Even though all involved realise this will lower the overall profit the investment still makes sense if its potential profits are higher than those in another sector. It is not unusual to see four gas stations occupying the four corners of an intersection. Despite technical overcapacity (there are more gas stations than necessary to meet the demands of local motorists and each gas station makes less profit as a result of the others' presence), this is an optimal use of investment resources from an economic viewpoint.[7]

68. Technical measures of fishery capacity do not indicate the "right" level of capacity. The decision to invest in fishing capacity depends on the return on investment (ROI) compared with other possible investments – which usually leads to optimal economic outcomes as resources are allocated according to the best potential return.

*The decision to invest in fishing capacity depends on the **return on investment (ROI)** compared with other options.*

69. If economic forces lead to the right amount of investment in the fishery, what is the problem? Unlike gas station owners, fishers use a common resource. The amount of fishing capacity that would lead to zero economic profits in the sector does not lead to an optimal harvest level, with the result that too many fishers chase too few fish.

70. Policies to reduce or control fishing capacity are generally motivated by the desire to manage the stock at MSY or MEY and maintain profitability – neither of which are truly capacity issues. A well-designed management system should be able to maintain the stock at the desired level irrespective of the number of fishers. Fishers vote with their feet (or boats), entering or leaving the sector depending on the profits to be made. Efforts to increase profitability can only exacerbate technical overcapacity as higher profits make the sector more attractive to new entrants. Trying to increase sector profits with decommissioning schemes is a treadmill: if reducing the number of vessels increases average profits, the incentives to invest in the fishery just get that much higher.

71. Overcapacity places additional pressure on the management system in several ways:

- It expands the size of the sector's lobbying organisations and provides them with ammunition (claiming lower profits) to support demands for increased support.
- It heightens pressure on fisheries managers to increase allowable effort or catches to provide greater fishing opportunities matching harvests to capacity.
- It heightens the temptation to engage in illegal, unreported and unregulated (IUU) fishing given the readily available fishing capacity.
- It complicates and compounds monitoring and enforcement costs owing to the large number of vessels participating in the fishery.

72. The above explains why matching the size of the sector to available biological resources helps reduce conflicts and maintain a more orderly and manageable sector.

73. Policy makers need to understand that without careful policy design, they should expect technical overcapacity to exist in fisheries. Reducing technical overcapacity requires changing the conditions that

7. In fact, any policy to alter this outcome puts the policy maker in the position of deciding how much profits different enterprises should make, a difficult job with a dubious history. It also requires a constant battle against the economic forces of adjustment that have been described here.

created it. One reason individual transferable quota (ITQ) systems are successful is that tradable rights strongly promote sector concentration and overall capacity reduction[8]. The upcoming section on market mechanisms will discuss this in more detail.

Overcapacity *vs.* adjustment

74. As previously discussed, capacity in a fishery's depends on the incentives to invest in it. But some situations (e.g. a collapse in the fish stock or other event leading to significantly lowered TAC or effort, a natural disaster, change in support policy, or trade impediment) necessitates significant and rapid adjustment. A sudden change in the ideal fleet size usually calls for **adjustment assistance** to prevent financial hardship and dislocation. These adjustment programmes seek to remedy the sudden presence of *economic* overcapacity.

> ***One-time adjustment policies** are more easily justified than ongoing capacity schemes.*

75. Policy responses (and their justification) differ in this situation, particularly when the systemic shock results from a policy change to the management system or sector support. Stakeholders may demand compensation and adjustment assistance (often termed **flanking measures** when associated with policy reform), while policy makers may wish to prevent huge losses to vessel owners or licence holders (Holland *et al.*, 1999).

76. The same policy tools (including licence or vessel buybacks, scrapping, early retirement aids, retraining and extension of unemployment benefits) are used for both adjustment assistance and capacity adjustment. The key difference is that adjustment assistance should be explicitly tied to the fishery's situational change; hence, it should be time-bound and targeted exclusively at sector leavers. Further, adjustment assistance operates in a situation of economic dislocation, while capacity adjustment attempts to alter individual investment and participation choices.

77. While policies that seek to prevent or compensate fisheries for economic losses (particularly from government-initiated factors) may seem appropriate, they lower the risk of investing in a fishery. As a result, policies that systematically and significantly reduce investment risks in fisheries will paradoxically increase investment levels. When fishers know the government will compensate them in bad times, they will remain in the fishery even when it earns them a relatively low income.

> *When fishers know the government will compensate them in bad times, they will remain in the fishery even when they lose money.*

Overcapacity and the management system

78. Ideally, management systems should be robust to the fact that technical overcapacity is a common feature of fisheries (and which technology tends to enhance over time) and be able to tolerate a situation where fishing power exceeds available harvest without falling prey to over-harvesting and resource collapse (or social unrest).

> ***The management system** has more impact on fishing capacity than most capacity adjustment schemes.*

79. OECD research and recommendations tend to support output- and market-based fisheries controls over input (effort) controls. One reason is that they tolerate capacity issues better. Input controls are easily thwarted by investments that increase fishing power within regulatory limits. For example, limiting vessel length leads to wider vessels, and limiting fishing days leads to faster and more efficient

8. One of the things that complicates ITQ designs in practice is the reluctance to let concentration and consolidation take place unchecked. There is a potential policy conflict between objectives of reducing technical overcapacity and preserving traditional fishing methods, participants and communities.

vessels and the "race to fish". By their nature, input controls will always be chasing technology and fighting fishers' capacity to increase harvest through alternative means.

Input controls *will always be chasing technology and fighting fishers' capacity to increase harvest through alternative means.* ***Output controls*** *eliminate this problem by limiting the overall harvest. Tradable output controls such as ITQs also help balance technical capacity to available resources.*

80. Output controls, while constrained by enforcement issues (in the face of hidden landings, high-grading, or other at-sea discarding activity), eliminate this problem by limiting the overall stock harvest to a set TAC. When combined with tradable access permits such as ITQs, they reduce capacity, leading to a better balance between technical capacity and resource levels.

Policy approaches to overcapacity – Decommissioning schemes

81. In principle, fisheries managers' best option is to ensure management systems prevent overcapacity and overfishing in the first place, by providing appropriate incentives for fishers to automatically adjust fishing capacity and effort to changing prices, costs and environmental conditions.

82. In OECD countries, decommissioning schemes include vessel buyback, scrapping or transfer programmes and licence retirement schemes or buybacks. Governments spent around USD 430 million on such programmes in 2005, accounting for 7% of their total financial transfers to the fishing sector.

Types of decommissioning schemes:

Vessel buyback

Licence retirement

Vessel scrapping

Vessel transfers

83. These schemes deal actively and visibly with excess capitalisation and capacity problems in fisheries. They enjoy strong political appeal and governments generally expect benefits from introducing them. The fishing industry also often actively pursues decommissioning schemes, both to improve profitability for fishers remaining in it and provide a dignified exit for marginal or unprofitable fishers. Fishery organisations regularly lobby governments for adjustment assistance.

Expenditures on decommissioning schemes *in OECD countries totalled around USD 430 million in 2005 and accounted for 7% of total government financial transfers*

84. Decommissioning schemes can prove effective when urgent action is needed to bring fishing capacity in line with available fisheries resources. However, their success is critically dependent on preliminary issues, such as assessing the current management regime and the financing source.

Management policies

85. All fisheries-related management policies must be coherent and mutually supportive. Decommissioning schemes that fail to permanently reduce capacity waste public resources, increase pressure on fish stocks, and create barriers to future sector adjustments.

86. If the fishery is open access and only the catch is controlled, decommissioning payments have no positive effect on fish stocks – in fact, quite the contrary, as increasingly efficient new vessels replace decommissioned vessels. One example is the Washington State Commercial Salmon Fishery (USA), which was essentially open access and saw three buyback programmes in the late 1990s at a cost of USD 14 million. A review of the three programmes determined they were not effective at durably reducing fishing capacity precisely because the fishery was open access.

Decommissioning schemes that fail to permanently reduce capacity waste public resources, increase pressure on fish stocks, and create barriers to future sector adjustments

87. In the context of the above discussion, it is obvious that capacity reduction schemes and open access fisheries don't mix. So why are such programs attempted? An answer is that the government believes that fishers are in financial hardship in the fishery, but are unable to leave the sector for various reasons. Under this view, decommissioning schemes give people a way out of a situation that nobody would wish to enter. This is rarely the case in practice, and such a situation could not persist over the long term.

88. Also, when effort is uncontrolled, the implemented scheme may not deliver due to expanded effort in limited-entry or regulated open-access fisheries. For example, Australia's Northern Prawn Fishery has been controlled by input measures and subjected to near-continuous restructuring and capacity reduction over the past two decades. Yet improved harvest technology and higher unregulated fishing inputs have largely negated the effects of the dramatic capacity reductions.

89. When effective use or property rights are in place, vessel decommissioning schemes have no effect on landings. They can, however, speed up the adjustment process and reduce pressure (from poor profitability and enforcement difficulties) on both the management system and the ecosystem. For instance, Norway's buyback programmes have resulted in improved profits thanks to a new individual quota regime that ties vessels to the quota.

Financing

Experience shows that a combination of industry and public funding improves incentives for co-operative management

90. Financing should be clearly defined to ensure the reform's political credibility. The "**beneficiary pays**" principle, which argues that industry participants who stand to benefit from a policy intervention should contribute to its costs. This principle forms the basis of the cost recovery programmes in (among others) New Zealand, Australia and Iceland. In most cases though, decommissioning schemes (e.g. in Mexico, Canada and Japan) have been 100% funded by governments and are a form of financial transfer to the sector(Box 3.2).

91. Mixtures of public and private funding are increasingly the norm. Industry contribution is often facilitated by a government loan, repaid through licence fees or an annual charge on landings. Greater industry involvement is the trend in the United States, as witness the three recent industry-funded schemes. Norway uses a fee on the value of first-hand landings of every Norwegian fishing vessel combined with a capital injection from government. Experience shows that a combination of industry and public funding improves incentives for co-operative management (particularly when sound fisheries management is in place) as the remaining fishers have a stronger stake in the fishery's future.

Design and implementation of decommissioning schemes: issues and best practices

A well designed decommissioning scheme should identify the adjustment target, articulate clear quantitative objectives and include good price setting mechanisms.

92. Based on a review of OECD case studies, decommissioning schemes have had mixed results. While some have achieved lasting capacity reductions, others have seen only transitory impacts on capacity despite high public expenditure.

93. A well designed decommissioning scheme should first identify the adjustment target (vessels, licences, or both), taking into account objectives, participation rules and budget constraints (purchasing licences is often cheaper than purchasing vessels). Quantitative objectives should be well defined, clearly articulated and measurable to ensure achievable reduction targets, with a positive impact on resource sustainability and the sector's structure.

94. The scheme should also include price setting for vessels, licences, fishing rights or gear buyback. The mechanisms used should maximise the impact of public funds on capacity changes and designed in a way that accurately reveals the price at which fishers are willing to sell their vessel or licence. That is, participants are not needlessly overpaid.

95. There are four broad types of price setting mechanisms: auctions, fixed rate payments, one-on-one negotiations, and independent valuations (Holland *et al.*, 1999). Each has advantages and disadvantages (Box 3.2).

Box 3.2. Auctions vs. fixed-rate payments

Auctions are the most effective means of ensuring that buyout prices for vessels or licences reflect their value to their owners. While there are many different auction formats, they all depend on the bidding process to incite owners to offer their vessel or licence for the full value they ascribe to it.

Auctions need sufficient bidding competition to work properly (Curtis and Squires, 2007), otherwise a small group of potential bidders can collude with each other on bids or use other forms of strategic behaviour. Auctions occurring over a number of years are also risky as fishers can use the results of previous rounds to update their bids. In other cases, ongoing buybacks may occur. As they become routine, bidders can determine the maximum likely acceptable bid, rather than bid according to their true valuation.

Fixed-rate payments set a fixed buyback price for vessels or licences and the fisher decides to take it or leave it. These may be easier to administer and have improved transparency, less uncertainty and lower transaction costs for both fishermen and the regulatory agency. However, they can be much less efficient if the price is set too high or too low. Unlike auctions, they require the government to have good information on the true value of licences or vessels.

Fixed-rate payments generally consist of a flat-rate payment per vessel or licence, or payment weighted according to specific criteria (such as vessel tonnage or power or target species). Applications are typically evaluated against specific criteria to determine whether the bids achieve value for money or meet particular goals.

Mexico used a flat-rate approach in its 2005 shrimp fishery trial decommissioning scheme. Weighted fixed-rate systems tend to be more common in Europe, where individual member states use weighting to adapt buyback schemes to meet specific objectives. France's 2006 scheme weighted payments according to the vessels' targeted fish species. Denmark's schemes feature weighted fixed rates per vessel, along with a comparative bidding process to select which vessels receive decommissioning grants.

96. Decommissioning schemes rely on a certain amount of social acceptability for success. Stakeholder involvement in its design and implementation can improve participation, compliance with objectives and operations (pilot programmes may help) and the likelihood of cooperation in the fishery's post-adjustment management.

97. Sometimes decommissioning schemes are put in place as a way to reduce effort.[9] When a fishery has a large amount of idle (latent) capacity, the decommissioning scheme can mop this up leaving no impact on fishing effort. However, purchasing latent capacity to avoid reactivation when conditions change help prevent overshooting of fishing effort.. In any event, governments should target both latent and active capacity to ensure that overall capacity is effectively reduced and not reactivated following the decommissioning scheme.

***Stakeholder involvement** in the design and implementation of the decommissioning scheme can improve participation, compliance with objectives and operations, and cooperation in the fishery's post-adjustment management.*

98. *Ex post* evaluations are important to determine the decommissioning scheme's effectiveness and impact and whether the programme has achieved its objectives. There are four broad types of *ex post* evaluations:

9. In open-access situations, this is no more likely to be successful than objectives of raising profits, and for the same reasons.

- national governments undertake in-depth evaluations of decommissioning schemes;
- national auditors focus on specific schemes and in-depth reviews of their effectiveness;
- supranational bodies (such as the European Commission) or inter-governmental organisations (such as the OECD) carry out evaluations;
- the academic community undertakes research on the economic costs and benefits of decommissioning schemes.

Long-term evaluation is required to gauge the durability and impact of the capacity adjustment process.

Political economy

99. . Three political economy factors need to be taken into account when developing a decommissioning scheme: 1) The rationale for introducing it, 2) Compensation and the distribution of benefits and 3) The credibility of both the objective and the government's efforts to achieve it.

100. **Factor 1: Rationale**. One of the advantages of decommissioning schemes is that they demonstrate action and policy commitment. Allowing fleet capacity to self-adjust can be perceived as indifference on the part of the government, and results are difficult to measure. Decommissioning programmes deliver funds to the sector, which has political benefits and can be balanced against the expense of such programmes.

101. Decommissioning schemes can overcome resistance to management reforms by compensating those who stand to lose from them. "Buyouts" can also be used to drive a wedge in a fishery subgroup attempting to block the reform, by creating divergent interests among its members and increasing co-ordination costs. The decommissioning scheme can serve as an enabler of needed reform, rather than solely as a means to adjust capacity.

> ***Capacity-adjustment programmes** can play an important role in a larger reform process by compensating fishers and aligning interests.*

102. **Factor 2: Compensation**. Decommissioning schemes can be driven by distributional concerns, offsetting the negative effects of change by providing individuals with a dignified exit from, and some return on their long-standing investment in, the fishery. The government can buy the fishers' assets, allowing them to either relocate or retrain. However, unless other policy measures are in place to assist economic diversification, decommissioning grants may not necessarily lead to sustainable social outcomes, particularly in fishery-dependent coastal regions.

103. **Factor 3: Credibility**. Capacity-adjustment programmes may lead fishers to believe that the government will cover losses arising from excessive capital investment (i.e. vessels), which would have the effect of promoting overinvestment. This problem can be curtailed if a decommissioning scheme for a particular fishery or fleet is described as a "one-off" opportunity for adjustment or exit, rather than a repeated scheme for the same fishery.

104. When it comes to fleet adjustment, policy incoherence can significantly undermine credibility. A classic example is decommissioning schemes co-existing with payments for vessel construction and modernisation. Until 2004, the European Union simultaneously provided grants on the one hand, for fishing vessels leaving the fleet and on the other, for building new vessels and modernising existing ones. These contradictory signals both called into question its commitment to structural adjustment and supported excessive investment.

Key insights

- Technical overcapacity is not the same as economic overcapacity. The decision to enter a fishery depends on the ROI, not on the fleet's overall catching power. Chronic technical overcapacity alone does not justify a policy response.

- Management systems should be robust to technical overcapacity as it is a normal feature of fisheries and address it through output-based rather than input-based control systems.

- Capacity-adjustment schemes have a more sound policy rationale when they respond to relatively sudden and unique changes in the fishery's economic situation and therefore should be carefully targeted and limited in time.

- Capacity adjustment schemes will be unsuccessful in either increasing profits or reducing effort so long as fishers can freely enter or exit the fishery.

- Market-based systems such as ITQs can better balance technical capacity with economic incentives.

- Capacity-adjustment programmes can play a major role in the policy reform process. They deliver funds to the sector to compensate for changes, signal governmental action and help build support for reforms.

REFERENCES

Holland, D., E. Gudmundsson and J. Gates (1999), "Do Fishing Vessel Buyback Programs Work: A Survey of the Evidence", *Marine Policy*, Vol. 23, No. 1, pp. 47-69.

OECD (2009), *Reducing Fishing Capacity: Best Practices for Decommissioning Schemes*, OECD Publishing, Paris.

CHAPTER 4: MARKET MECHANISMS TO MANAGE FISHERIES

105. A broad theme of OECD work is the usefulness of market approaches in reaching policy objectives, based on the observation of the benefits of freer trade and well-functioning markets. Market forces are powerful. Policies that ignore or oppose them tend to deliver unexpected side effects stemming from the decisions and actions of those they affect.

106. Chapter 2 outlined some basic elements of fisheries economics. Chapter 3 enlarged upon them in the context of fisheries investment and capacity. A key message was that some undesirable outcomes in poorly managed fisheries stem from individual stakeholder incentives rather than simple error or lack of information. For example, policies to reduce fleet capacity are unlikely to succeed if they do not address the underlying economic factors.

> ***Market forces are powerful**. Policies that ignore or oppose them tend to result in unexpected side effects as market incentives assert themselves.*

107. Market mechanisms are a fairly recent development in fisheries management, and as such have not yet been widely adopted. Reform is resisted because it is easier for those effected to estimate the costs and risks they bear than the benefits they expect to receive. Moreover, when established management policies are successfully managing fish stocks, policy makers may be reluctant to undertake reform.

108. Yet the potential benefits of market-based policies make undertaking the reform process worthwhile. Fisheries managers must do more than simply ensure a sustainable stock. They must also acknowledge and enable other objectives – perhaps most importantly, maximising the fishery's economic value to users and society. They have a broad range of market-based policies at their disposal which do not deter from traditional management tools such as TAC setting, regulation, monitoring and enforcement.

109. The number of different market-based policies and their potential role in fisheries management is often poorly understood. This chapter discusses these mechanisms and ways in which the fisheries manager sucessfully implement them to ensure maximum benefits. It sets the stage for the following chapter covering the economics of rebuilding fisheries.

> *Fisheries managers must do more than simply ensure a sustainable stock. Their job is to maximise the fishery's economic value to users and society*

Fisheries management mechanisms – objectives and methods

110. As stated in Chapter 1, without a healthy stock, the fishery policy cannot achieve its social and economic objectives. The fisheries manager's first job is to manage the stock sustainably, choosing a management system that is as compatible as possible with that broader set of objectives.

111. The main appeal of market mechanisms is their potential to contribute to multiple objectives, including cost-effective resource management. That means that market mechanisms have the potential not just to do better at managing stocks, but also help achieve other important objectives. For example, a well-designed market-based system can improve profitability, energy efficiency, quality and marketability of fish and fleet structure (among other things), where traditional input control approaches can have negative impacts on all of these.

112. Within the broader scope of fisheries objectives, fisheries managers have two primary aims: maintain fish stock productivity and control access (Figure 4.1).

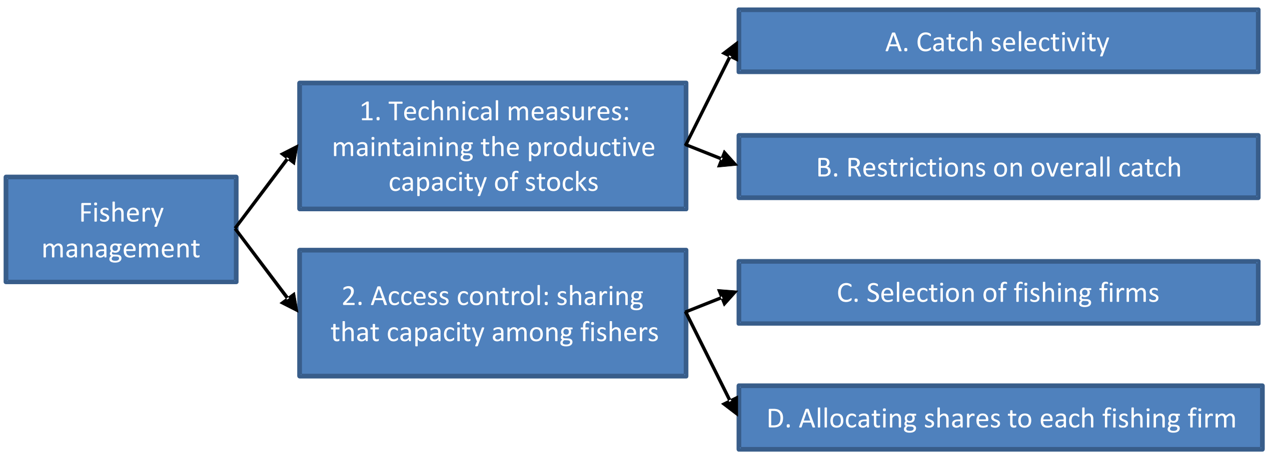
- Measures to ***maintain*** the fish stock typically involve instruments that:

- prevent the premature harvest of juveniles, by imposing standards on gear selectivity, harvesting times and locations, and minimum landing sizes; and

- maintain a targeted level of spawning biomass, by limiting catches (TAC) or fishing effort (days at sea for vessels, season limits).

- Measures to ***control*** individual and collective access to the resource involve allocating the stock's limited productive potential. This dual process entails selecting (licensing) the fishing firms authorised to harvest each stock and setting the share allocated to them. When the management system does not set individual quotas or access restrictions, the fishers' share of the harvest depends on their capacity to harvest relative to other fishers in the designated time.[10]

Figure 4.1. The two components of fisheries management



Source: OECD (2006).

113. Fisheries management relies on two main mechanisms: economic instruments (market mechanisms) and regulatory and legal measures (command and control). Market mechanisms seek to achieve policy objectives by understanding and using the self-interested behaviour of fishers, while regulatory and legal measures tend to ignore or work against these incentives.

114. **Economic measures** (market mechanisms) affect the costs and benefits of the choices facing fishers so that they exploit the resource more efficiently. They involve either:

- ***Market creation:*** Market rights or permits set up a market interplay which leaves most decisions up to individual agents and gives holders certain rights to use the resource and sell their right to others; or

- ***Monetary transfer:*** Payments, charges and taxes aim to influence behaviour through economic incentives that are *not* based on market interplay.

10. This leads to the "race to fish" phenomenon, where fishers exert maximum effort in competition with other fishers to harvest the resource before the overall TAC effort limit is reached.

115. **Regulatory and legal measures** restrict fishers' choices and are less flexible than market instruments as they do not allow fishers to determine the best means to pursue their fishing activities at the lowest cost. In fact, they may entail extra costs as fishers try to avoid or subvert them in response to the fishery's underlying economic incentives. These include limitations on catch, crew, days at sea, vessel size and power and gear type.

116. Fishery management systems are never entirely based on market-based tools. There will always be a role for regulatory and legal measures as these can often help achieve specific objectives at lower cost. For example, putting in place a regulation requiring turtle excluder devices to be included in fishing gear is more straightforward to implement and enforce than market-based incentives to promote their use. Over time, technology may be expected to enable market-based approaches to replace regulatory ones in different cases.

The benefits of market mechanisms

117. Market mechanisms are not always more effective than regulatory approaches at maintaining stock status. Their advantage is in the system's ability to accommodate other objectives. For example, individual vessel quotas or allocations can eliminate the "race to fish", making fishing safer and more efficient. Fishers who can time their landings better can obtain better prices for their fish by:

- selling at a time when demand is highest
- obtaining a higher-quality product by catching fish in a way that favours quality over speed
- being able to access the fresh – rather than frozen – market.

118. Fishers who fish at a slower pace can often optimise their input (for example, by decreasing fuel use), making fishing safer, more efficient, and more profitable.

119. Overcapacity is a problem in many fisheries and significant resources have been spent on decommissioning schemes and other capacity-reduction policies.[11] When market instruments such as quotas or effort allocations are tradable, they reduce fleet capacity very effectively by promoting concentration – which creates difficulties if policy objectives aim to maintain fleet composition and distribution. Nevertheless, an appropriately sized fleet presents considerable benefits: greater flexibility for policy reform, higher profitability per fisher, less risk of overfishing, and potentially lower monitoring and enforcement costs.(Box 4.1)

***Market mechanisms** can reduce costs and increase revenues for fishers by increasing efficiency and market flexibility.*

120. Tradability can also increase fishery-generated resource rents by decreasing average costs. This happens when low-cost operators buy the rights of higher-cost operators – a transaction which benefits both parties and heightens the fishery's overall profitability.

11. Chapter 3 showed that overcapacity is a technical and political-economy problem brought on by the economic incentives provided to fishers under certain circumstances.

Box 4.1. A natural experiment in fisheries management: Atlantic sea scallops

The Atlantic sea scallop fishery is pursued by Canadian and US fishers under similar environmental conditions and using similar technology. However, the fisheries management system diverged significantly in 1984 with the introduction of a tradable quota system in Canada. How profits and stocks have evolved on the two sides of the border since that time provides a natural experiment in fisheries management.

The US System:

Historically an open access fishery, limited entry was introduced through a moratorium on the issuance of new licenses in 1994, leaving more than 350 license holders, including just about anyone who could document any significant scallop catch in the preceding years. This number of licences were estimated at the time to exceed the capacity consistent with stock rebuilding by about 33 percent. Licenses can be transferred only through sale or transfer of the vessel to which it was attached, and a licence may not be ‘‘stacked’’ with other licenses on another vessel. This measure impeded consolidation of the fishery and took on greater significance when limits were put on the amount of days any license holder could be at sea fishing scallops.

Because of excessive capacity, additional measures to control fishing effort were also adopted. The allowable days at sea, fell from an initial 200, to 120 by 2000, which was estimated to be barely enough to allow a full-time vessel to recover its fixed costs under normal operating conditions. A maximum crew size of seven was adopted; an important limitation since shucking scallops at sea is very labour intensive. Minimum diameters were prescribed for the rings on scallop dredges to allow small scallops to escape and minimum size restrictions were retained. In other words, the US adopted a system of stringent effort controls, to be enforced through compulsory monitoring and enforcement.

The Canadian system:

In 1984 an enterprise allocation (EA) system was introduced in the Canadian scallop fishery. In an EA system, portions of the catch are awarded not to individual vessels but to operating companies, which can then harvest their quota largely as they think best. The government accepted responsibility for setting the TAC with industry advice but insisting that the license holders work out for themselves the initial quota allocation.

Results;

Because of the flexibility afforded license holders and their ability to plan rationally for changes in capacity, the Canadian fishery has been able to utilize its fixed capital more effectively. In the United States, restrictions on allowable days at sea, have impinged heavily on those operators who would have fished their vessels more intensively.

An important indicator of profitability is the catch per day at sea. Operating costs for fuel, ice, food, and crew rise linearly with the number of days spent at sea. Therefore, the best indicator of a vessel’s operating margin is its catch per sea day. In this indicator, the advantage of the Canadian scallop fleet is striking. Catch per day at sea has risen almost four-fold since the EA system was adopted. On the Canadian side, overall scallop abundance is greater and the cooperative survey program has produced a more detailed knowledge of good scallop concentrations in the patchy bottom conditions. Little effort is wasted in harvesting the TAC. Moreover, fishing has targeted larger scallops, producing a larger and more valuable yield per tow. In the US fishery, catch per sea day fell significantly over the same period because of excessive effort, lower abundance, greater reliance on immature scallops, and less detailed knowledge of resource conditions. As a result of these diverging trends, catch per sea-day in 1998 favoured the Canadian fleet by at least a seven-fold margin, though when the regimes diverged in 1986 the margin was only about 70 percent.

Source : Repetto (2001)

Property rights

Market creation *comes from tradability. The ability to trade is central to many of the efficiency benefits of market instruments.*

121. As Chapter 2 showed, the open-access problem results in poor outcomes for fisheries. When fishers do not have rights connected with the stock or harvest, competition

to capture the resource leads to overuse and rent dissipation. While the latter is not a problem from a purely economic perspective, fisheries policies often aim to preserve at least some rents in the harvesting sector. Moreover, rents are dissipated in open-access situations through increased deadweight losses, inefficiency and needlessly high costs for fishers. Market mechanisms can address this problem by assigning property rights to fishers.

122. Property rights can be divided into a number of separate elements (Box 4.2), each with a particular impact and role to play in an economic instrument. Designing that instrument involves deciding which elements should be included. Tradability is particularly controversial, as it usually leads to consolidation and structural adjustment. However, the ability to trade is central to obtaining many of the efficiency benefits of market instruments. The idea of *market creation* centres on transferable permits, as tradability is the key feature of that particular market mechanism.

Box 4.2. Attributes of property rights

Exclusivity: whether others are prevented from damaging or interfering with an owner's rights

Duration: the length of time the owner of a right may exercise ownership

Quality of title: the certainty, security and enforceability of the property right. In some cases, the incentive to self-enforce the property right may be strong

Transferability: the extent to which the rights entitlement may be transferred by selling, leasing or trading

Divisibility: the ability to divide (a) property rights more narrowly, producing new recognised rights, perhaps specified by season, region, ground, species, age or other classification and (b) the quota amount into smaller amounts and to transfer some quota to others

Flexibility: the ability of property rights holders to "freely" structure operations to achieve their goals

Source: OECD *Using Market Measures to Manage Fisheries: Smoothing the Path,* 2006.

123. Each of the above elements may be required to manage specific objectives. Some attributes (exclusivity, flexibility and duration) aim primarily to enhance the use of existing fishing capacities. Others (divisibility and flexibility) allow short-term adjustment to biological and economical variations. Others still (duration, title quality and transferability) target long-term adjustment and sound investment in the fishery.

Designing and choosing market mechanisms

124. OECD countries have at up a number of market mechanisms, using different subsets of property rights (Table 4.1).

Table 4.1. Main market mechanisms: Examples and key features

Market mechanism	Key characteristics and objectives	Examples of fisheries or countries where applied	Key features
Territorial-use rights	A defined area is allocated to a group, whose users share the right. The rights are usually durable and have a high degree of transferability – both formally or informally – within the group.	Ocean quahog (Iceland); oyster (United States); mussels and scallops (New Zealand); abalone (Japan); lake and some coastal area resources (Sweden); aquaculture (Mexico).	Usually allocated to a group who then undertakes fishing by allocating rights to users within the group. Usually of long duration and with high degree of formal and informal transferability within the group.
Community-based catch quotas	Quotas are allocated to a "fishing community" and rights allocated to users on a cooperative basis.	Japan; Korea; Canada; community development quotas for Eskimo and Aleut Native Alaskans (United States); allocation of permanent share of TAC to Maori (New Zealand); collective quotas allocated to producers' organisations (European Union).	High degree of exclusivity, divisibility and flexibility. Depending on community size and cohesion, have the potential to reduce the "race to fish" and allow for short-term adjustment.
Vessel catch limits	Restrict the amount of catch that each vessel can land for a given period of time or trip.	Australia; Canada; Denmark; France; Germany; Italy; Ireland; the Netherlands; New Zealand; Norway; United Kingdom; United States.	Low or moderate levels for most property rights: limited exclusivity and may not reduce the "race to fish", but do provide some flexibility and quality of title. Some innovative variants may ease short-term adjustment to biological and economical variations.
Individual non-transferable quotas	Grant one user the right to catch a given amount of fish (most often part of a TAC).	Germany; United Kingdom; Italy; Spain; Denmark; Norway; Canada; Portugal; United States; France; Belgium.	High exclusivity and flexibility enables users to use their rights in a least-cost way. The "race to fish" is almost eliminated and investments adapted to fishing opportunities. However, the absence of transferability restricts harvesting efficiency.
Individual transferable quotas	Provide a right to catch a given percentage of a TAC, which is then transferable.	Australia; Canada; Iceland; New Zealand; Norway; Poland; United States.	This instrument rates highly on all criteria. Its features permit appropriate long-term incentives for investment decisions and optimising short-term use of fishing capacities.
Limited non-transferable licences	Can be attached to a vessel, owner, or both. Must be limited in number and applied to a specific stock or fishery to be considered "market-like".	Australia; Belgium; Canada; Greece; Iceland; Italy; Japan; the Netherlands; United Kingdom; United States; France; Japan; Spain.	Help reduce the race to fish and prevent rent dissipation by restricting access to stock. But the lack of transferability and divisibility limits optimal use of fishing capacity.

Table 4.1. Main market mechanisms: Examples and key features (*cont.*)

Market mechanism	Key characteristics and objectives	Examples of fisheries or countries where applied	Key features
Limited transferable licences	Give fishers heightened incentive to adjust capacity and effort over the short- to long-term in response to natural and economic conditions.	Mexico; United Kingdom; Norway; and (to a lesser extent) France.	Rank relatively high on all characteristics and are generally granted for an extended period. But the absence of divisibility restricts possibilities to realise short-term adjustment to economic and natural fluctuations.
Individual non-transferable effort quotas	Rights are attached to the quantity of effort units that a fisher can employ for a given period of time.	Allowable fishing days (Iceland, Belgium); limited number of pots in crab and lobster fisheries (Australia, Canada, France, United Kingdom, US); limited number of fishing hours per day in scallop fishery (France).	Rank moderate to high on some attributes (exclusivity, duration, quality of title), low for others. Provide some form of indirect exclusivity when industry is small and homogeneous, leading to sound investment when short- and long-term adjustment remain limited. Tend to be used in fisheries for sedentary species.
Individual transferable effort quotas	Same rights, but transferable.	Tradable fishing days (Spain's 300s fleet) and fishing capacity (Sweden).	Transferability makes short and long-term adjustment easier and enables better use of fishing capacities.

Source: OECD (2006), *Using Market Mechanisms to Manage Fisheries: Smoothing the Path.*

125. Fishers are especially interested in long-term rights. Establishing long-term rights converts the stock into a capital asset in the eyes of fishers, the value of which they will seek to maximise. When fishers can benefit from improved stock status through higher future harvests , they have an incentive to conserve and enhance stocks that does not exist when rights are temporary or non-existent.

126. Output-based approaches (e.g. individual quotas) can lead to e.g. discarding, high-grading and underreporting by fishers, on stock. They require higher monitoring and enforcement and policy makers should keep this in mind in the planning stages.

> ***Long term rights** give fishers an incentive to conserve stocks to maximize value and profits*

127. All market-like instruments can be affected by the "international quality of the title". When several parties share the stocks, the title depends partly on the quality of their co-operation. Actions by outsiders to harvest the stock can lessen the quality of title provided by the national management scheme in the EU (e.g. ITQs in the Netherlands or vessel catch limits in France), and in most areas (e.g. Northwest Atlantic Fisheries Organization, North East Atlantic Fisheries Commission) under Regional Fisheries Management Organisations (RFMOs). When international co-operation is limited and third-party operators can access these fisheries (which leads to IUU fishing), two types of problems can arise:

> *All market-like instruments can be affected by the "**international quality of the title**". When several nations share the stocks, benefits of the system depend in part on the degree of co-operation*

- "sovereign risk" in the country regulating the fishery may grow (e.g. a fishery may be closed before the quotas are exhausted owing to suspected IUU catches);
- IUU fishing may have negative effects on compliance by rights holders facing "unfair" competition.

Implementing market mechanisms: tracks to follow

128. Experience and research suggest that fisheries managers must address an array of technical, social and administrative challenges to successfully develop and implement management systems based on market mechanisms. When faced with straddling stocks and stocks of highly migratory species, domestic fisheries may be forced into a particular pattern of fishing or management that makes reform more difficult due to competitive pressures or international obligations placing restrictions on domestic fisheries. The 10 operational paths or "tracks" proposed below may help address these challenges and form part of a "reform strategy" to ease the transition to sustainable fisheries.[12]

1. Make all stakeholders comfortable with the concept of market mechanisms

129. Increased use of market mechanisms faces two major obstacles: i) a false perception about the nature of these instruments, which can be overcome through better understanding and means to explain their functioning to fisheries stakeholders and ii) concerns about "privatising" publicly owned fisheries resources, which can be addressed by clarifying the fact that use rights do not equate ownership. The idea of fisheries as a ***public*** resource is thus not lost and market mechanisms in fact help maximise public benefits.

12. see OECD (2006), *Using market mechanisms to manage fisheries: Smoothing the path*.

2. Use an incremental approach to implementing market-like instruments

130. The technical details of management reforms (e.g. duration of transition periods, rate of stock rebuilding, etc.) are of utmost importance for stakeholder acceptance – hence the necessity to first reach a consensus about the rate of change proposed. Also, policy makers should base their proposals on an assessment of how best to implement reform.

131. Implementing the new management system gradually may help minimise its economic and social impacts and can keep the process manageable. Concentrating initially on a specific part of the fleet, *e.g.* that most amenable to change and where transaction costs can be limited. For example, a segment with a small number of homogeneous stakeholders.

132. Experience in OECD countries shows that incremental implementation of market mechanisms generally involves: i) putting in place technical measures aimed primarily at protecting juveniles and secondly at limiting overall catch; ii) establishing non-transferable use rights (limited non-transferable licences, individual quotas, etc.; followed by iii) introduction of partial, informal or full transferability (ITQs in fisheries suited to their use, otherwise transferable licences). Such systems can apply first to larger operators and then extended to smaller near-shore fishers.

Ten paths to implementing market mechanisms

1. *Make all stakeholders comfortable with the concept*
2. *Use an incremental approach to implementing market-like instruments*
3. *Avoid a "one-size-fits-all" strategy*
4. *Careful design the process to allocate rights*
5. *Use market forces pragmatically*
6. *Overcome the issue of rights concentration*
7. *Use the "demonstration effect"*
8. *Involve stakeholders in the reform process*
9. *Integrate fisheries characteristics*
10. *Deal pragmatically with trade-offs*

3. Avoid a "one-size-fits-all" strategy

133. The number of market-like instruments and their implementations suggests that many different approaches can prove successful. Even within "stronger" ones such as ITQs, considerable variations in design and implementation among countries reflect differences in fisheries' economic, social, historical and cultural aspects and highlight the need for managers to be flexible and adaptable during the design phase.

134. Be consistent where possible. Using similar management instruments in different fisheries has its benefits, such as economies of scale and lessons from "learning by doing". It makes monitoring and management easier and more efficient and facilitates stakeholder and regulator understanding – of particular importance when jurisdictions overlap but follow different rules. A country's general fisheries management is likely to benefit from a more homogeneous and comprehensive regime of market-like instruments – which could reduce "capacity transfer" problems among fisheries managed under different market-like instruments.

135. Experiences from OECD member countries suggest that some specific fishing groups (e.g. small-scale operators in the United Kingdom and until recently in Iceland) are not always included in the "general" system (Box 4.3). Several access regulation systems or variants sometimes co-exist, e.g. when heterogeneous management systems do not significantly complicate fisheries management, or when it may be rational to keep access to some fisheries "unregulated" – at least temporarily – although technical measures prevail in most cases.

136. More fundamentally, the co-existence of different market-like instruments can be explained by different societal objectives for each fishery activity. Fisheries serve a variety of social, cultural, political, economic and ecological goals. In any given situation, these multiple objectives depend on societal policy decisions. In turn, the choice of fisheries institutions and management approaches depends on these objectives and the priorities attached to each (Crutchfield, 1973; FAO, 1997; OECD, 1997 OECD 2000; Charles, 2001). In some countries, the main management objective for coastal fisheries may be to keep the level of employment as stable as possible. In this case, public authorities may prefer market-like instruments where licences are non-transferable (LLs) or non-transferable catch (IQ) and effort (IE) quotas (which ensure the stability and cohesion of the fishing community) and different market-like instruments in other (e.g. large-scale) fisheries.

Box 4.3. Mixed instruments in the English Channel bass fishery

In the English Channel bass fishery, the greater share of the catch is realised by a small number of large operators (pelagic trawlers) and the remainder by a large number of small-scale fishers (commercial and recreational long-liners). In such cases, it may be worthwhile to concentrate on the fleet that has the bigger impact on the resource and which is the easiest to monitor. In the bass fishery, the costs of closely managing and monitoring the small scale fleet may exceed the benefits from doing so, particularly if this segment has little impact in terms of catches.

Source: OECD (2006), *Using market instruments to manage fisheries: Smoothing the path*.

4. Carefully design the process to allocate rights

137. The issue of who is entitled to use rights – and in what quantity – is a difficult one in practice as it raises two key questions: i) how should the rights be initially allocated? and ii) how should it evolve in the future? From a theoretical perspective, the initial allocation should not affect the final allocation after rights-holders trade amongst themselves.[13] It will, however, affect the distribution of benefits.

Rights allocation goes more smoothly with good stakeholder participation, as the process inherently creates winners and losers.

138. Rights allocation is determined by political, rather than economic, forces. It is driven by concerns about distribution, equity and consensus, rather than efficiency (which tradability will take care of). The challenge for managers is to minimise conflicts and costs. Successful rights allocation benefits from strong stakeholder participation, as the process inherently selects winners and losers in the fishery. Some form of appeals process can be helpful to deal with particular difficulties. Sometimes it is more pragmatic to allocate rights in two stages. First, rights are allocated collectively to communities, fishing sectors or other identifiable groups. Second, each of these communities or groups determines which individuals within them obtain rights, and in what amount.

139. The duration of fishing rights is an important factor in investments decisions and reform's social acceptability. Without long-term access rights, fishers demonstrate little willingness to accept short-term sacrifices for long term improvements in the stock; in other words, they must be able to benefit from their investment in the resource base. In Australia, individual rights systems were accepted mainly because the government explicitly committed to maintaining existing privileges in perpetuity, guaranteeing that rights would not be re-allocated by public auction.

***Free allocation on the basis of historic catches** is a pragmatic approach, at the cost of loss of control over the distribution of benefits.*

140. Use rights are often distributed free of charge based on historic catches. This causes the least disruption

13. This presumes a trading system which places few restrictions on rights holders.

to existing participants and provides them with a potentially valuable asset at no cost – which is a good way to build acceptance (Box 4.4)[14]. But this approach prevents the policy maker from deciding who benefits from the reform – existing participants reap its benefits.[15] Its fairness is also questionable – especially if the period over which the "history" is calculated is one of overfishing and stock depletion, since those who contributed least to overfishing may receive the lowest quotas. To remedy this, and if the system allows it, the government can purchase and re-allocate rights after the initial distribution. Thus, while free allocation on the basis of historic catches is a pragmatic approach, it can have important trade-offs for the policy maker.

Box 4.4. Initial allocations of ITQs in the Finnish salmon fishery

In 1991, an ITQ system was suggested to allocate the TAC for the Finnish salmon fishery, which suffered from the usual open-access problems and their consequences, i.e. high early effort leading to short seasons. Initially, policy makers proposed to auction initial rights to reach a nearly optimal quota distribution. They believed this system, which was less dependent on past management and equally available to all, was more fair – a more narrow allocation could have been thought to decrease competition.

Yet the fishers strongly resisted this approach, claiming not only that it would increase uncertainty, but that they had already invested without expectation of such regulation and had no money to purchase quotas. This led to a compromise solution, which would allocate most of the TAC to fishers on a historical basis, with the balance put at auction. But this compromise was not enacted, not because the fishers' concerns were not heard, but because proponents of the ITQ system realised it could not be successful unless all the fishers accepted the initial allocation.

Policy makers saw the large share of quota given fishers free of charge as the price to pay for implementing the system. Yet at least some quota had to be auctioned so that the Office of Free Competition would allow the system to be introduced. Thus pragmatic compromise and recognition of institutional limitations are likely features of any reform.

Source: OECD (1993) *The Use of Individual Quotas in Fisheries Management*.

5. Use market forces pragmatically

141. **Tradability** of access rights is controversial because it can set off uncontrolled consolidation, counteracting other distributional policy objectives. However, it is key to obtaining the efficiency benefits of market approaches and is a desirable characteristic of market mechanisms because:

- long-term tradability facilitates structural adjustment by allowing the market to select the most profitable fishing operators;
- short-term tradability allows for system flexibility (it ensures the most appropriate use of the rights); and
- Tradability allows the true/correct value of the fishing right to be revealed in the marketplace. By setting an explicit or official price for the right, it allows its value to be included in the fishing company's assets and potentially used as collateral. It also improves the transparency needed for appropriate management decisions. For example, when the

Components of Market mechanisms for rights of access:

- ***Tradability****: allows rights holders to trade rights to others.*
- ***Banking****: allows rights holders to postpone or store the rights use for later use.*
- ***Borrowing****: allows rights holders to overrun their permissible levels of quota at a given point in time in exchange for a quota reduction in the following fishing period.*

14. Initial rights in an overfished fishery are likely to be near zero, but can appreciate rapidly as the resource recovers. See OECD (2010), *The Economics of Rebuilding Fisheries*, Chapter 3.

15. However, it is possible to tax away some of the rents as they develop over time, which would enable some redistribution of benefits from harvesters to broader social objectives.

right is implicit, its value can be capitalised within the price of the associated fishing vessel, conflating the value of these separate items.

142. **Banking** of access rights is a provision which allows right holders to postpone or store the rights use for later use. **Borrowing** allows them to overrun their permissible levels of quota at a given point in time in exchange for reduced quota in the next fishing period. Both provisions provide flexibility for the firms involved, if appropriate safeguards are in place. Several Australian fisheries have provisions for quota overruns; in New Zealand, they are permitted up to a 10% limit of the original quota for all species.

143. The operating and running costs of market mechanisms can increase fisheries' monitoring and control costs. Who should pay these costs? Several countries (including Australia, Iceland and New Zealand) have developed "cost recovery schemes" to help offset ITQ administration and enforcement expenses. In general, it makes sense to recover these kinds of costs from beneficiaries rather than placing the burden upon the taxpayer. However, in early phases of implementation, the value of the right to the fisher may be less than the administrative cost, making them reluctant to bear the costs. The value of such rights tends to increase over time, in particular when the initial stock status is poor. A phased approach to recovering costs may therefore be prudent.

144. Some fisheries may prefer to implement alternative tradable systems based on input regulation. These systems convert fishing possibilities (individual catch quotas) into fishing capacities (individual effort quotas) and may be most appropriate for sedentary species such as crab and lobster.

6. Overcome the issue of rights concentration

145. As previously noted, tradable fishing rights can lead to industry consolidation that favours larger operators, potentially reducing employment in small-scale fishing communities. The situation may also arise where fishers pay non-fishing rights holders for access. This can result in political economy difficulties for the government.

146. Economic concentration or consolidation, in fisheries or elsewhere, is generally deemed beneficial for the economy so long as it does not lead to monopolies. Attempts to preserve small fishers risk perpetuating low profitability and low incomes in rural communities. While many countries make provisions or "carve-outs" in rights-based systems for small fishers, better approaches usually exist. Rural development is best pursued by targeted approaches that improve the attractiveness of rural areas to residents and investors.

*Sector-based approaches to **rural development** are less effective than targeted approaches that improve the attractiveness of rural areas to residents and investors*

147. Under "tenant fishing" systems, fishers pay a fee to use the holder's fishing rights. While this may be perceived as unfair, it is no different than a farmer operating on rented land. A fisher may have many reasons for choosing to rent a fishing right rather than purchase it. Further, an active rental market can help reveal the value of both the rights and the resource to users. Policy makers can minimise the risk of criticism by ensuring that the initial rights allocation is perceived as fair and that the rental market is transparent and accessible to all.

7. Use the "demonstration effect"

148. Uncertainty over the outcomes of policy reform can be reduced by *ex ante* impact assessments,[16] which help identify its winners, losers, and total gains. However, proper impact assessments (which

16. *Ex ante* impact assessment is an analysis of the activity targeted by new measures prior to reform. It provides an overview of the context for the reform and gives an idea of the measure's potential impacts.

themselves contain uncertainties) may be too expensive compared with the reform's overall budget. As an alternative, managers can draw lessons from successful implementation of market mechanisms in other jurisdictions. As more fisheries adopt market-based instruments, more positive examples will be available and overall confidence in them will continue to grow.

> ***The demonstration effect****: Using experiences in other countries to demonstrate benefits and overcome resistance to reform.*

8. Involve stakeholders in the reform process

149. The fishing industry and those involved in the coastal or ocean economies must be closely involved throughout the institutional reform to improve the chances of shared "ownership" of both the process and outcome. Stakeholder involvement produces two clear benefits: i) it minimises conflicts related to distributional and equity issues and ii) it reduces the long-term compliance costs. The two-stage process outlined in Point 4 is a good example: devolving responsibility to local communities and organisations deflects criticism and shares responsibility.

> ***Stakeholder involvement*** *minimises conflicts related to distributional and equity issues and improves compliance. Devolving responsibility to local communities and organisations helps deflects criticism by sharing responsibility.*

150. Stakeholder involvement is much easier if the industry itself is actively pushing for reforms – as in Canada, the Netherlands, Iceland and New Zealand, where it acted as a driving force for change. Taking things a step further, right holders in New Zealand combined to help finance research activities (e.g. on the rock lobster and hoki fisheries).

151. A clearly articulated vision of the reform's possible outcomes will help stakeholders understand, trust and accept it. Any reform will produce some losers. It is important to clarify the negative short-term economic and social effects and how (if at all) they will be mitigated. Time and effort invested up front will help ensure successful implementation.

9. Integrate fisheries characteristics

152. Specific schemes should be designed and implemented according to the specific characteristics of the fisheries targeted, including:

- *Extent of natural fluctuation*. Most management systems allocate fixed percentages of a TAC or total allowable effort (TAE) subject to periodical review. Some formulas allocate rights to fishing firms for an indefinite period. Others allocate fixed individual rights for a set period and adjust the volume according to annual stock variability, either re-issuing rights as they expire or buying back surplus rights and issuing additional rights.
- *The degree of biological and technical interactions* (single-species *vs.* multi-species fisheries): Several market mechanisms address the issue of multi-species fisheries, including converting all catches into a standard unit (e.g. cod-equivalent in Iceland); introducing "by-catch quotas" (as in EU industrial sprat fisheries featuring high by-catch of juvenile herring), and applying a special fee for by-catch. When it comes to "sequential" fisheries (i.e. fisheries that target the same stock at different times, different places and different growth stages), institutional arrangements to maximise the overall use of the resource (e.g. in French crab fisheries) combining several management tools (in particular access regulation and technical measures) can be useful.
- *Nature of the exploited resource* (migratory *vs.* sedentary): Sedentary resources are more amenable to market mechanisms – such as territorial use rights in fisheries (TURF), limited (transferable) licences and ITQs – as the stock presents a surer investment for fishers. When the resource is migratory, the level of exclusivity decreases. But ITQ systems can work for migratory

species even when they cross jurisdictions, (e.g. ITQs in Canada, Italy and Portugal, and for southern bluefin tuna in Australia). Domestic fishers can gain from market mechanisms, even when the TAC is set by an RFMO.

- *Trade characteristics of the fishery* (export-led *vs.* local consumption): output controls can be difficult to enforce in a fishery that supplies local markets and has many landing sites – input controls (such as IEQs) are probably more cost-effective. However, collective management (e.g. pooling systems in Japan) can also work, as it gives the whole community an economic stake in the system's effectiveness. Output-based market mechanisms offer good results when the fishing industry is geographically concentrated, with few landing sites. Daily, weekly or monthly vessel catch limits (e.g. in Ireland, the United Kingdom, Germany and France) can also be used, but offer less flexibility. Trade flows are generally easier to monitor than catches, making ITQs more practical in export-oriented fisheries.

Individual transferable quotas (ITQs) offer greater economic efficiency for fishers but often have high monitoring and compliance costs. These tools are more suited to situations where monitoring and compliance are easier.

10. Deal pragmatically with trade-offs

153. The design and implementation of market mechanisms include trade-offs between economic efficiency and other policy objectives, particularly those involving distributional features and preserving the notion of fish stocks as a public (or community) good. That said, market mechanisms can also help achieve other policy objectives, such as stable incomes, an improved investment climate and overcapacity reduction. Market mechanisms are part and parcel of an overall fisheries management strategy. Well designed systems can deal with the trade-offs while ensuring maximum benefits for all concerned.

Key Insights

- Market-based approaches to fisheries management can help the fisheries manager meet a broad number of policy objectives more effectively than other approaches.

- Market-based instruments, when well-designed and flexible, offer fishers the opportunity to improve the efficiency and profitability of their operations.

- Market-based instruments are part of a larger fisheries management strategy, and do not replace regulations and other technical measures.

- While some fisheries are better suited for the use of market instruments than others, the broad scope of options available means that there are ways to introduce these tools in nearly any fishery.

- Introducing market-based instruments creates winners and losers, especially when it comes to the initial allocation of rights. Stakeholder involvement and ownership of the process is needed to smooth the path to reform.

REFERENCES

OECD (1993), The Use of Individual Quotas in Fisheries Management, OECD, Paris.

OECD (2006), Using Market Mechanisms to Manage Fisheries – Smoothing the Path, OECD, Paris.

CHAPTER 5: REBUILDING FISHERIES

154. This chapter highlights the benefits and challenges in rebuilding fisheries. It starts by discussing the motivations for rebuilding followed by an overview and comparison of possible trajectories across fisheries and over time. It also covers several challenges related to uncertainty and risks in rebuilding.

155. The focus is on rebuilding fisheries rather than fish stocks. If the policy aim is to rebuild fish stocks from a purely biological perspective, the most effective approach is usually to stop fishing, perhaps also undertaking stock or habitat enhancement. However, if the aim is to rebuild the fishery as an economic sector, then the policy manager must take other considerations into account. Benchmarks for time-paths, adjustment measures and other programme building blocks must be set. Biological considerations are inherent in all socio-economically based rebuilding plans; it is not possible to design such plans without a healthy stock as an endpoint. But the biological resource must be rebuilt in the context of ongoing economic activity, in all but the worst cases.

156. Many fisheries are faring poorly and in need of rebuilding (Box 5.1). Depleted stocks put both biological sustainability and economic prosperity at risk, but success is not guaranteed. The collapse of the Northwest Atlantic cod fishery and its failure to recover despite a moratorium on fishing effort has raised questions regarding the best way to recover depleted stocks (Caddy and Agnew, 2004; Rosenberg and Mogensen, 2007; Wakeford *et al*., 2007). Establishing good principles and guidelines for the rebuilding plan can help ensure its success.

> *It is not possible to design a rebuilding plans that does not have a healthy stock as its end goal.*

157. Fisheries that do not operate at or near their maximum potential represent a lost opportunity. Better managed stocks lead to bigger harvests and lower costs, which equal more profits for fishers.A World Bank study estimated that the annual rent dissipated by world fisheries is around USD 50 billion, mostly owing to poor governance (World Bank, 2009).

> *Rebuilding depleted fish stocks could bring an extra USD 50 billion in profits for fishers worldwide.*

158. Fisheries are never isolated from the rest of the economy or society. The process from resource harvesting to final consumption or even waste disposal is a long chain spanning several phases and involving various stakeholders and economic considerations. The specific effects of rebuilding on each and every element of the value chain are difficult to assess. Overall, however, rebuilt fisheries should increase welfare along the production chain and throughout the local economy.

159. Various aspects of fisheries rebuilding and management such as ecological considerations, species existence values, and biodiversity are not captured by market forces because they lack markets. Government intervention is necessary to properly address these externalities.

160. In addition to the poor state of many stocks, the arguments for fisheries rebuilding are many:

- From an *ecosystem* perspective, high fishing mortality and excessive effort can result in the fishing activity no longer being viable, which may also negatively affect the ocean environment and other living organisms. Rebuilding a fishery helps secure biodiversity and ecosystem resilience.
- From an *economic* viewpoint, even a biologically sustainable fishery experiencing low harvest levels due to excess harvesting represents a waste of economic potential, yielding lower profits and income than are possible.. Dwindling or fluctuating stocks and catches create problems for

processing firms, markets and the value chain. Fluctuations in supply and quality make it difficult for retailers keep their shelves stocked and for consumers to evaluate the product on offer. They also complicate logistics increasing costs in the value chain.

- From a *social* viewpoint, excess harvesting and effort has many negative consequences, including fluctuating employment, difficult working conditions and compromised worker safety. Declining stocks may also have other social implications, such as loss of fishing culture, know-how and expertise. Larger and more stable catches benefit fishing communities, especially where alternative employment opportunities are rare.
- At the regional level, the *socio-economic* benefits of rebuilding fisheries include maintaining both cultural heritage and jobs in coastal communities.

161. Signatories of international treaties (e.g. the United Nations Convention on the Law of the Sea) commit to managing their fisheries sustainably and responsibly. At the 2002 World Summit on Sustainable Development (WSSD), governments agreed to the ambitious objective of rebuilding fish stocks by committing to "[m]aintain or restore stocks to levels that can produce the maximum sustainable yield[17] with the aim of achieving these goals for depleted stocks on an urgent basis and where possible not later than 2015" (UN, 2002).

Box 5.1. The state of the world fisheries

It is technically difficult to assess the state of the world's fisheries. The FAO uses the following classifications for stock status:

- Underexploited, undeveloped or new fishery: believed to have a significant potential for expansion in total production.

- Moderately exploited, exploited with a low level of fishing effort: believed to have some limited potential for expansion in total production.

- Fully exploited: the fishery is operating at or close to an optimal yield level, with no expected room for further expansion.

- Overexploited: the fishery is being exploited at above a level which is believed to be sustainable in the long term, with no potential room for further expansion and a higher risk of stock depletion/collapse.

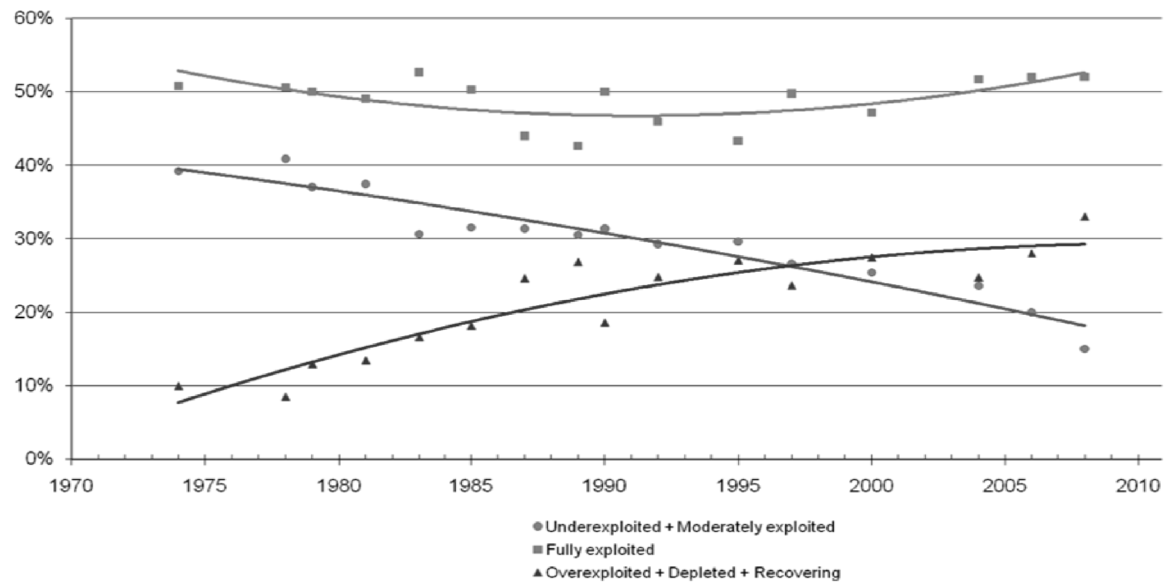
- Depleted: catches are well below historical levels, irrespective of the amount of fishing effort exerted.

- Recovering: Catches are again increasing after having been depleted or a collapse from a previous high.

Data suggest that the stock situation is serious, especially with regard to the number of species that are overexploited, depleted or recovering, but positive signs remain. By 1995, the proportion of stocks harvested near MSY had increased. Also, the proportion of stocks recovering (not shown in the figure) has increased, mostly in recent years. However, the number of stocks offering potential for expansion has decreased, demonstrating that there is little scope for increasing world catches.

17. Maximum sustainable yield (MSY) is defined as the largest average catch or yield that can continuously be taken from a stock under existing environmental conditions (see for example Parker, 2003).

Global trends in the state of exploitation of the world's fish stocks 1974-2004

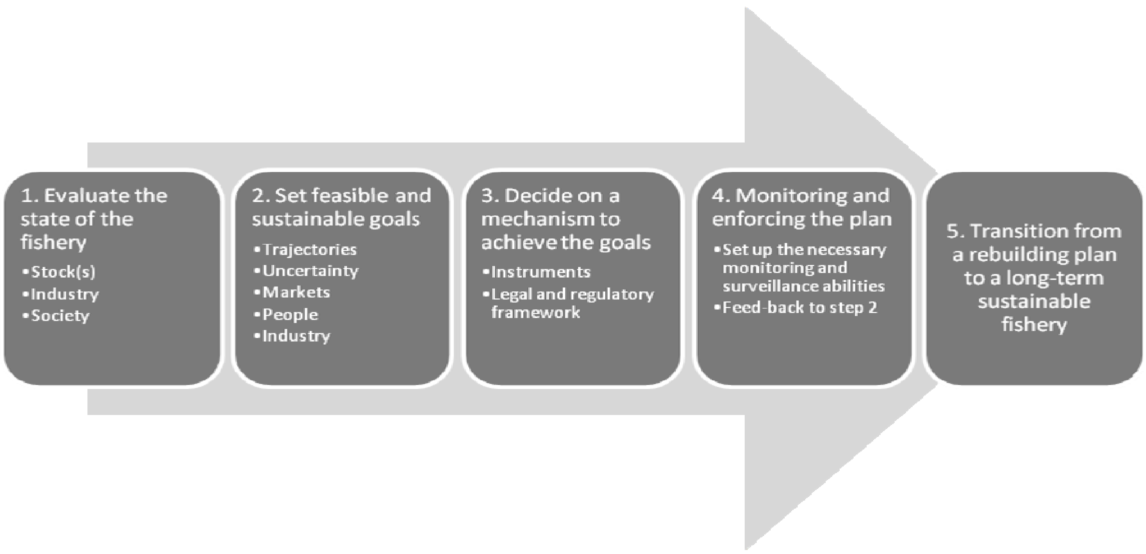


Source: FAO (2005) *Review of the State of World Marine Fishery Resources*.

The steps to rebuilding

162. A rebuilding plan is a process which (irrespective of its specific design) can be divided into five steps (Figure 5.1).

Figure 5.1. Steps of a rebuilding fisheries plan



- Step 1: *evaluate the state of the fishery*, economically and environmentally. Once the decision to rebuild a specific fishery has been taken, gather relevant data, being mindful of the costs and benefits of acquiring new information.

- Step 2: set *feasible and sustainable goals*. Determine the key issue of how quickly the fishery should be rebuilt, taking into account how markets, people and industry will be affected and existing uncertainties. Ensuring feasible objectives implies identifying relevant stakeholders and defining their roles in the rebuilding plan and distribution of costs and benefits. Rebuilding plans whose objectives are aligned with stakeholders' interests have a greater likelihood of success.

- Step 3: *decide on mechanisms to achieve the goals*. The need for rebuilding usually indicates some weakness in past approaches, which entails that the management instruments and regulatory framework require reform. Some mechanisms (*e.g.* adjustment aids or other measures to help with transitional issues) will end once the rebuilding process is complete (see Chapter 6). Others will be more durable.

- Step 4: determine a mechanism for *monitoring the performance* of the plan. Transparent and shared monitoring of the plan's successes or failures provides important feedback and helps build consensus. The plan itself should be flexible and contain adaptive mechanisms. For example, should monitoring indicate that the biological or socio-economic circumstances have changed, both objectives and mechanisms can be modified without re-initiating the whole process.

- Step 5: set up a *post-rebuilding* fisheries management regime that will keep the fishery on a sustainable footing with a management regime that provides incentives that ensure the durability of reforms and rebuilding and minimise the risk of another decline. Again, stakeholders must see real benefits in and be part of the solution.[18]

163. The five steps of rebuilding plans shown in Figure 5.1 are interdependent. For example, the practical constraints of monitoring and enforcement may limit the objectives and mechanisms used to attain them. Further, different mechanisms require different approaches to monitoring. In practice, rebuilding plans should be assembled as a package containing elements from each of the steps described.

Rebuilding: how fast?

164. Any rebuilding plan will mean decreased fishing mortality – at least temporarily – as more fish must be left in the water to allow the stock to grow. Deciding how much harvesting should be reduced and how fast recovery should take place involves trade-offs between short-term pain and long-term gains.

165. Consider three different harvesting trajectories leading to the target stock and harvest level (Figure 5.2). Implicit in each of the scenarios is that biomass will grow faster when the harvest rate is lower, so low harvest rates early in the rebuilding period will allow reaching the target biomass – and therefore the target harvest rate –more quickly. The thick line shows a plan which imposes a total moratorium until the stock has recovered. The two other plans do not impose a moratorium, but differ according to the *allowable* harvest rate at the beginning of the plan and its adjustment until the *target* harvest rate is reached. The thin line presents a plan with a relatively low initial harvest rate and a conservative policy (though not a moratorium) that allows the harvest rate to grow relatively quickly until the target harvest rate (and target biomass) is reached at a somewhat later point than with a moratorium. The dotted line shows a plan with a

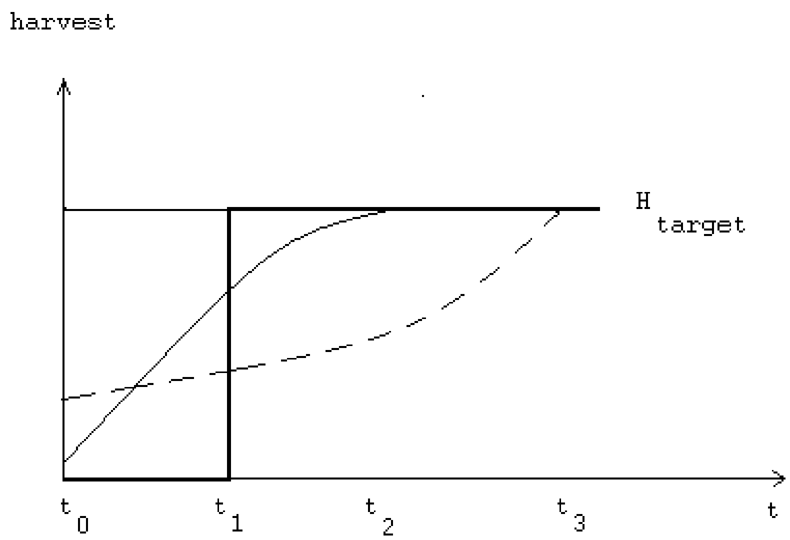
> ***Rebuilding plans** have to balance the biological and economic needs of the fishery over the short and long term.*

18. On this point, see also Sutinen (2008).

relatively high initial harvest rate, followed by a relatively slow increase in the harvest rate, meaning that the target harvest rate is not reached much later. These trajectories can also be named according to the speed with which they reach the target biomass and harvest rate: "fast" (scenario 1), "medium" (scenario 2) and "slow" (scenario 3).

166. These three scenarios are examples of different harvest control (fishing mortality) rules. Also called catch-rules or feed-back rules in fisheries economics, harvest control rules are functions that define the legal harvest size according to the stock size at any given time (*e.g.* Anderson, 2010; OECD, 2009). For the stock to grow, the *recovery harvest control rule* must provide for harvest rates that are lower than the growth rate so long as the stock size is less than the target.

Figure 5.2. Three different harvest trajectories



167. Both the speed of rebuilding and the target chosen depend on the "discount rate" – that is, the relative preference for short-term *vs.* long-term gains. Individuals, corporations and governments have different discount rates determined by their needs and objectives. As stewards of the resource, governments usually take a long-term view, factoring in future generations. Private stakeholders may value benefits in the near term more strongly, especially when the future is uncertain.

Governments usually take a long-term view, while private stakeholders may have a more short-term perspective, especially when the future is uncertain.

168. Disparity between public and private discount rates may create problems, particularly when it comes to gaining stakeholder support. A rebuilding plan that public authorities considers to yield net benefits may not be seen as worthwhile by private stakeholders. This is the reason rebuilding plans tend to be gradual rather than aim to rebuild the stock as quickly as possible so that more income is received in the near term. Costello et al. (2010) showed that in many cases, the optimal pace of rebuilding is often slower than the fastest possible route (Box 5.2).

169. Yet stakeholders do not always want to delay rebuilding, nor do governments always want to rebuild faster. If rebuilding takes too long, current stakeholders may not be able to reap its benefits, as the composition of the stakeholder group may change. Giving stakeholders a vested interest in the stock will encourage them to treat it as an asset to be maximised – which is more likely to bring their objectives in line with that of the fisheries manager.[19]

19. This, of course, was the subject of Chapter 4.

Box 5.2. A study of the value of rebuilding

Costello *et al.* use a model to examine three different rebuilding strategies, *i.e.* “fast”, “slow” and “optimal”, with the baseline case where the fishery is not rebuilt and remains in a collapsed state. In all cases the fishery begins in the collapsed state. In the “fast” scenario, the fishery is closed until the stock biomass reaches the set target. In the “optimal” scenario, the fishery is rebuilt by fishing according to the economic optimal policy until the stock biomass reaches the set target. In the “slow” scenario, fishing effort exceeds the economic optimal policy by 20% for the time period it would have taken to rebuild. When that point is reached the policy reverts to the economic optimal policy until the biomass reaches the target. Those three scenarios are compared with the net present value of maintaining the fishery in a collapsed state. The main results of this modelling exercise are shown below.

Net present values per year (2008 USD Thousands)

Species	Baseline	Additional value if optimal	Additional value if fast	Additional value if slow	Rebuilding time in years		
					Optimal	Fast	Slow
Subtropical small pelagic	38 705	64 236	41 953	64 025	8	7	9
Subtropical shrimp	391	23 908	17 283	23 262	4	2	4
Subtropical grouper	997	1 779	1 655	1 788	5	3	5
Cold temperate scallop	23 943	96 499	92 621	94 382	15	5	16
Cold temperate flounder	9 561	37 306	29 508	36 126	6	3	7
Subtropical wrasse	58	131	117	124	10	4	10
Subtropical snapper	1 812	2 887	1 656	2 835	8	7	8
Subtropical jack	650	2 526	2 308	2 523	8	4	8
Temperate hake	56 999	228 427	182 698	218 226	7	2	7
Tropical/suptropical lobster	9 000	24 602	18 257	23 565	6	2	6
Temperate rockfish	23	17	13	18	26	19	29
Suptropical sparid	208	601	579	573	22	6	29
Warm temperate snapper	449	1 580	1 453	1 576	17	6	18
Cold temperate sole	4 783	1 405	1 430	773	5	3	6
Temperate monkfish	30 219	134 929	128 859	133 815	19	3	28
Temperate filefish	1 242	2 815	2 812	2 689	12	4	18
Subtropical clam	36	3	-7	3	4	4	5
Temperate small pelagic	9 654	22 282	20 010	22 223	24	14	25

* From rebuilding given different rebuilding times (optimal, fast and slow scenarios)
Source : Costello *et al.* (2010)

Uncertainty in rebuilding plans

170. Uncertainties in the design and implementation of fisheries rebuilding plans relate to lack of knowledge about the biosphere, the workings of the fishing activity itself, and how it is affected by changes in natural and/or man-made conditions. The main sources of uncertainties can be classified as follows:

- ***Process*** uncertainty: arises from natural variability, *e.g.* in recruitment over time – an important factor when designing a rebuilding plan.
- ***Observation*** uncertainty: results from measurement and sampling errors, *e.g.* catch and landing data are quite often (and sometimes significantly) imperfect.
- ***Model*** uncertainty: arises from limited understanding of the relationships between different elements of the ecosphere and how this influences the fish stock .

- ***Estimation*** uncertainty***:*** comes from the use of models built on incomplete data – prevalent in all fisheries models where data collection is difficult and costly.

- ***Institutional*** uncertainty: linked to the process of defining an effective plan, *e.g.* difficulties in proper risk communication, or institutional or legal issues over different stakeholder roles in the rebuilding process from design to implementation. It can also arise from a lack of well-defined and operationally feasible objectives (Stephenson and Lane, 1995).

- ***Implementation*** uncertainty: doubt that policies will work due to factors such as lack of institutional capacity, misaligned incentives, ineffective monitoring and weak enforcement processes.

171. Four of the above-mentioned sources of uncertainty stem from the difficulty of predicting the future based on incomplete and imperfect data and knowledge. Because managing rebuilding is inherently a forward-looking exercise, fisheries managers often call upon models to help shape their understanding and support decision making. They do so not because models are necessarily accurate or suited to the task, but because the need for such information is acute. Awareness of the available tools' limitations will go a long way in ensuring flexible rebuilding plans.

The Management Strategy Evaluation (MSE) framework

172. For each rebuilding plan, fisheries managers should undertake a formal risk analysis identifying sources and types of risk. The MSE framework can be useful in identifying and implementing rebuilding strategies that are both robust to several types of uncertainty and capable of balancing multiple economic, social and biological objectives (Box 5.3). [20]

173. MSE is a general design and testing framework for management procedures that specify decision rules for setting and adjusting TACs or effort levels to achieve a set of fishery management objectives.[21] Administrators generally select management procedures with the assumption that they will help reach a pre-specified and quantified management objective. The MSE framework uses simulation testing to determine different management procedures' robustness to uncertainty. It differs from simple harvest control rules in that the procedure must specify the data and assessment methods used to link decisions to outcomes, *e.g.* how the TAC that achieves the target fishing mortality rate is actually calculated.

---

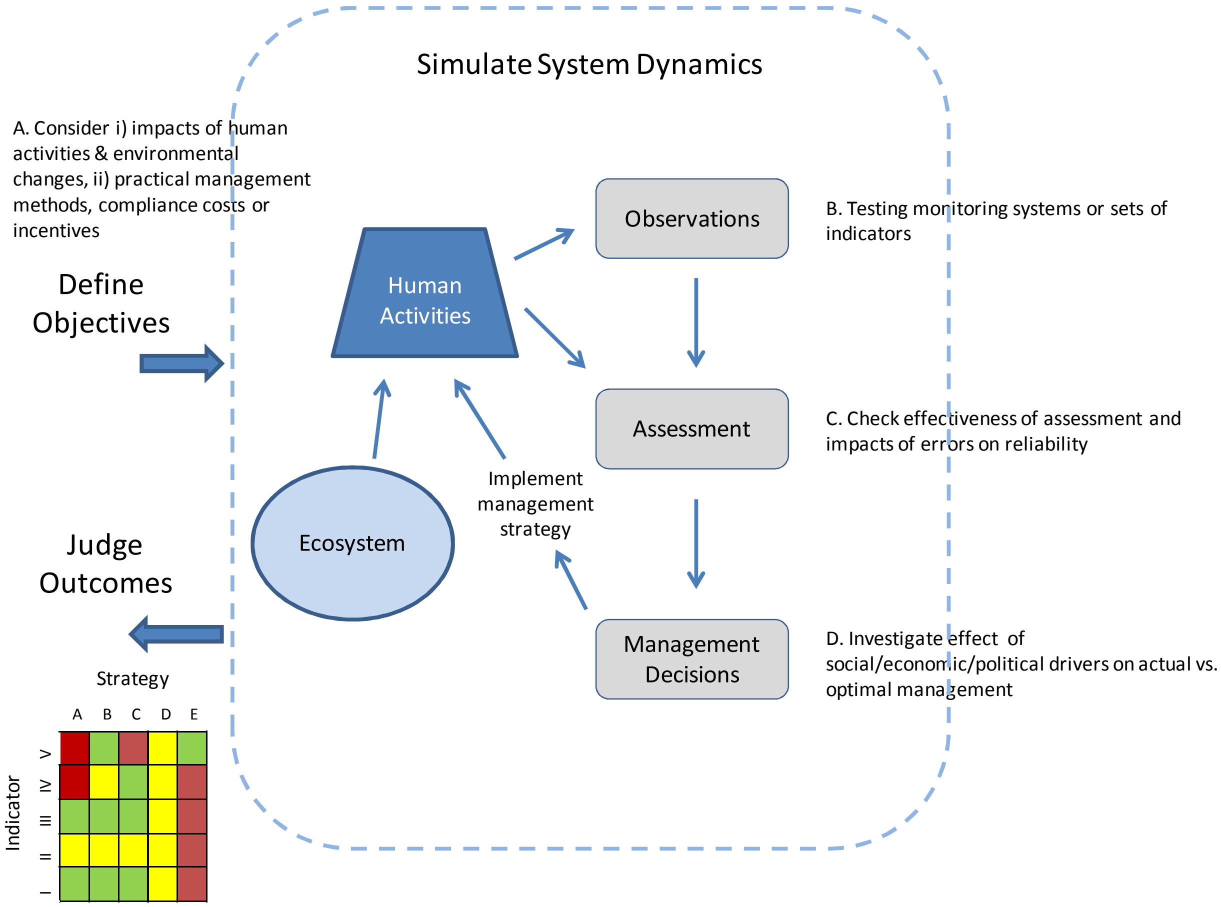
20. On the MSE framework and its use in different fisheries, see Holland (2010), on which this discussion is largely based.

21. There are very few examples of MSEs that have explicitly incorporated economics or economic objectives, but incorporating bio-economic models into the MSE framework could provide management advice to fisheries managers and stakeholders. See Holland (2010).

Box 5.3. The Management Strategy Evaluation (MSE) Framework

Management strategy evaluation (MSE) in the broad sense involves assessing the consequences of a range of management strategies or options and presenting the results in a way which lays bare the tradeoffs across a range of management objectives. In contrast to some previous approaches to fisheries assessment, it does not seek to produce an optimal strategy or decision. Instead it seeks to provide the decision maker with the information on which to base a rational decision, given their objectives, preferences, and attitudes to risk.

The MSE framework incorporates a number of interlinked model components, such as population dynamics, data collection, data analysis and stock assessment, a harvest control rule specifying a management action, a harvest decision process and an implementation plan for the management action. An operating model is then used to generate ecosystem dynamics, including natural system variations. Data are collected from the operating model to mimic fishery data and variability, and fed into the assessment model. The outcome of the assessment model and harvest control rule determines the management action. Fleet effort and catch are then modelled, taking into consideration potential implementation errors, and the resulting catches are fed back into the operating model. This cycle is then repeated to model the whole management cycle.



Source: CSIRO http://www.cmar.csiro.au/research/mse/

174. These interlinked model components allow fisheries managers to test the effects of modifying different parts (such as by changing the operating model) as well as test assumptions. It also allows them to run alternative management scenarios, by running numerous stochastic simulations over several years to see how well different procedures perform given different constraints. They can then compare how well

the various management procedures reach predetermined objectives. For example, they might look for a rule that has a low probability of stock collapse (e.g. a specific percentage of the simulation runs), a low average variance in TACs and a relatively high average catch size. Choosing the management procedures usually involves compromising among these different objectives, since they are often at odds.

175. Using MSE and pre-specified management procedures to determine management actions has several potential advantages over the more common approach of performing regular or periodic stock assessments followed by decisions on TACs. The MSE approach explicitly identifies management procedures that are robust to variations, uncertainties and errors, both with respect to the model's biological component and its implementation. If done correctly, it also allows an explicit definition of management objectives, which can be weighed against each other. As MSEs typically report a variety of indicators, stakeholders can consider the different trade-offs.

176. The MSE framework also has its drawbacks: i) it is time-consuming and can reduce managers' flexibility after implementation (Butterworth, 2007); ii) it is only as good as the underlying models and assumptions on which it relies; and iii) perhaps more importantly, it has been developed without much consideration for socio-economic aspects.

Additional considerations concerning uncertainty

177. Given the different types and sources of uncertainties, one might be tempted to look for general approaches to deal with uncertainty. One way forward (Charles, 1998) is to design the rebuilding plan so that it is *robust, adaptive and precautionary* and provides acceptable results even without a complete understanding of the fishery system itself.

> ***Dealing with uncertainty*** *means ensuring that a plan is highly likely to have acceptable results in all cases, not simply trying to maximise potential benefits. Plans should be* ***robust****,* ***adaptive****, and* ***precautionary***

- The plan should be *robust,* in the sense that even lacking perfect knowledge, it will at least provide some level of success. Fisheries managers should prefer plans that perform well within the expected range of uncertainty.
- The plan should be *adaptive,* in the sense that it should be flexible enough to make use of new information and knowledge. Incorporating input from various stakeholders may help make management more adaptive to various changes during the fishing season.
- The plan should be *precautionary*, in the sense that a robust and adaptive rebuilding plan does not free fisheries managers from uncertainty. Hence, it balances risks (e.g. between stock depletion and possibly foregone economic profits) and counters increased uncertainty with more conservative measures (e.g. setting lower catch targets).

Rebuilding instruments

178. Chapter 4 of this handbook discussed market instruments available to fisheries managers. Having established the plan's objectives and trajectory, tools and policies must be selected to create the appropriate conditions and incentives for fishers to reach their targets. No single solution will work in all situations. The approach selected will depend on management objectives, available information the nature and type(s) of participants, the ability to monitor and enforce regulations, and stakeholder involvement in the process.

179. A rebuilding plan is more than just stetting a TAC, as the underlying forces which lead to excessive harvesting and rent dissipation are still at play. Rights-based fisheries management based on output controls (quotas) have proven efficient at controlling exploitation and preserving stocks while also

generating profits and reducing the number of participants in fisheries (Sutinen, 1999). Given the right incentives, there is every reason to believe they are also effective at rebuilding them (Grafton *et al*., 2006; Sutinen, 1999; Larkin *et al*., 2007).

> ***Rights-based management** tools offer a number of advantages for rebuilding fisheries.*

180. A study by Sutinen (1999) on the effectiveness of different management instruments in OECD countries showed that time and area closures are not very effective at conserving resources, although they may be required in plans where species rebuilding is necessary to protect a subset of the population or its habitat (such as spawning grounds and/or spawning fish). Technical input controls have proven ineffective at limiting fishing mortality and are not a likely choice for rebuilding fisheries.

Key insights

- The management system that resulted in the need for rebuilding will most likely not be suited for the rebuilding effort. If overfishing or rent dissipation is the problem, as opposed to purely biological or environmental factors, then changes will be required in the way the fishery is managed.

- A fishery can be sustainable in the sense that its stock is relatively stable, yet still be overexploited. Rebuilding can yield significant economic benefits for fishers and ancillary sectors.

- A rebuilding plan has five interrelated steps: evaluation, goal setting, tool selection, monitoring and a post-rebuilding plan. Using a structured approach such as an MSE framework while accommodating uncertainty is more likely to yield positive results.

- Rebuilding fisheries is about obtaining maximum benefits over time. Simply stopping fishing until the stock is rebuilt is unlikely to be the best approach, and carries a number of economic risks. Balancing the interests of all stakeholders with public objectives and the limitations imposed by the resource biology is key to a successful rebuilding effort.

REFERENCES

Anderson, L.G. (2010), "Setting allowable catch levels within a stock rebuilding plan", *OECD Workshop Proceedings: Economics of Rebuilding Fisheries*, Newport, RI.

Butterworth, D.S. (2007), "Why a Management Procedure Approach? Some Positives and Negatives", *ICES Journal of Marine Sciences*, 64:613-617.

Caddy, J.F. and D.J. Agnew (2004), "An Overview of Recent Global Experience with Recovery Plans for Depleted Marine Resources and Suggested Guidelines for Recovery Planning", *Review of Fish and Fisheries*, Vol. 14, pp. 43-112.

Costello, C., *et al*. (2012), *The Economic Value of Rebuilding Fisheries*, OECD Food, Agriculture and Fisheries Working Papers, No. 55, OECD Publishing, http://dx.doi.org/10.1787/5k9bfqnmptd2-en

FAO (1995), *Code of Conduct for Responsible Fisheries,* FAO, Rome.

FAO (2002), *CWP Handbook of Fishery Statistical Standards,* Section G: Fishing Areas – General, CWP Data Collection, FAO Fisheries and Aquaculture Department [online], Rome, updated 10 January 2002. [Cited 12 December 2011], http://www.fao.org/fishery/cwp/handbook/G/en

FAO (2005) *Review of the State of World Marine Fishery Resources*, FAO, Rome

Grafton et al. (2006),"Incentive-based approaches to sustainable fisheries", *Canadian Journal of Fisheries and Aquatic Sciences*, vol. 63, pp. 699-710.

Holland, D. S. (2010), "Management Strategy Evaluation and Management Procedures: Tools for Rebuilding and Sustaining Fisheries", *OECD Food, Agriculture and Fisheries Working Papers*, No. 25, OECD Publishing, http://dx.doi.org/10.1787/5kmd77jhvkjf-en

Larkin, S.L., *et al.* (2007), "Optimal Rebuilding of Fish Stocks in Different Nations: Bioeconomic Lessons for Regulators", *Marine Resource Economics*, Vol. 21, pp. 395-413.

OECD (1997), *Towards Sustainable Fisheries,* OECD, Paris.

OECD (2006), *Using Market Mechanisms to Manage Fisheries*, OECD, Paris.

OECD (2010), *The Economics of Rebuilding Fisheries. Workshop Proceedings*, OECD, Paris.

OECD (2011), *Fisheries Policy Reform. National Experiences*, OECD, Paris.

Rosenberg, A.A. and C.B. Mogensen (2007), *A Template for the Development of Plans to Recover Overfished Stocks*, WWF, www.panda.org/marine.

Sutinen (1999), "What works well and why: evidence from fishery-management experiences in OECD countries", *ICES Journal of Marine Science*, vol. 56, Issue 6, pp. 1051-1058.

UN (United Nations) (1995), Agreement for the Implementation of the Provisions of the United Nations Convention on the Law of the Sea of 10 December 1982 Relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks. A/CONF.164/37.

UN (2002), *Report of the World Summit on Sustainable Development*, Johannesburg, South Africa, 26 August-4 September 2002, Chapter 1.2, Plan of implementation of the WSSD (www.Johannesburgsummit.org).World Summit of Sustainable Development website: http://www.un.org/events/wssd/

Wakeford, R.C., D.J. Agnew and C.C. Mees (2007), *Review of Institutional Arrangements and Evaluation of Factors Associated with Successful stock Recovery Programs,* CEC 6th Framework Programme No. 022717 UNCOVER, MRAG Report, March 2007.

World Bank, (2008), *The Sunken Billions. The Economic Justification for Fisheries Reform*, World Bank, Washington D.C.

Worm, B., *et al.* (2009), "Rebuilding Global Fisheries", *Science,* Vol. 325, pp. 578-585.

Zhuang, J. Z., *et al.* (2007), "Theory and Practice in the Choice of Social Discount Rate for Cost-benefit Analysis. A Survey", *ERD Working Paper*, No. 94, Asian Development Bank, May 2007.

CHAPTER 6: THE HUMAN DIMENSION OF FISHERIES REFORM

Introduction

181. Part of the fisheries manager's responsibility is to help develop a fishing industry that maximises both the private and social benefits of the resource. Modern fisheries management is concerned with a broader set of policy objectives, deals with a wider range of stakeholders, and does so with a more limited resource base than has been the case in the past. Effectively achieving the government's goals requires an understanding of the motivation and interest of all the players involved and an approach that works with those motivations to successfully implement policies.

182. Fishing is an important part of the coastal communities where it operates. It provides jobs in rural areas where often few alternatives exist. For many, it represents tradition and a way of life worth preserving. However, the fishing sector cannot be expected to always play that role in every place where it has done so in the past. In many cases, the resource stock is just not sufficient, in others, new technologies and the need for adequate and sustainable profits means that something has to change.

183. Just because reforms are necessary does not make them easy, nor the choices obvious. But the lessons in this handbook can help. Involving stakeholders, making use of market-based solutions where possible, being clear about objectives, having a robust and adaptive policy-making process and understanding the limits of the resource are all part of achieving successful reforms.

184. Many actions can be taken to help those negatively impacted by reform and ensure that the costs and benefits are shared by all. All reforms create winners and losers, and it is not possible to give everybody everything they want. Adjustment policies can help build support for reform, by helping those who remain the fishery adapt to changes, and by helping those who exit do so with viable options.

185. By virtue of its role as manager of the fishery, the government inevitably risks being blamed for any negative outcomes. Stakeholder groups use this to stall or prevent needed reforms or to demand compensation for them. Fisheries managers need effective strategies to respond to public and stakeholder pressure in a way that builds consensus for reforms that meet government objectives while treating those affected in a fair and balanced way.

The role of the sector in the economy

186. According to FAO estimates, 44.9 million persons worldwide were employed in capture fisheries and aquaculture production (i.e. the primary industry) in 2008, of which 85.5% worked in fisheries harvesting and aquaculture production in Asia (China alone accounted for 13.3 million people). But productivity, as measured in tonnes of fish landed per person employed, varied considerably. In Asian capture fisheries, each employee produced an average of 2.4 tonnes of fish annually, compared to 24 tonnes/person in Europe and 18 tonnes/person in North America.

187. Productivity variations tell us a lot about the different roles fisheries play in societies. European and North American fisheries tend to be more "industrialised" and commercial, with larger vessels and more mechanisation and equipment. In countries with high productivity, policies play a larger role in shaping the industry and balancing income, employment and other objectives.

188. Asian fisheries, on the other hand, tend to be small scale, with a higher share of artisanal (subsistence) fishers. As a result, the role of the fishery in the economy, and policy makers' aspirations for it, vary greatly. Low productivity can be a signal that the fisheries sector is acting as the employer of last

resort, soaking up surplus labour but providing only minimal income. In this case, development policies that depend on the fisheries sector to generate employment are misguided.

Productivity increasing ***investments in fisheries*** *raise overall incomes but cause labour to be released from the sector. The challenge is to manage that outmigration, rather than lock in subsistence producers.*

189. The fishing industry's relative importance and impact on the economy and local fishing communities play a large role in policy development and objective-setting (Box 6.1). It is clear that in some cases, policy-makers understand very well the trade-off between efficiency on the one hand and traditional operation on the other. However, preserving traditional fishing activities may or may not be sustainable in the long term as technology and market progress will continue to put pressure on traditional methods. A better approach is to identify areas of special priority or exceptional quality and direct targeted policies towards their conservation while allowing the benefits of consolidation and efficiency elsewhere.

Box 6.1. Preserving small communities in the UK

Policy makers in the United Kingdom have stressed the desire to keep small peripheral communities alive. In fact, discussions often focus on the need to ensure that small fishing communities not only survive for the benefit of the fishing community itself, but also as part of broader objectives (*e.g.* ensuring fishing for tourism purposes or ensuring a local supply of marine protein). This has often led to a "ring fencing" of small-scale artisanal fisheries, endowed with a special status and rules in the fisheries management system. The following is an excerpt from from a parliamentary commission discussing proposals for a transferrable rights system:

"The Common Fisheries Policy should protect fishing communities as well as fish. The introduction of Transferable Fishing Concessions (TFCs) as a mechanism to reduce fleet capacity highlights a broader debate over the interaction between overfishing, fleet size and employment in coastal areas. We recognise that introducing TFCs can reduce fleet capacity and improve environmental outcomes. However, we are deeply concerned that introducing TFCs will damage the viability of coastal communities. Department for Environment, Food and Rural Affairs (Defra) must decide what shape of fishing industry it wants in future. Therefore if Defra believes that a reduction in fleet capacity is needed, safeguards must be put in place to protect coastal communities and prevent excessive consolidation of the fleet in favour of larger operations.

"… In order to protect coastal communities from the potentially negative impact of fleet consolidation, Defra should not extend a system of Transferable Fishing Concessions into the under 10 m sector. Additional safeguards could include a limit on the percentage of national fishing concessions that can be held by a single vessel, a one-way valve to prevent transfers from small scale operations to large-scale operations, and a facility to allocate additional concessions to vessels that provide additional social or environmental benefits.

"…If a system of Transferable Fishing Concessions is introduced, Defra should implement a mechanism to discourage leasing of quota and to redirect unused quota towards more environmentally and socially sustainable fishing operators. We propose a siphon mechanism whereby if an operator chooses to lease his fishing rights rather than use them himself, a percentage of his allocation is returned to the national envelope. This can be reallocated to active fishermen in such a way as to restore traditional fishing activities in coastal communities and ensure the continuance of the socio-economic benefits that these activities provide."

Source : Environment, Food and Rural Affairs Committee - Twelfth Report: EU proposals for reform of the Common Fisheries Policy

Demographics, structural change and reform

190. Many fishers in OECD countries are older than the average population. Barriers to entry, limited prospects, long hours and dirty, difficult and dangerous working conditions can make the sector unattractive to potential entrants The sector's current demographic structure foreshadows inevitable (if gradual) change in the number and composition of fishers.

191. The demographics of sector participants provides an opportunity to address the capacity problem in the fishing fleet and increase average remuneration. While natural attrition in the workforce reduces overall participation in the fishery and pressure on the resource and incomes, this is a slow process that cannot be counted on to deliver results in a useful timeframe. Moreover, since new entrants tend to be more productive, each one disproportionately replaces the fishing capacity lost through retirement. The speed with which new entrants join the fishing sector depends on expected returns and alternatives, both in terms of wages and ROI.

The speed with which new entrants join the fishing sector depends on what alternatives exist, both in terms of wages and return on investment. Diverse rural economies and good infrastructure links can reduce pressure on fisheries to act as the local driver of employment

192. A common observation in many OECD fisheries is that a small number of large actors will typically have a dominant market share, even if the market comprises a large number of participants The working conditions, gear, work methods and social role/function of the large-scale and small-scale fleets are quite different (Box 6.2), as are policy objectives and tools directed at them.

Box 6.2. Important labour issues in the fishing sector

- Fishing is a hazardous occupation (see further in this report);
- Fishermen working in small-scale and artisanal fisheries have distinct characteristics compared with large-scale fisheries and the labour force in general;
- Fishermen often work in the context of an employment relationship involving many people (payment system based on share of catch), which may lead to exclusions from worker protection laws;
- Many fishermen are only seasonally and occasionally employed in the sector;
- Efforts to reduce fishing effort capacity may lead to insufficient income or unemployment for many fishermen;
- Low union membership rates or lack of fishermen's organisations may impair social protection and social dialogue.

Source : International Labour Organization (ILO) (2004), Conditions of work in the fishing sector, ILO, Geneva.

193. Industrial fleets have greater potential impact on stocks; they are more likely to respond effectively to market instruments, and less likely to have low income issues. They respond well to market-based economic instruments, such as individual vessel quotas or licences. Artisanal fleets are more likely to exhibit low average incomes and capacity problems prompted by "sticky" investments; they are less able to efficiently move capital in or out of the fishery. They respond better to group quotas, co-management or community based quotas, which are more empowering.

194. As is the case in other economic sectors, structural change in fisheries often goes hand in hand with dislocation, stress and redistribution of income and wealth. In most cases, fisheries reform means that part of the labour force will need to find alternative sources of income. How easily this is done will depend on the mobility of the workforce and availability of employment alternatives. Fishers are often located in rural areas offering few alternative employment opportunities (see Box 6.3). They also tend to have specific skills that do not transfer well to other sectors, especially to jobs providing equivalent income opportunities.

Box 6.3. Structural change in fisheries: Dealing with the human dimension

In situations of perfect labour markets, fisheries adjustment that reduces employment in the sector will result in a shift of individuals to other occupations or locations. However, in many fisheries, labour is relatively geographically immobile as fishers place a high value on the communities in which they live. There is often a significant amount of occupational immobility. This occupational immobility is compounded by the specialised skills required of fishers and an increasing average age which might impact the perceived worthiness of retraining programmes. Competing or unclear objectives, a lack of labour mobility and attention to the role of short- and long-term responsive policies are key challenges for fisheries adjustment. Efforts to establish clear objectives, ensure economic diversification through re-training, coherence with other policies already in place, and maintaining immediate and long-term responses, are critical to the success of programmes for sustainable fishery systems.

Source: *Structural Change in Fisheries: Dealing with the Human Dimension* (OECD, 2007a)

195. When structural change is a result of policy reform, "**flanking measures**" – that is, measures designed to speed adjustment, provide compensation or otherwise deal with the secondary effects of policy reform – are often provided. Such measures include education and retraining allowances, extended unemployment insurance, early retirement, and vessel or licence buyback schemes.

196. Flanking measures – especially those providing financial compensation – should be temporary and targeted to reduce any dependency and likelihood of inhibiting rather than promoting adjustment. In many cases, adjustment and compensation schemes work they are effective at easing transitions, but because they make reform more acceptable to fishers. Managers who feature them as part of the "price of reform" risk diluting their social benefits and should carefully balance their costs and benefits.

Financial compensation should be temporary and targeted; otherwise it can inhibit rather than promote adjustment. Use of compensation can build consensus for reform but at a cost that needs to be balanced against the benefits of reform.

197. Tradable quota systems can also help ease reform when the exiting participant takes with them the value of the quota they have sold. This can form a nest egg for retirement or financial cushion during their transition to a different sector, providing many of the benefits of financial compensation, but financed by the sector rather than by taxpayers.

Human dimensions and political economy of reform

198. Any sector where government policies have an impact on profits will see stakeholder lobbying. Regulatory or budgetary policies have an important effect on incomes, ROI and other outcomes important to stakeholders, so they naturally seek to influence these. Lobbying activities usually aim to maximise benefits for the group doing the lobbying, which does not necessarily match the general interests of society (Box 6.4). Part of the policy development and reform process consists in dealing constructively with lobbying activity to maintain stakeholder support without sacrificing social goals and benefits.

Box 6.4. Lobbying and strategic behaviour

Lobbying seeks to further the economic interests a defined group of individuals or industry stakeholders. Successful lobbying generates important benefits for the interest group but only relativelysmall losses to individuals not directly involved in the activity. Benefits of lobbying are usually concentrated and measureable while the costs are widely spread and hard to identify. For this reason, lobbying can be successful even when the result does not provide a net benefit once all costs are accounted for. Successful lobbying depends on effective contact with the responsible decision makers, combined with good media and public relations. Some of the messages that may be expected from lobbying groups are:

- *Every year is a tough year*. Lobbying for benefits is predicated on the need for special treatment, so fishers will rarely acknowledge that they are profitable or that current returns are sufficient.
- *Everyone is an artisan*. Large-scale industrial operations are less sympathetic to the public than are small artisanal fishers, which typically spring to the public's mind when thinking about fisheries. Lobbying groups use the artisanal fishery as the face of their communications strategy even when most benefits accrue to larger operations
- *Economic spillovers are large.* To justify targeted support, lobbyists claim that policies that benefit them will also benefit the economy at large, supporting this with exaggerated multiplier effects and broad definitions of the sector.
- *Small changes will have dramatic impacts.* Lobbyists often characterise the impact on the sector of reforms – even mild ones – as dramatic, as witness the protests about the impact of increased fuel costs in 2008.

Industry lobbying seeks its most effective audience, which does not always fit with fisheries managers' plans. The following is the finding of a report on fisheries in Australia highlighting the value of having and using clear processes and venues for consultation:

"Finding: The Minister's Office has been used inappropriately by industry lobbyists to undermine the formal Fisheries processes and recommendations, engaging the Minister and advisors on a range of issues, including inappropriate operational issues. This practice has undermined the integrity of, and confidence in, fisheries management and needs to be rectified. [The report recommends that] consultation with the commercial fishing sector takes place through … the Ministerial Fisheries Advisory Council on major strategy and policy issues …[and through the] Executive Director, Fisheries on major operational issues." (Stevens *et al.*, 2012)

199. Economic circumstances influence policy making by narrowing the set of politically feasible alternatives. It is more difficult to introduce reforms like shifting harvest levels to MSY when many fishers have low incomes and few alternative employment opportunities exist. Moreover, when the sector is otherwise in good economic shape, a negative shock will have a less critical economic impact and the management response is usually more effective (Grafton *et al.,* 2006).

200. As this handbook has emphasised, fisheries managers and policy makers need to work cooperatively with stakeholders to deliver effective outcomes. But providing the latter with incentives to participate must go hand in hand with a fair distribution of the benefits of reform to all. Finding this balance, and offsetting the influence of lobbying activities, will require broad consultation (primarily with fishers' organisations and secondarily with broader civil society groups) and strong connections among fisheries policy makers and other government agents. Bridge-building between thematic areas of government is already an important feature of policy coherence. Ideally, government ministries or agencies responsible for implicated domains – such as environment, natural resources, industry or employment – should have a formal mandate and role (Box 6.5).

A contributing factor to the collapse of the eastern Atlantic Cod stocks in Canada was the regulator's concerns that reduced harvests would generate bankruptcies and unemployment.

Box 6.5. European Commission processes

Commission initiatives, whether in the form of general Communications or more specific proposals for Regulations, Decision or Directives, are prepared by the relevant technical directorate general (DG). They are then discussed with other relevant Commission DGs and amended if necessary in a process known as inter-service consultation. Proposals for legislation are then checked by the Legal Service. Once the proposal is fully ready, it will be put on the agenda for a forthcoming Commission College meeting by the Secretary-General, who reports directly to the President of the Commission. If there is agreement, the College will adopt the proposal and send it to Council and the European Parliament for their consideration. The decision to adopt a proposal by the College is made, in most cases, by simple majority voting.

Source : James Brown, Institute for European Environmental Policy (OECD, 2007b)

Addressing the human dimensions

201. Fisheries management comprises a set of policies and objectives, including stock management. But it is rarely advisable or sustainable to use stock management parameters (*e.g.* harvest level) to achieve economic goals if they are not compatible with long-term resource conservation. Governments may use a number of different policy tools to support fishers and achieve other policy objectives. When these result in transfers affecting fishers' real income, reforming them can have negative impacts requiring the use of transitional policies.

__Re-instrumentation__ is replacing one form of support with an equivalent alternative – e.g. replacing fuel tax concessions with an income-support payment.

202. Different reform strategies are possible, depending on the duration of implementation and use of compensation (Table 6.1):

- Gradual reform without compensation reduces interventions over time significantly enough to yield benefits, but slowly enough to avoid resistance (*squeeze-out*). When it is offered with compensation, the old policy may be terminated and replaced with a series of cash payments (*cash-out*). When these payments are made over an unlimited duration, the process is called "re-instrumentation".
- Rapid reform terminates a policy completely without a phase-out period, either with (*buy-out*) or without (*cut-out*) compensation.

Table 6.1. Alternative support reform strategies

Compensation?	Duration of implementation	
	Long	Short
Yes	Cash-out	Buy-out
No	Squeeze-out	Cut-out

Source: OECD (2007b) *Structural Change in Fisheries: Dealing with the Human Dimension.*

203. Managers have several ways of dealing with transitional issues in the context of support reform. Following are five common approaches:

- *Reliance on existing social assistance*: easy, low-cost and administratively simple, this approach is best used for smaller reforms, but may not be politically feasible in small rural areas with longstanding economic problems. The additional social security available to fishers in France and Norway when direct fisheries supports are modified or withdrawn is one example of this approach.

- *Fiddling with reform*: features longer phase-in periods, exemptions and carve-outs and other selective changes designed to enhance the acceptability and reduce the impact of reform. While this approach has the advantage of being targeted, its compromises can become permanent and sabotage adjustment. Hence, using it can damage credibility and raise doubts about the government's commitment to reform.

- *Economic diversification*: aims at making the local economy and labour market more resilient to reforms. Active labour market programmes – *e.g.* employment insurance, early retirement, counselling and training, regional supports, aid to industry and infrastructure investments – have proven successful, are well understood and have a high level of political acceptability. However, regional support systems can preserve inefficient industries and distort markets, especially when alternative industries are already receiving support.

- *Compensation*: effective at obtaining reform, but carries risks. Matching its level to stakeholders' perceived costs is difficult as estimates often do not include stakeholders' positive adjustment actions. Optimal compensation has more to do with the amount required to reach an agreement than with indemnifying losses; full compensation is not necessarily an objective. Compensation should always be targeted, time-limited and tailored to allow adjustment and minimise costs and market distortions.

- *Packaging reforms*: combining changes in management with changes in supportive policies can ease adjustment costs and lead to greater efficiency and economic opportunity. New Zealand eliminated subsidies in the early 1990s at the same time as it introduced rights-based management. The new system gave those remaining in the fishery a good chance of creating a profitable business and allowed them to buy out leavers.

Key insights

- Due to fisheries' rural nature and the sometimes limited alternative opportunities available to fishers, policy objectives often include preserving employment and income. However, this objective can stall or prevent needed reforms. Used effectively, adjustment policies enable reforms.

- Few reforms can succeed without stakeholder acceptance and participation, yet policy makers must balance the need to obtain acceptance with the need to meet overall social objectives. While there may sometimes be a real need for flanking measures to help adjustment, these policies may simply be the cost to pay for stakeholder cooperation.

- While sector consolidation can bring economic and management benefits, it is often at odds with social objectives regarding rural economic activity and preserving traditional enterprises. General measures to enhance the rural economy are usually more effective than sector-based approaches.

- The ageing work force will inevitably lead to changes in the structure of the fisheries sector, but demographic changes alone cannot deliver needed structural adjustment.

- Some of the policy tools available to aid transition and adjustment are *active labour market programmes, existing social security systems, selective exemptions, compensation,* and *packaging reforms*. All need to be precisely targeted and time-limited to avoid delaying or preventing adjustment.

REFERENCES

Fitzpatrick, J. (1988), "Fishing Technology", in *Oceans Yearbook 8*, University of Chicago Press, Chicago.

Grafton, R., *et al*. (2006), "Incentive-Based Approaches to Sustainable Fisheries", *Canadian Journal of Fisheries and Aquatic Sciences*, Vol. 63, pp. 699-710.

ILO (International Labour Office) (2004), *Conditions of Work in the Fishing Sector,* ILO, Geneva.

OECD (2007a), *Subsidy Reform and Sustainable Development: Political Economy Aspects*, OECD, Paris.

OECD (2007b), *Structural Change in Fisheries: Dealing with the Human Dimension*, OECD, Paris.

Stevens, R., I. Cartwright and P. Neville (2012), *Independent Review of NSW Commercial Fisheries Policy, Management and Administration*, *www.dpi.nsw.gov.au/__data/assets/pdf_file/0015/433041/Full-report.pdf.*

CHAPTER 7: POLICY COHERENCE FOR DEVELOPMENT

Introduction

204. Fisheries policies in most OECD countries have many objectives relating to the state of the resource and surrounding environment, the number, distribution and characteristics of fishers, etc. Chapter 1 described policy objectives, different ways to develop and pursue them effectively, and the need for governments to consider them when developing policies. In particular, it stated the need for policies to clearly match objectives.

205. Decision-makers face difficult policy choices to balance immediate economic gains with the long-term sustainable and responsible management of natural fisheries resources. These competing policy interests combined with poor governance, serious administrative capacity constraints and changing global fish production and consumption patterns have led to mismanagement, degradation, and overexploitation of fisheries. This illustrates the inextricable policy linkages that tie OECD and non-OECD countries together. Fish stocks are global public goods and can only be protected by cooperation in governance and strong partnerships, distinctive responsibilities and reciprocal obligations. Concurrently, the cooperation should embrace a wide range of stakeholders at global, regional, national or local levels –such as developed and developing countries' governments, multilateral institutions, the private sector, regional fisheries organisations, and regional banks (OECD 2012).

206. At the same time, cooperation by itself doesn't lead to policy coherence. Different social groups will have different objectives, and many of these will be incompatible or in opposition with those of others. Putting these groups in the same room will not automatically solve these differences (FAO 2004). For the policy maker then, the challenge is not to reconcile all objectives, but to avoid situations where conflicting policies lead to waste and frustrate progress. Doing better on reconciling objectives and policies is possible, but will never be perfect nor the process complete. Moreover, achieving policy coherence does not automatically solve all problems; bad policies that are in perfect concert remain bad.

207. Many countries see the fishery sector as a means through which they can meet their objectives for (among other things) rural development, environment, social equity and fairness, trade and food security. This is because fisheries make up a relatively larger share of the economy, and fishers are predominantly poor and rural. Fisheries and aquaculture policies are looked to as a means of providing economic growth, alleviating rural poverty, and providing a reliable source of nutrition. The broad scope of objectives that must be served provides additional complications for the fisheries manager, especially when they must share the policy development space with different government ministries, foreign development agencies and NGOs (Box 7.1).

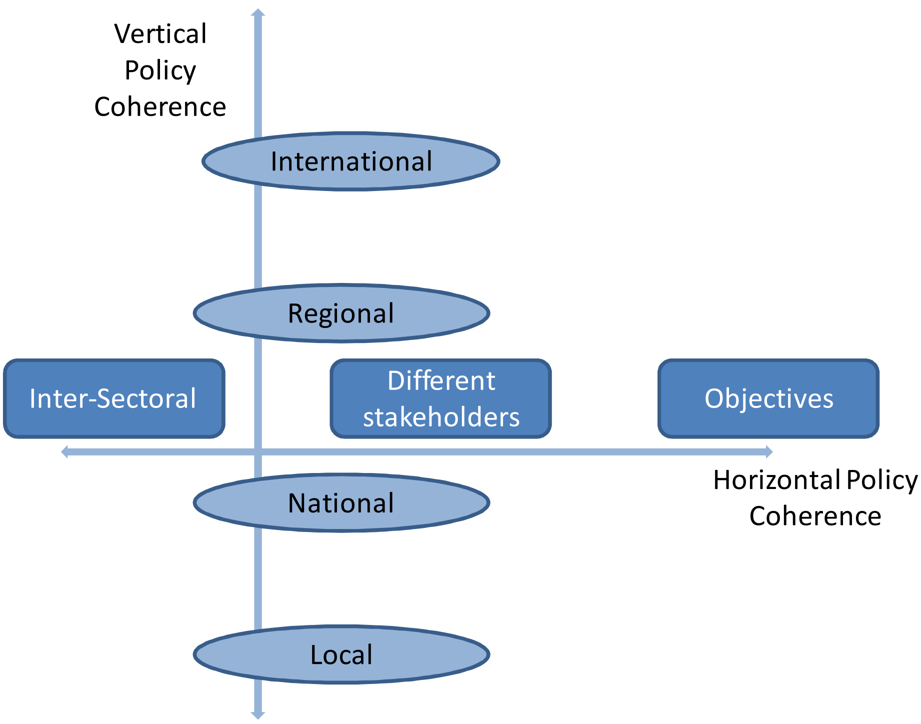
> ***Policy coherence*** *means ensuring that policies in different domains do not have conflicting effects. It has been identified as a key element of the OECD Green Growth Strategy and is an essential component of durable and effective policy frameworks.*

Box 7.1. Policy coherence for development

The policy coherence for development framework includes four elements:

- **Internal**: consistency among the ends, means, and resources a country allocates to implementing development objectives;
- **Whole of government**: congruence, complementarity and co-ordination of various policies within a country;
- **Harmonisation**: consistency of policies across donor countries; and
- **Alignment**: consistency between the policies and practices of one or more donor countries and its developing country partner(s).

These elements define elements of horizontal policy coherence, where objectives and policies within a country are aligned, and vertical policy coherence, which is consistency between different countries, regions, or governments.



208. With so many government objectives depending at least in part on the performance of the fisheries sector, the degree to which different objectives and policies are compatible will determine success in achieving sustainable development goals worldwide, including the Millennium Development Goals (MDGs) and the vision of the OECD Development Strategy. For OECD countries, the challenge is to align development assistance objectives with fisheries policies such as trade, access agreements, capacity building provisions, joint management of fish resources (*e.g.* straddling or high seas stocks and RFMOs) and development assistance directed at aquaculture and fisheries.

Policy coherence for development –The developed country perspective

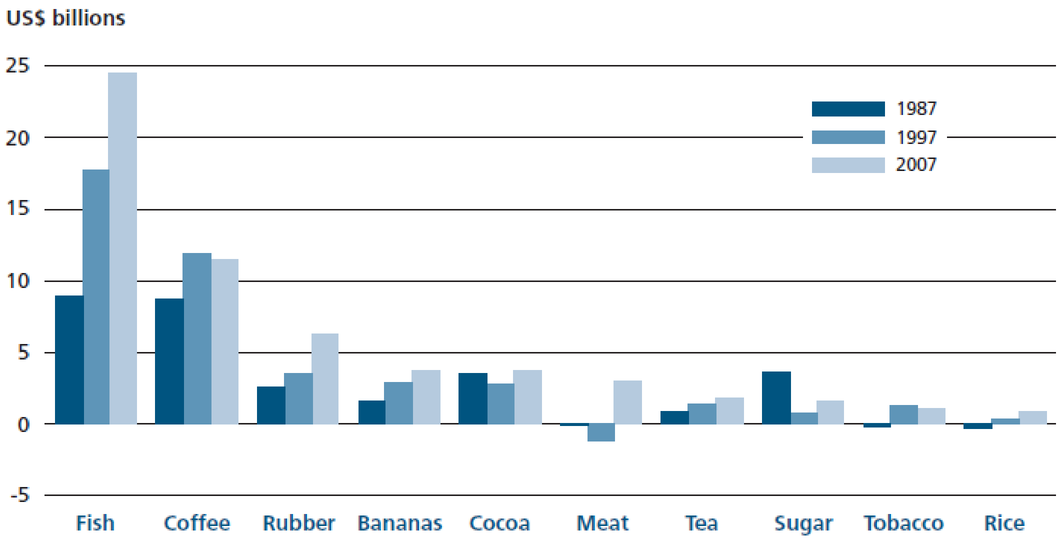
To improve performance in policy coherence for development requires being aware of a few key questions:

- How are developing countries affected by domestic fisheries policy?

- What can be done to assist developing countries which might be harmed by fisheries policies or their reform?
- How can domestic policy objectives be achieved in ways which were more consistent with the needs of developing countries?
- How can developing countries be helped to take better advantage of opportunities created by fisheries policy reform?

209. Policy coherence for development is not solely a problem for fisheries and fisheries policies, but there are many reasons why this issue is of particular importance for fisheries. For OECD countries, the crux of the issue is the nexus between trade policy and domestic support on the one hand, and development policy on the other, but there are many ways that governments can improve their internal operation to improve policy coherence (Box 7.2). At present, non-OECD countries are the main suppliers to the world fish market while OECD Countries are the main markets (OECD countries import about 60% of their fish from developing countries). The increased fisheries globalisation and international connectivity of fish production and trade is a key characteristic of the global fisheries value chain; given resource constraints in the fisheries of OECD countries, markets have become more dependent on fish imports from non-OECD countries (Figure 7.1).

Figure 7.1. Net exports of selected commodities from developing countries



Source: FAO (2010), *State of the World's Fisheries*, FAO, Rome.

Box 7.2. Lessons learned from OECD Country Studies

Phase One: Setting and prioritising objectives – requires political commitment and policy statements

- Educate and engage the public, working with civil society, research organisations and partner countries, to raise awareness and build support for PCD, on a long-term basis.
- Make public commitments to PCD, endorsed at the highest political level, with clear links to poverty reduction and internationally-agreed development goals.
- Publish clearly prioritised and time-bound action agendas for making progress on PCD.

Phase Two: Co-ordinating policy and its implementation – requires policy co-ordination mechanisms

- Ensure that informal working practices support effective communication between ministries.
- Establish formal mechanisms at sufficiently high levels of government for inter-ministerial co-ordination and policy arbitration, ensuring that mandates and responsibilities are clear and fully involving ministries beyond development and foreign affairs.

Source : OECD *Policy Coherence for Development--Lessons Learned* 2008.

Trade policies

210. Fisheries trade policies are an important consideration in policy coherence for development. Tariffs for fish and fish products are still in place in major import markets – even if they are low compared to other food products. While preferential access agreements provide some relief, tariff escalation can make it difficult for emerging economies to add value to their domestic production before export. Tariff structures conflict with the goals of the countries that impose them in terms of development assistance, protecting domestic processing at the expense of trade-driven development.

211. A number of non-tariff barriers (including labelling, packaging and inspection requirements, sanitary standards and more recently eco-labelling initiatives) also make it difficult for emerging economies to benefit from their resource endowment. These costly requirements also bias trade toward bulk products (e.g. fillets and loins rather than ready meals), to the detriment of value-added products.

212. Eliminating trade barriers is relative straightforward, if politically difficult, and can help developing countries advance, but finding solutions to non-tariff barriers can be more challenging. The health and safety objectives of importing countries rely heavily on sanitary and packaging requirements and other technical standards. So long as they do not discriminate against imported products, these requirements are unlikely to change.

213. Foreign direct investment from importing countries can improve infrastructure and provide expertise to help producers in developing countries bring their exportable products up to international standards. As for developing countries, they should welcome FDI and promote the development of modern infrastructure rather than try to preserve artisanal fisheries.

Fisheries access agreements

214. Fisheries access agreements provide opportunity for distant water fleets (fishing vessels that fish outside their own countries' waters) and also important revenue to developing coastal states. They

originated with the introduction of the expanded 200-mile EEZs, which became commonplace after 1977 and prevented many long-distance fleets from accessing fisheries where they traditionally operated. Thirty-five years later, fisheries access agreements are still in place, but now seem driven by excess fleet capacity on the part of the countries seeking access. Reducing fleet capacity to match available domestic resources can help reduce dependence on these arrangements. The main concern with fisheries access agreements is that, while they do produce revenue for the recipient, these access agreements can prevent domestic fisheries from reaching their potential by crowding out domestic fishers.

215. The development benefits of fisheries access agreements are modest in relation to their costs (OECD, 2006). While emerging fishing countries may find it difficult to resist the substantial financial compensation involved, these arrangements are often not well controlled and may lead to IUU fishing. Moreover, they often comprise a large part of the host country's budget, making reform difficult, and can lead to corruption when the funds are diverted.

216. Fisheries access agreements can be useful in specific circumstances if they are designed properly. Market-based instruments can ensure that market forces play a role in valuing access – a significant improvement over negotiations that may not be entirely fair or transparent. For example, developing country authorities can auction fishing licences or rights to fleets, thereby establishing the value of the fishery and ensuring a fair return for the host. This may also alleviate the problem of implicit subsidies to domestic fishers that occur when the authorities cannot recover the cost of access agreements from their distant water fishers. These subsidies likely conflict not only with development goals, but also with domestic goals of developing competitive, market-oriented fisheries.

> ***Tariff escalation*** *is the application of higher tariffs on value added products. This prevents developing country exporters from bringing higher value-added products to market.*

Regulation

217. Regulatory policies in the fisheries sector address legitimate public interests such as food safety and quality, consumer protection (Sanitary and Phytosanitary Standards as agreed at the WTO relate to food hygiene, packaging, traceability, and labelling requirements) and intellectual property protection. In addition to public tariff and non-tariff measures, developing country exporters have to face potential barriers to trade in the form of requirements for private certification. Eco-labelling and other types of sustainability, food quality or legality certification are increasingly required by major buyers in OECD markets. Due to high costs or lack of data availability, compliance with these schemes may be prohibitive for producers in developing countries. These policies are likely to have trade effects and indirectly affect local production, exports, employment, and food security in developing countries by limiting the market for fish products from developing countries, and/or increasing production costs. The WTO Agreement on Technical Barriers to Trade is a first step to ensure that regulatory measures, including regulations, standards, testing and certification procedures, do not create unnecessary obstacles to trade. However policy coherence initiatives must go further by considering the impact on developing countries of growing importance of non-tariff measures in OECD countries and designing differential regimes for these countries, particularly least developed countries (OECD 2012).

> *The* ***WTO Agreement on Technical Barriers to Trade*** *is a first step to ensure that regulatory measures do not create unnecessary obstacles to trade.*

Development assistance

218. Development assistance can help developing counties to build capacity for policy development and implementation in a way that will help them formulate and achieve their objectives. In fact, the Johannesburg Plan of Implementation (adopted by the WSSD meeting in September 2002) states that: *To achieve sustainable fisheries, the following actions are required at all levels: ... strengthen donor co-*

ordination and partnerships between international financial institutions, bilateral agencies and other relevant stakeholders to enable developing countries, in particular the least developed countries and small island developing states and countries with economies in transition, to develop their national regional and sub-regional capacities for infrastructure and integrated management and the sustainable use of fisheries. (UN, 2002)

219. Development co-operation can provide financial aid but also foster increased policy coherence across policy domains by engaging developed and developing countries across all policy domains, not just aid. This implies innovative forms of co-operation by aid agencies and a 'whole of government' approach that recognises the development consequences of policies that originate outside aid agencies (or indeed outside the public sector entirely, as is the case of private investment and labelling initiatives or the voluntary sector). This also means that assessment of development impacts should take account of the footprint of the full range of policies with respect to environmental sustainability and poverty reduction – aid and beyond (OECD 2012).

Policy Coherence for development—the developing country perspective.

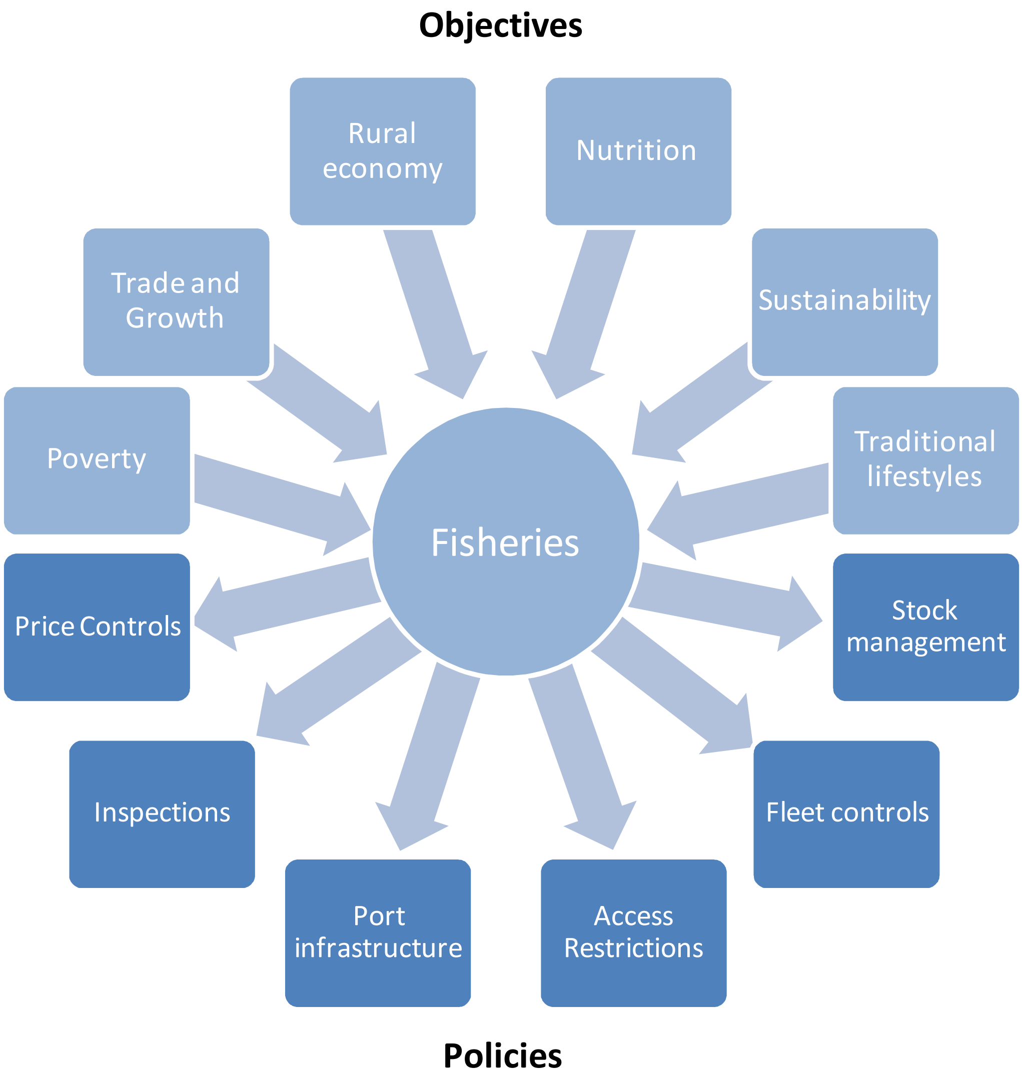
220. For many countries in development, a prerequisite for success is establishing good governance and rule of law. Reducing corruption, developing institutional capacity and creating an environment supportive of investment are all ways that countries can lay the foundations for development of their fisheries sector.

221. The connection between fisheries and development in developing countries is particularly strong (Figure 7.2). There is a tendency to see the fisheries sector as holding the solution to many problems, which leads to inconsistency in policy objectives and delayed development. Moreover, policy makers face the combined challenge of the political economy of fisheries reform and pressures from various stakeholder groups, which has led to many instances of failed reform and poor fisheries management outcomes. However, developing countries are not alone in having a range of (possibly inconsistent) objectives for their fisheries. Developing the institutional capacity to formulate good objectives and set policy is a necessary first step. This step can be assisted by drawing upon the national experiences of OECD counties, both good and bad.

222. Even when developing countries design and put in place sound policy, they may lack the resources to monitor and enforce compliance. The lack of resources to enforce robust governance is a serious problem in many emerging economies. Importing nations can help by demanding assurances that fish products were produced legally, and through better controls of their own distant-water fleets. Sharing responsibility for enforcement among partner countries can also help stretch scarce resources.

223. In the case of developing countries with poor infrastructure and weak institutions, assistance can help them adapt more effectively to the globalised and rapidly changing world of fisheries. Improving port and handling facilities as well as inspection services can open new markets for developing countries and help them add value to their products.

Figure 7.2. Policy coherence challenges for developing countries



Key insights

- Policy coherence for development cuts across several policy domains and requires effective communication and co-ordination – not only among government bodies within a country, but also among countries. Achieving real coherence is challenging and co-ordination failures outweigh successes. Support to domestic interests can contradict and hinder development goals.

- Policy coherence involves both ensuring that objectives do not conflict and that policies do not hinder unrelated objectives. Perfect policy coherence is not possible in practice, but a "whole of government" approach can help countries to do better.

- While increasing awareness of policy conflicts is an important first step, policy coherence will come about in the context of larger policy reforms rather than in addition to existing policies. Ensuring that domestic support is more targeted and transparent can reduce conflicts generated by indirect supports (such as tariffs and other barriers) and access agreements.

- Policy coherence for development requires a commitment to multilateralism and a recognition of shared interest and responsibilities. Progress cannot be made without concrete mechanisms such as international frameworks, treaties and agreements.

- Clear objectives and carefully targeted measures reduces policy spill-overs, as well as the likelihood and impact of poor policy coherence. Good policy design can simplify policy coherence.

REFERENCES

FAO (2004), *Policy Coherence for agriculture and development*, FAO, Rome.

FAO (2010), *State of the World's Fisheries*, FAO, Rome.

Hersoug, B. (2006), "Chapter 3: Policy Coherence in Fisheries and Aquaculture: Possibilities and Constraints", in *Fishing for Coherence: Proceedings of the Workshop on Policy Coherence for Development in Fisheries*, OECD, Paris.

OECD (2002a), "Development Co-operation Report 2001", *The DAC Journal*, Vol. 3, No. 1, OECD, Paris.

OECD (2002b), *Improving Policy Coherence and Integration for Sustainable Development: A Checklist*, OECD, Paris.

OECD (2006a), *Fishing for Coherence: Fisheries and Development Policies*, OECD, Paris.

OECD (2006b), *Fishing for Coherence: Proceedings of the Workshop on Policy Coherence for Development in Fisheries*, OECD, Paris.

OECD (2008a) *Policy Coherence for Development—Lessons Learned* Policy Brief, December 2008.

OECD (2008b), *Fishing for Coherence in West Africa: Policy Coherence in the Fisheries Sector in Seven West African Countries*, OECD, SWAC, Paris.

OECD (2012) *Policy Framework For Policy Coherence For Development Working Paper no 1*, OECD Office of the Secretary-General Unit for Policy Coherence for Development.

CHAPTER 8: FISHERIES MANAGERS' RESPONSE TO PRIVATE CERTIFICATION

224. Due to concerns about sustainability and the effectiveness of fisheries and aquaculture management, the public (comprising consumers, retailers and NGOs) are demanding assurances that the food they purchase has been sustainably produced. A number of private entities have established eco-labels and certification schemes that claim to provide the consumer with credible information while also serving the interests of fishers and processors wishing to convey positive product information to maintain their markets. Some customer concerns regarding product characteristics can only be addressed by involving the whole production chain, and labels help facilitate this.

Labels respond to the need of the whole production chain to be more responsive to consumer concerns

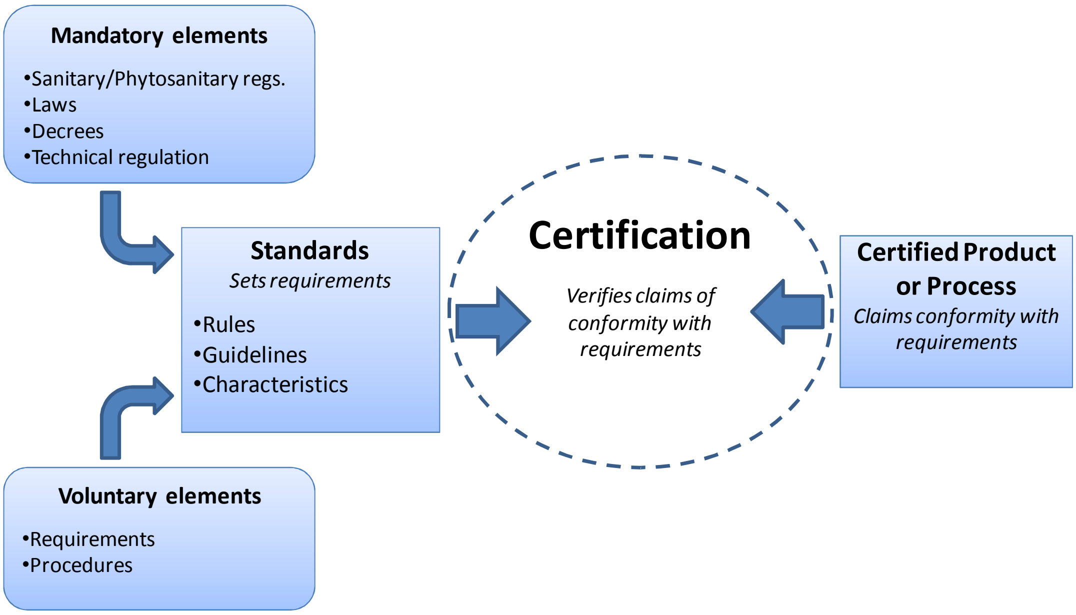
225. This chapter focuses on the role of fisheries managers and other authorities with regard to private eco-labelling and looks at possible responses. NGOs can see food labels as an opportunity to promote their particular agendas, and may seek to influence their content. As certification and eco-labels become more prominent in the marketplace, determining the appropriate role of fisheries managers and public regulators becomes more challenging and strategic.

Approaches to and objectives of private certification

226. Certification is a procedure whereby certification bodies provide assurance that food or food control systems conform to standards. These can be mandatory (part of existing law), voluntary, or have elements of both. Their requirements can take the shape of rules, guidelines or product characteristics (Figure 8.1). Certification is a form of quality identification that signals specific attributes to the user or consumer along the value chain. [22]

[22] Quality is understood broadly to include characteristics of a product and its production process.

Figure 8.1. Relationships between the key components related to certification

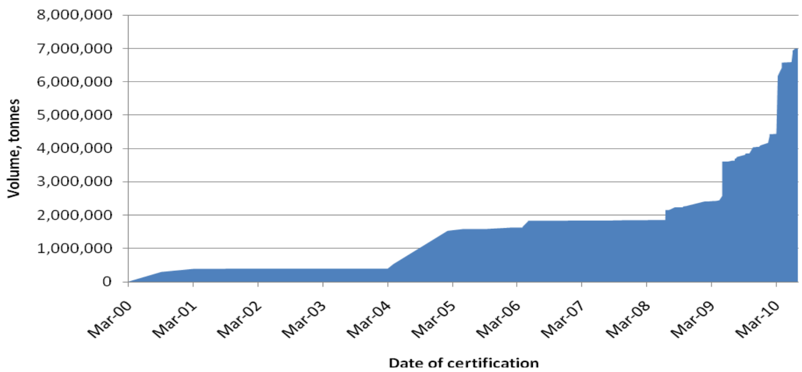


Source: OECD *Fisheries and Aquaculture Certification* (2011)

227. Fisheries managers can play a role in determining a standard's mandatory elements – *i.e.* those related to compliance with existing laws and regulation. But as the next section will discuss, fisheries policy makers also have many other interests, and therefore wish to influence the certification process – particularly as certification depends on the outcome of their fisheries policies.

228. An increasing share of new fish products are marketed in association with some type of environmental claim. In some species markets, certification has become a *de facto* requirement. The two main private fisheries eco-labels are the Marine Stewardship Council (MSC) and Friends of the Sea (FoS). MSC certification is more expensive to obtain and maintain than FoS, but is commonly acknowledged as more rigorous. Both have seen strong growth in the volume of fisheries they certify (Figure 8.2).

Figure 8.2. Volume of MSC-certified fisheries



Source: Nimmo, F. and G. Macfadyen (2010).

229. Demand for labelling and certification of fisheries products comes mainly from the retail sector. For the retailer, stocking products that are certified sustainable contributes to marketing plans and corporate social responsibility (CSR) frameworks. To be successful, labelling and certification systems must be practical for – and deliver value to – the fish marketing chain, down to the retail level. They heighten consumer awareness and consumption of sustainable products, underpin brand values and attract public attention to controversial issues.

230. Private fishery eco-labels aim not only to inform consumers about product characteristics, but also to modify consumer behaviour and shape public opinion – the overriding objective being to influence fisheries management policy and improve fisheries' sustainability.

> ***Public labelling efforts*** *are essentially the management system certifying itself. Hence, they are inherently less credible than private efforts that can claim independence from the management system.*

231. Standards and labels work best when a) they provide consumers with a sound basis for informed and considered purchasing choices and b) their promoters can argue that their certification is the most credible because it is based on best practices and provides accurate, complete and trustworthy information. Consumers may perceive a public fisheries sustainability label as enlightened self-interest. Private fisheries labels are more likely to succeed, as their third-party nature makes them less vulnerable to conflict-of-interest claims. Yet while private labels can be credible in ways public labels cannot, some public involvement can enhance the credibility of private labels by improving the perceived quality of standards.

232. Obtaining certification under a system such as MSC can require data beyond that currently available in a fishery. Fisheries managers must make a cost-benefit analysis of data collection, balancing cost and practicality against the data's value and utility for managing the fishery. A particular fishery may not have the necessary data to be certified by a standard, yet collecting additional data will increase the cost of certification to the point where it may no longer be feasible. Managers should determine early in the process how additional data collection can be done practically and whether its cost should be borne by stakeholders or public authorities.

Possible responses by fisheries managers

233. The strong growth in private labels and certification, and the growing demand for these in the marketplace, make them difficult to ignore. Fisheries management is clearly a matter of public policy. But the question remains of whether private certification systems can help advance and support the objectives of fisheries managers, or whether they add more complications than benefits. While the answer depends on a number of factors, private certification generally has both positive and negative impacts on the fishery (Table 8.1).

Table 8.1 Pros and cons of certification schemes

Pros	Cons
For certified fisheries, can effectively bring sustainability message to consumers.	Non-certified fisheries can be disadvantaged in the market, even when equivalent to certified products in terms of sustainability.
Can identify and help resolve traceability problems in the marketing chain.	Segregation of certified products can increase costs along the chain (chain of custody audits).
Can motivate positive changes in fisheries practices.	Certification can be expensive to obtain and maintain.
Can help fishers access markets or maintain market share.	May have trade implications conflicting with development objectives.
	Can require costly or impractical additional data collection.

234. Some observers believe that private eco-labels are not very relevant to policy, and should remain a matter of consumer choice in the marketplace. Others believe they can help remedy some domestic fishing industries' marketing problems and thus are worth supporting, for example by underwriting the cost of certification. Ideally, governments will take advantage of any positive interaction with the private sector to further their sustainability agendas. They will have to decide whether they view private labelling and certification as fundamentally positive or negative, and whether their approach to it is active or passive (Figure 8.3).

Figure 8.3. Possible responses to certification schemes

	Positive	Negative
Active	Fund	Compete
Passive	Support	Ignore

235. Perhaps the simplest and most positive approach is for the government to cover the fishery's private certification costs. This approach is not entirely without complications as it can be construed as subsidising the sector, with the potential to provoke trade conflicts. Because they are not connected to government circles, private labelling schemes have not been seriously challenged under international trade law – indeed, there is ongoing discussion of applying WTO trading rules to them. Public involvement in the certification system could complicate matters.

236. Another, less positive, response is to counteract the growing influence and cost of private labels by developing a competing public certification and labelling scheme with the aim of better controlling definitions and objectives. This approach is not generally successful. Adding new labels to the marketplace increases consumer confusion and requires considerable marketing, promotion and start-up costs. Further, as the government is also the fisheries manager, its label may be perceived as self-certification – which for obvious reasons carries low credibility – and concerned more with the interests of fishers than consumers or fish stocks.

237. One reason fisheries managers establish alternatives to private labelling systems is disagreement over the definition of the word "sustainable". For example, a fisheries biologist would emphasise the stock size and spawning stock biomass; an economist would emphasise fleet and social profitability, and so on.

The number of stakeholders who should ideally be involved in the discussion further complicates matters. Developing an agreed fisheries and aquaculture certification framework that sets minimum requirements and a benchmarking mechanism can address many problems. The *FAO Guidelines for the Eco-labelling of Fish and Fishery Products from Marine Capture Fisheries,* the recently approved *FAO Technical Guidelines on Aquaculture Certification,* and the guidelines for inland fisheries certification (under development) have already made much progress in establishing these elements.

238. Public authorities can also help improve certification schemes by providing a strong accreditation framework contributing to the reliability and impartiality of third-party certification. If deemed reliable, the private sector can carry out monitoring and control functions (e.g. of food quality, but also increasingly of seafood sustainability) which would otherwise be charged to the public sector.

239. Certification systems can improve compliance with fisheries regulations by requiring implementation of traceability systems. These have multiple benefits for individual firms, the fishing industry and the public sector and reward legal fishing practices (Box 8.1).

Box 8.1. Traceability

Traceability helps ensure that the form and content of a product conforms with that agreed by seller and buyer and that it is separated from like products in the production process. Suppliers have an interest in tracing products and services throughout the production process because it can lead to improved methods and smarter processes. Benefits of tracing products through the chain of custody include:

- Food and Safety – help trace products and establish liability in contamination cases. Efficient tracing can limit recalls specifically to the affected units, reducing costs.
- Marketing benefits – businesses may use labels to enable differentiating and tracing their products, e.g with the MSC scheme.
- Legal requirements – e.g. prove the accuracy of a product claim regarding origin, production method, etc.
- Trade requirements – determine duties, tariffs, or other trade regulations impacting the product.
- Insurance requirements – e.g. proof of ownership
- Technical requirements.

All these rationales are relevant to the fisheries sector, with recent emphasis on commercial benefits and ensuring truthful and verifiable information on product labels.

Source: Adapted from Schmidt (2000).

240. It is not advisable for public authorities, and fisheries manager in particular, to ignore private certification schemes. NGOs can make positive contributions, but they represent primarily their own interests whereas fisheries managers must act in the broader public interest. At minimum, governments are involved through existing laws and regulations covering labelling and advertising in the marketplace. Specific frameworks for certification and eco-labelling can increase transparency and credibility. For example, the United Kingdom's Department for Environment, Food and Rural Affairs (DEFRA) produces the Green Claims Guidance document (DEFRA, 2011) which helps promote clear and useful labels while identifying legislative requirements and other resources. Accreditation agencies may also play a role in recognising certification bodies.

Policy coherence for development and private certification

241. Fish and fish products are the most traded food commodity (FAO, 2010). A large share of the world fish supply is traded, and most originates in developing countries. Keeping in mind the overall objective of promoting sustainable fisheries, managers need to weigh the potential trade implications of certification schemes and more specifically, whether the efficiency gains from the information provided by certification outweigh the equity losses from the schemes' limited market access.

242. Critics of private labelling schemes point to their potentially trade-distorting effects, particularly in making access to value chains more difficult for small-scale producers from developing countries. They see certification schemes as a technical barrier to trade driven by the value chain and exempt from international trade disciplines (which typically apply only to government policy). While some developers of certification schemes claim to use a participative approach, financial and human capital constraints may limit participation by developing countries. Hence, eco-labelling schemes may result in a form of "green protectionism".

Certification requirements which respect different framework conditions in different countries need not pose a problem for policy coherence in development

243. Others view private certification as a catalyst for trade, since investments to upgrade developing countries' production systems to meet standards would ultimately improve their opportunities in international markets (OECD, 2007) while safeguarding the fisheries resource base. The FAO has studied the impact of certification on capacity building and concludes that well-tailored certification requirements which respect different framework conditions can foster policy coherence in development.

244. The recent OECD Declaration on Green Growth underlines the need to co-ordinate international development activities to help developing countries achieve green growth, including ensuring compatible trade and environmental policies and respecting internationally agreed trade rules such as transparency and non-discrimination. Developers of certification schemes have responded by offering a variety of solutions: the MSC has established the Developing World Program to enable data-poor fisheries to obtain certification, while the Global Aquaculture Alliance works closely with small-scale fish farmers to build capacity in view of certification.

Key insights

- Private labelling and certification systems, particularly eco-labels, play an increasingly major role in the marketplace and are not a temporary phenomenon.

- Certification schemes can help align incentives for both fishers and the public by moving information up and down the food value chain. Ideally, they can help fisheries managers achieve their objectives.

- Depending on specific objectives, fisheries managers can help develop and support certification systems. They have a range of options, from actively funding their fishery's certification to influencing the certification scheme through a number of co-ordinating or supporting actions.

- The current patterns of fish trade reinforce the development implications of certification schemes. Fisheries managers must take special care to ensure their coherence with development objectives.

REFERENCES

DEFRA (2011), *Green Claims Guidance*, Department for Environment, Food and Rural Affairs, United Kingdom.

FAO (2010), *State of the World's Fisheries*, FAO, Rome.

Nimmo and Macfadyen (2010), *Cost-Benefit Distribution and Transmission in Environmental Certification of Capture Fisheries: A Comparative Analysis,* OECD internal document, OECD, Paris.

OECD (2007)

OECD (2012), *Fisheries and Aquaculture Certification*, OECD, Paris.

Schmidt, Carl-Christian (2000), "Traceability in Fisheries: consumer wants and governments needs: Lessons learned from past experiences", *paper prepared for the International Conference on Fisheries Monitoring, Control and Surveillance*, Brussels, Belgium, 24-27 October 2000.

CHAPTER 9: FUTURE ISSUES IN FISHERIES MANAGEMENT

245. The world in which commercial fisheries operate is changing quickly, as is the role of fisheries managers. Within a couple of decades, fisheries management has shifted from maximising the amount of fish taken from a boundless sea to managing demands on a scarce resource that is increasingly threatened.

246. Commercial fishers, once by far the dominant human presence in the world's oceans, now share the marine environment with other users of equal or greater economic importance. They must contend with a number of competing objectives for ocean resources – from booming coastal communities, through preserving ecosystems, to promoting recreational fishing, tourism, etc. Increasingly, the quality of the marine environment, the health of its ecosystem, and the impacts of global warming are issues with which the fisheries manager must deal effectively (Table 9.1).

247. This chapter will consider future challenges facing fisheries managers and suggest ways forward and approaches to them.

Table 9.1 Dimensions of future issues in fisheries management

Future Issue	Explanation
Multiple users of fishing areas	Coastal development and increased affluence in coastal zones increase demand for coastal areas and oceans as an amenity. Aquaculture, recreational users, power generation and other new economic actors will claim areas traditionally used for fishing and demand compromise between impacts of commercial fishing and other uses.
Ecosystem-based and whole-ocean management	Stock management will be driven by concerns regarding the ecosystem as the underlying support for the stock. Managing the ecosystem to maximise stock productivity will become increasingly possible and demanded. Ocean ecosystem's *in-situ* value will increase.
Global warming and pollution impacts	Long-term changes in ocean conditions will drive increased risk and uncertainty in fisheries.

Aquaculture

248. Thirty years ago, capture fisheries were the world's main commercial fish source. Today, production is split between capture and aquaculture, which is set to overtake commercial fishing as the most important source of fish products by 2018 (OECD, 2011). This ongoing and dramatic change in fish production will have a profound impact on capture fisheries.

> ***Aquaculture** is set to overtake commercial fishing as the most important source of fish products by 2018*

249. Demand for fish as feed for aquaculture has stimulated reduction fisheries (fisheries that produce meal and oil). Concurrently, aquaculture output is increasing the overall supply of fish at a time when capture fisheries have reached their output limits. The growing share of aquaculture in total fish supplies means lower fish prices, more supply for fish processors, and inevitably more competition for commercial fishers.

250. Beyond its market impacts, marine aquaculture potentially conflicts with commercial fishing – particularly regarding competition for space, pollution and disease generation, and the incidence of aquaculture escapes (Table 9.2).

Table 9.2. Aquaculture production externalities and growth

Externality	Main cause	Possible solutions
Discharge	Feed, feed conversion, feed components	Feed quotas, fallowing, cleaning
Disease	Density, location	Separation from wild stocks, improved control
Escapees	Storms, accidents	Stronger cages, sterilisation, paying local fishermen to catch the escapees
Space	User conflicts/conflicting use	Reserved areas

251. In most aquaculture production systems (except for bivalves such as oysters and mussels) the reared animals produce organic matter (faeces). In systems that produce carnivorous species (e.g. salmon, sea bass and bream) and add feed compounds, the excess feed not ingested by the animals adds phosphor and nitrogen to the marine or inland water environment.

252. Much of aquaculture operates in open ocean conditions, and escapees from fish farms have been a problem. These can affect wild stocks, interact genetically with wild fish and increase competition for food. Norwegian researchers report that escaped farmed salmon represent 20-100% of the wild fish migrating in the Norwegian coastline (OECD 2010, Chapter 10), a proportion that has prompted a number of responses from Norwegian authorities (Box 9.1).

Box 9.1. Responses to escapees from Norwegian aquaculture

Norwegian officials have put in place a number of initiatives to address the problem of escapees from aquaculture operations, including:

- Requirements on mandatory reporting.
- Establishment of the Norwegian Escapee Commission to discuss and analyse past events.
- Development of a Norwegian technical standard for sea cage farms.
- Additional research and training of fish farmers to prevent escapees.

Source: OECD (2010) *Advancing the Aquaculture Agenda: Workshop Proceedings*.

253. Fisheries managers can take the following actions to respond to the growing importance of aquaculture:

- Develop an integrated framework for aquaculture regulation, replacing patchworks of jurisdictions and responsibilities.
- Improve monitoring and measurement of the impact of aquaculture to provide input for policy development.
- Develop coastal zoning plans delimiting areas of exclusive or shared use for different marine activities.

Recreational fishing

254. While recreational fishing has a long history, its interaction with commercial fishing has only recently become problematic. Recreational and commercial fisheries both depend on fish stocks as the basis of their activity, but the similarities end there. The majority of fish caught by recreational fishers are released. The primary output of recreational fishing is not fish, but the experience of fishing (Table 9.3).

The primary output of recreational fishing is not fish, but the experience of fishing

Table 9.3. Recreational *vs.* commercial fishing

	Commercial Fishery	**Recreational Fishery**
Activity	Renewable resource extraction Processing Marketing	Outdoor recreation
Product	Fish	Angling experience Catching fish Harvesting fish Aesthetics
Output Measure	Tonnes	Angler-days
Producing Sector	Commercial Fishermen Processors Distributors	Independent anglers Lodges Charters
Consumers	Seafood consumers	Anglers

Source: Gislason (2006).

255. While most of the fish caught are released, recreational fisheries do place some demands on the resource which can create conflicts with commercial fishing interests. Recreational fishers require a certain level of catchability and hence have an interest in conserving the *in situ* fish population. They desire abundance and large fish sizes, while commercial fishers are more interested in total harvest in tonnes.

Recreational fishing operations need abundant stocks of large fish to attract customers.

256. Given its relatively small net takings of fish, recreational fishing's growing importance as an economic activity (Table 9.4) does not in itself increase conflicts with commercial fishing. Decreased overall fish stocks due to poor management by commercial fisheries is a more frequent cause of conflict. As the stock decreases, along with commercial harvest levels, the quantity required by the recreational fishery becomes proportionally more significant (Figure 9.1).

257. Commercial fisheries policy and stock management are often influenced by the sector's role in supporting rural development and local economies. Recreational fishing probably supports more economic activity per fish caught – and can have more direct economic multipliers in the local economy – thanks to contributions of recreational fisheries operators and tourists using local hospitality services. Policy makers who improve measurement and reporting of recreational fishing's economic impact can help balance the roles of the commercial and recreational sectors and increase the total economic impact of the fishery resource.

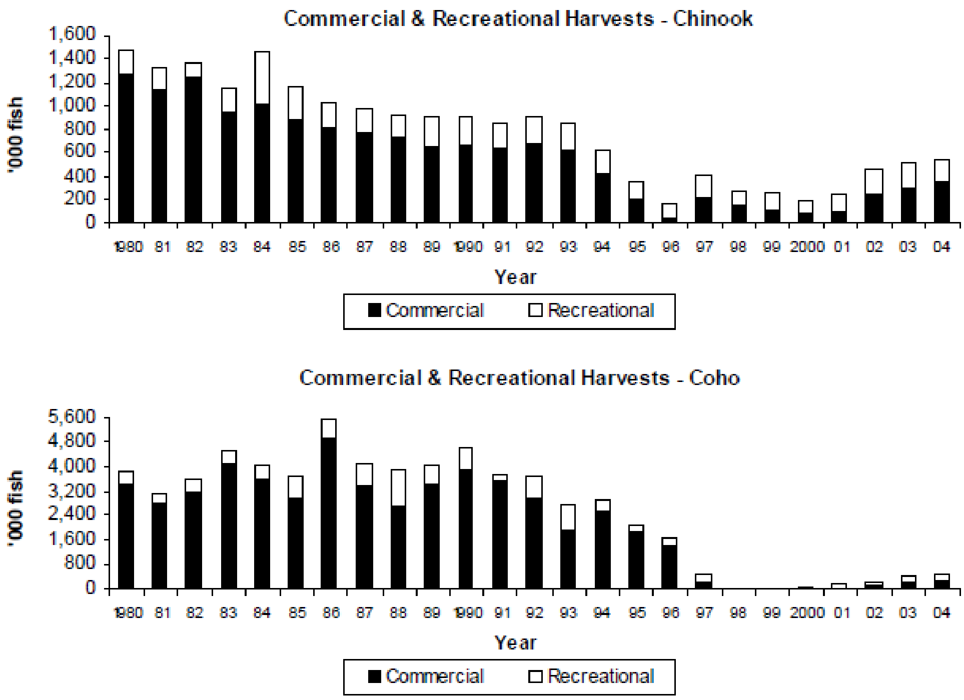
***Improved measurement and reporting** of recreational fishing's economic impact can help balance policy attention between commercial and recreational activities.*

Table 9.4. Recreational fisheries statistics

Location	Recreational fishing statistics
Europe	An estimated 21.3 million anglers fish in 22 European countries, with an estimated expenditure on recreational fishing in excess of USD 10 billion in 10 of the countries in Western Europe where data were available (Cowx, 1998b)
United States	In, 1996, 18% of the US population 16 years of age and older, *i.e.,* 35 million persons, spent 514 million angler-days in fresh waters, expending USD 38.0 billion (US Fish and Wildlife Service, 1997). In 2001, anglers in US marine waters of the Atlantic, Gulf, and Pacific coasts made an estimated 84.3 million fishing trips and captured more than 440 million fish, of which 187 million were estimated to have been retained (US Department of Commerce, 2002). In the United States, only 12% of the entire population has never participated in recreational angling (US Department of Commerce, 2002).
Canada	In Canada, 3.6 million anglers spent 47.9 million days and caught over 232.8 million fishes while spending USD 6.7 billion of which USD 4.7 billion was wholly attributed to the sport in 2000. Of these fish, some 84.6 million were retained (Department of Fisheries and Oceans, 2003).
Australia	In 2002, an estimated 3.4 million anglers in Australia contributed to 20.6 million angler-days and caught in excess of 70 million finfish, while spending in excess of USD 1.3 billion (Australian Department for Agriculture Fisheries and Forestry, 2003).
Global statistics	In 1995, the estimated total recreational catch worldwide was 2 million tonnes, representing an important source of animal protein in many developing countries (Coates, 1995). In 2004, it was estimated (using extrapolations from North American fisheries statistics) that total annual recreational catch worldwide was 47 billion fish per year, of which roughly two-thirds were released (Cooke and Cowx, 2004) Estimated freshwater recreational fishing effort represented roughly half of the food fishing effort from a global perspective relative to all fishing effort (*e.g*., marine recreational and commercial fishing effort (Kapetsky, 2001).

Source: Cooke and Cowx (2006).

Figure 9.1 Recreational and commercial salmon fisheries in Canada



Source: Gislason (2006).

258. Aside from good stock management leading to abundant fish stocks, conflicts between commercial and recreational fishers can be minimised in several ways:

- Improve communication between commercial and recreational stakeholders to promote understanding of everyone's interests. This includes better measuring and reporting of recreational fish catches as part of overall stock management.

- Maintain a respectful distance between commercial fisheries operations and common recreational fishing locations. This can be agreed upon in advance, or based on observation at the scene.

- Allow recreational fishers to participate in tradable quota schemes and other rights-based management systems.

- Rather than allocate fixed percentages of the fishery, establish a minimum set-aside for recreational fishing prioritising the activity at low stock levels, but giving commercial fishers a large share of harvest at higher stock levels. Over time, this provides more consistency to recreational fishers and more fish to commercial fishers.

- The higher economic value per fish generated by recreational fisheries makes compensation or other financial transfers possible, providing commercial fishers incentives to leave more fish for recreational fishing. This can be achieved through direct quota purchase, negotiation between the two sectors, or a government mediation programme.

Competing aquatic uses

259. Fishers face potential conflicts with a number of different users of the coastal and marine zone. As the BP spill in the Gulf of Mexico illustrates, both shipping and oil and gas exploration carry a risk of pollution. Forestry and agriculture can also have negative impacts on water quality through run-off. Coastal areas are developing and attracting a growing number of tourists and residents. While these often wealthy populations increase the demand for conservation and amenity use, coastal development can also cause pollution (Box 9.2).

260. Concern about the state of the world's oceans has led to a number of initiatives (Intergovernmental Oceanographic Commission/ United Nations Educational, Cultural and Scientific Organization, International Maritime Organization, FAO, United Nations Development Programme, 2011) – all of which have diagnosed oceans and coasts as significantly degraded and at risk. As a key player, the fisheries sector will be required to fulfil its role in improving the state of the world's oceans. This means doing a better job of managing fish stocks for the future, but also mitigating the impact of the fishing sector on ocean ecosystems.

***The Global Ocean Observing System** is a permanent global system for observations, modelling and analysis of marine and ocean variables to support operational ocean services worldwide.*

Box 9.2. Negative impacts of development and waste disposal in coastal areas

- Red tide, generated by eutrophication as a result of excessive household and industrial waste water.
- Oil pollution from shipping.
- Loss of wetland and seabed as a result of development and land reclamation.
- Damage to fish caused by water intake and heating from power plants.
- Presence of plastic and other durable discarded municipal waste.
- Presence of chemical and toxic pollution such as from heavy metals, polychlorinated biphenyl (PCB), etc.

Source : OECD *Reconciling Pressures on the Coastal Zone*, (1996)

261. A constant theme throughout this handbook has been that good stock management is the core of fisheries management. Most policy problems and conflicts in fisheries are rooted in a failure to manage the stock sustainably to serve the public interest. Heavily exploited fisheries conflict with objectives such as protecting biodiversity or maintaining undisturbed natural marine areas for other purposes. For example, activities involving education, diving, photography, tourism, and scientific research often depend on waters teeming with large and approachable organisms.

Uses of coastal and ocean areas

- *Habitat for people, plants and animals*
- *Food source*
- *Transportation and trade*
- *Mineral extraction*
- *Oil and gas extraction*
- *Dumping and waste*
- *Tourism and recreational activities*
- *Cultural significance*
- *Carbon absorbtion*

262. While good stock management is a prerequisite for resolving user conflicts, it is not enough. The challenge lies in devising policies and institutions that can resolve these conflicts, ideally through concrete mechanisms that lead to solutions that will benefit all users, and without undue costs to commercial fishers.

263. Marine reserves constitute one possible approach. They offer several advantages over traditional fishery management solutions as they can deal simultaneously with conflicting objectives. Commercial fishers can continue their activities outside the reserves, while non-fishing activities are allowed inside them. Furthermore, reserves can be a source of new biomass recruitment into the fishery – thereby boosting stock growth and resource resilience – and can benefit fishers by limiting oil and gas exploration in biologically important areas.

264. Integrated ocean management (IOM) is a systems-oriented approach to governance that seeks to deal effectively with the complex interactions in marine systems. It is similar to ecosystem-based management in that it deals fully with both human and non-human components of the overall system, drawing on a diverse tool-kit of approaches to govern human activities at sea (Charles, 2011).

265. Barberán (2002) described how to approach IOM in practice: "The implementation of effective ocean and coastal integrated management involves establishing the necessary network (policy, legal, financial, and technical), and requires the involvement of governmental organisations, local communities and of the private sector. Moreover, these efforts should also concentrate on establishing a regular interagency co-ordination process and sustainable management of coastal areas and marine resources at all levels."

***Types of "integration" in IOM**:*
- Inter-sectoral integration
- Intergovernmental integration
- Spatial integration
- Science-management integration
- International integration

266. A key goal of IOM is to produce present-day socio-economic benefits to humans and resolve conflicts among users of resources and ocean space while maintaining – and if necessary restoring – the ecosystem health and ecosystem services that future generations will require to produce their own socio-economic benefits.

267. The potential of IOM to act as an additional layer of bureaucracy with the potential to complicate fisheries management, delay decision making, and channel funding, personnel or research away from fisheries is a source of concern. Hence, it is important to focus on providing "value-added" to each ocean sector through effective higher-level actions and streamlined decision processes.

268. Several solutions to the problems arising from competing uses have been proposed, including:

- Create appropriate institutions or regulations to defuse conflicts. This is especially useful in the case of user rights allocation.
- Consult all parties in order to identify a common ground for conflict resolution.
- Use marine fisheries reserves to conserve the amenity value of important coastal locations. Depending on the fishery, this can create increased benefits for commercial fishers and other users.
- Generate information on the state of the coastal zone to address problems proactively.
- Use ocean and ecosystem-based management to integrate a broader set of issues into fisheries management and policy development.

Key Insights

- Other users of coastal and ocean resources are generating more economic activity than ever before. Interactions between these users and commercial fishing operations need to become mainstreamed into fisheries management policy.

- As aquaculture and other users continue to grow, colleting good information on their contribution to local and national economies will be important in ensuring that fisheries policies maximize total social benefits and use of the resource is appropriately balanced.

- The most important thing fisheries managers can do in response to the emergence of competing users is to do a good job managing the stock and incorporating ecosystem concerns into management decisions. Fisheries management will inevitably be called upon to take a broader set of concerns into account.

- Allowing other users to participate in quota trading schemes will help ensure that resources go to their best use and the value of quota reflects the true value of the resource.

REFERENCES

Barberán, José Antonio De Yturriaga (2002) *EU Presidency Statement - Law of the Sea*, Sixth Committee (Legal Affairs), United Nations, April 11, 2002.

Charles, (2011) Integrated Ocean Management and the Fisheries Sector: Interactions, Economic Tools and Governance Structures, OECD consultant's report (TAD/FI(2011)4).

Cooke, S. J., and I. G. Cowx (2006), "Contrasting recreational and commercial fishing: searching for common issues to promote unified conservation of fisheries resources and aquatic environments", Biological Conservation vol. 128 pp. 93–108.

Gislason, Gordon (2006), "Commercial vs Recreational Fisheries Allocation in Canada: Pacific Herring, Salmon and Halibut" Paper Presented to Sharing the Fish 06 Conference Freemantle, Western Australia 26 February – 2 March 2006.

OECD (1996), Reconciling Pressures on the Coastal Zone, OECD, Paris.

OECD 2010, Advancing the Aquaculture Agenda: Workshop Proceedings. OECD, Paris.

OECD (2011) The OECD-FAO Agricultural Outlook 2011-2020, OECD, Paris

CHAPTER 10. MANAGING FISHERIES: KEY ISSUES AND A POLICY CHECKLIST FOR SOUND FISHERIES MANAGEMENT

Introduction

269. The fisheries sector stands at a crossroads. The past several decades have witnessed a major increase in fishing capacity, fisheries landings and problems with fish stocks. Many fish stocks are overexploited and risk collapse, and fishers have suffered as a result. Policy makers and fishers are increasingly aware that action is needed. But the road to a sustainable fisheries sector is long. To get there, fisheries managers must challenge old ideas and preconceived notions and embrace new ideas and engage new stakeholders. Short term questions of employment and profits of fishers must not be traded off against longer term sustainability. To do anything else is to court disaster: collapsed fisheries, empty harbours, and permanent crisis.

270. This handbook draws upon a decade of OECD work that identifies both the challenges facing fisheries and solutions to them. This work is based on the view that adopting coherent policy principles can deliver tremendous benefits. Most important among these principles are using the power of markets to solve problems and establishing an open and inclusive policy development process.

271. Fisheries managers and policy makers need to be more focussed on public objectives such as conserving important ecosystems, fostering coastal development, fairness across economic sectors and countries, and promoting sustainable and responsible consumption. This means consulting more broadly, taking into account the broad scope of resource users and others concerned with fisheries and their impact on the environment. It means taking a "whole of government" view and being specific and clear about what fisheries management hopes to achieve. Success is measured in how effectively and efficiently these goals and objectives are met. In this new view of fisheries objectives, improving the state of the resource is part of a process leading to success, not the central objective.

272. Which leads to an apparent contradiction: While fisheries managers need to expand the scope of their objectives beyond the traditional, in almost every case and for nearly every situation, success comes more from doing well at stock management than from anything else. A stock that is healthy and productive, and kept at or near MSY, solves most of the policy problems the fisheries manager will face. So in fact we come full circle, from recognising that fisheries management is about more than just managing the stock, to understanding that managing the resource base remains the most important thing that the fisheries manager can do.

273. What are the benefits of good stock management? This handbook has identified a few:

- improved profitability and income for fishers and related industries,
- improved economic contribution of the sector to local and national economies,
- better robustness to natural shocks, IUU fishing, or other risks,
- fewer conflicts with other resource users,
- better policy coherence for development leading to more inclusive growth and income opportunities,

- greater market opportunities from increased consumer confidence in fish products.

All of the above are shared objectives of policy. In many cases, good stock management eliminates or reduce the need for specific policies to achieve these broader objectives (in other words, they will sort themselves out).

274. How do we achieve good fisheries management in practice? Again, this handbook provides some advice. Most important is the need to recognise the power of economic incentives. Policies that ignore or work against the forces that drive effort and investment in fisheries are unlikely to succeed in the long term, and can be damaging to the sector and the resource base. Market-based approaches that seek to understand and use the economic motivations of fishers are better at managing stocks and make almost every other aspect of fisheries management easier. For example, a well-designed market-based system can improve profitability and energy efficiency, enhance fish quality and marketability and speed up fleet adjustment.

275. A major hurdle in reforming fisheries management and introducing market-based policies stems from how fish resources are viewed. Many see fish as a public good and a resource that should be accessible to all. This viewpoint is sensible, but does not lead to sensible outcomes. Establishing property rights in fisheries raises difficult questions of distribution, fairness and equity. This is why the first steps in putting a market-based system in place are often the hardest. Once established, the benefits become clear and support for the system grows. With it comes the recognition that ***maximising the social benefit of the resource does not mean that anyone who wishes should have unlimited access, but that the policy maker must act in everyone's best interest.***

276. Moving to good stock management and adopting market-based approaches to achieve it is not easy. The second major principle identified in this handbook is the need for a robust policy development process. This process depends on involving all concerned parties, both within and outside the fisheries sector, being pragmatic about trade-offs between achieving reform and its costs (regarding such matters as compensation and quota allocations), and doing a good job of identifying the benefits and costs of reform. Giving fisher organisations ownership of parts of the process (such as quota allocation) can yield better decisions while helping smooth the path to reform – as can ensuring that flanking measures are in place to help those that are negatively affected.

A Policy checklist

277. The following is a list of Dos and Don'ts for good policy-making for fisheries managers.

Do:

- *Consult with stakeholders* early and throughout the policy development or reform process; listen to those you consult with. Without fishers' trust and buy-in, the consensus needed for effective reform will not arise.

- *Co-ordinate with other government agencies* to reduce policy conflicts. Policy coherence requires continual effort, but can greatly increase the likelihood of meeting government objectives, both inside and outside fisheries.

- *Put concrete mechanisms in place* to handle the consultation and coordination described above. The lines of communication need to be established and processes put in place to handle them. An ad-hoc approach is less credible and more difficult to sustain. Moreover, without explicit processes for consultation, stakeholders will try to find the most politically effective route to having their views heard, often circumventing the fisheries manager and undermining their efforts.

- *Set clear, measurable, and time-limited objectives*. Without these, the effectiveness of policies cannot be determined, and the purpose of fisheries management is unclear.

- *Target policies* to intended beneficiaries and minimize spillovers. This increases efficiency and the ratio of benefits to costs, especially when combined with tailoring (see below).

- *Tailor policies* to achieve their purpose at least cost. Avoid overcompensation, unnecessary expenditure, and waste. This maximises the net benefits of policies and saves resources.

- *Use the principles of the policy design cycle* and adaptive management to continually evaluate and adjust policies for maximum benefit at least cost. Measuring the impacts of policies and evaluating their effectiveness not only helps ensure efficiency but also helps avoid "path dependence", where longstanding policy approaches continue even as times change.

- *Get stock management right* first, then evaluate the need for additional policies to meet objectives. Maintaining stocks at MSY often solves problems that would otherwise require additional fixes

- *Use market-based instruments* where possible. Maximise their impact by avoiding restrictions on ownership, use or trading of rights. Well-designed ITQ systems can improve the profitability, energy efficiency, quality and marketability of fish and fleet structure (among other things), whereas traditional input control approaches can have negative impacts on all of these.

- *Share the benefits of reform.* The fisheries resource is a public good, and this does not change when rights are allocated to fishers in a market-based system. While policy makers may decide to let the majority of benefits of reform accrue to rights-holders, the government maintains the right to tax resource rents for the benefit of all citizens.

- *Use rural development and other general social policies*, rather than sector-based policies to solve rural economy issues. These are more targeted and effective and avoid distorting incentives and harming profitability in fisheries.

Don't:

- *Don't control the size and distribution of the fishing fleet* as a way to maintain traditional activities or rural areas. This conflicts fundamentally with efficiency and profitability, and makes over-harvesting much more likely.

- *Don't use input controls* as the primary means to manage harvest levels. Fishers' attempts to circumvent the effects of input controls increase their costs and make their operations more difficult. That said, input controls are an important part of the fishery manager's toolbox and have an important role to play in shaping the operation of a fishery, by prohibiting harmful gear types or closing the fishery during spawning seasons, for example.

- *Don't let special interests determine policy.* While stakeholder's views should be considered, the fisheries manager must look to overall societal needs and benefits. Setting clear objectives helps minimise the influence of lobbying.

- *Don't try to control every aspect of a fishery*. Market approaches work because the set the right conditions for fishers to do well, not because they specify what "well" means. In particular, attempting to manage fleet structure (size, distribution and number of vessels) poses many serious risks.

- *Don't resist change*. The path to development in any sector entails an using more capital, taking advantage of new technologies, and adjusting to the realities of the global marketplace. Traditional communities do not depend on fishing vessels of a certain size or type; they depend on a sustainable and profitable fishery that contributes to the economic and social fabric of the community.

- *Don't get caught in the trap of false competitiveness*. A truly competitive economic sector faces market competition on a level playing field. Subsidies such as fuel tax concessions and vessel construction or modernisation schemes cannot deliver true competitiveness, and their side-effects make them unsustainable.

Moving forward

278. Fisheries reform is underway. There are many success stories of rebuilding stocks and reform leading to profitable and sustainable fisheries. Yet much remains to be done. This handbook can help put fisheries on a sustainable footing that balances economic, environmental and social objectives. The reader is encouraged to follow the ongoing work of the OECD, in particular the OECD *Green Growth Strategy* and the OECD Committee for Fisheries. You can find the OECD on the web at www.oecd.org.

GLOSSARY

Adaptive management	A structured, iterative process of robust decision making in the face of uncertainty, with an aim to reducing uncertainty over time via system monitoring
Adjustment assistance	Programs that are established to mitigate the negative impacts of policy reform or hasten its benefits. Also called "flanking measures"
Beneficiary pays principle	Requires industry participants who stand to benefit from a policy intervention to contribute to its costs.
Capital stuffing	The tendency for excessive investment in productive inputs in response to regulations reducing fishing effort.
Discount rate	The relative weight given to short-term *vs.* long-term gains.
Divisibility	The ability to divide (a) property rights more narrowly, producing new recognised rights specified perhaps by season, region, ground, species, age or other classification and (b), the amount of quota into smaller amounts and to transfer some quota to others.
Duration	Length of time the owner of a right may exercise his ownership. A short duration leads to uncertainty.
Economic overcapacity	When the return on investment in fisheries is less than that of other sectors.
Economic profits	Profits in excess of the amount required to stay in the industry (also called rents).
***Ex ante* impact assessment**	An analysis of the activity targeted by new measures prior to reform that provides an overview of the context for the reform and gives an idea of the measure's potential impacts.
Exclusivity	Determines whether others are prevented from damaging or interfering with an owner's rights.
Fisheries access agreements	Agreements between two countries providing for access to the domestic fisheries of one (usually developing) country by the distant water fleet of another (usually developed) country.

Flanking measures	Adjustment and compensation schemes designed to ease structural change, e.g. education and retraining allowances, extended unemployment insurance, early retirement, and vessel or licence buyback schemes.
Flexibility	The ability of property rights holders to "freely" structure operations to achieve their goals.
Harvest (fishing mortality) control rule	A function that defines what the size of the harvest should be according to the size of the stock at any given time
Maximum sustainable yield	The largest average catch or yield that can continuously be taken from a stock under existing environmental conditions
NPV	Net present value; an evaluation of the current value of a discounted stream of future benefits.
Opportunity costs	The amount of money one could have made by investing in the next best thing.
Quality of title	Refers to certainty, security and enforceability of the property right. In some cases the incentive to self-enforce the property right may be strong.
Rents	See economic profits.
Sovereign risk	Right of the government to change the rules (unexpected closure of a fishery) for environmental, safety (e.g. pollution) or social reasons (e.g. new allocation of rights) represent a challenge to the security aspect of the characteristic. Sovereign risk may also be affected by international co-operation.
Stochastic variability	Random or unpredictable changes that are not susceptible to control.
Technical overcapacity	When the potential harvesting capacity of the fishing fleet is larger than the harvestable biomass.
Tradability	The ability to trade property to others.
Transferability	Extent to which the entitlement to a right can be transferred by selling, leasing or trading.
Tragedy of the commons	Over-exploitation of the fishery through unlimited access
Zero economic profits	A key indicator of well-functioning markets (consisting of accounting profits + opportunity costs) which describes the optimal equilibrium condition of markets and the economy.

附件 4

政府財政移轉議題報告：TAD/FI(2012)13

For Official Use TAD/FI(2012)13

Organisation de Coopération et de Développement Économiques
Organisation for Economic Co-operation and Development 01-Oct-2012

English - Or. English

TRADE AND AGRICULTURE DIRECTORATE
FISHERIES COMMITTEE

TAD/FI(2012)13
For Official Use

GOVERNMENT FINANCIAL TRANSFERS (GFT) REVIEW: INTRODUCTION AND PROPOSED AGENDA

Paris, 29-31 October 2012

This document is presented to the 110th session of the Committee for Fisheries under Draft Agenda item 6 for DISCUSSION and DECISION.

Contact: Roger Martini (email: roger.martini@oecd.org)

JT03327426

English - Or. English

GOVERNMENT FINANCIAL TRANSFERS (GFT) REVIEW: INTRODUCTION AND PROPOSED AGENDA

Introduction and Background

1. The GFT database is a unique resource that aids understanding of the application of fisheries policies across OECD countries. There is no cross-country source of data on fisheries policies with the same scope, and the GFT data helps improve transparency and open government, supports research by governments and academia as well as supports trade negotiations.

2. Yet, the GFT has much unrealised potential. Its impact could be greater, in particular with respect to media and public communications. One way of doing this is by consistently using and reporting the data. The GFT was used successfully in the publication *Financial Support to Fisheries: Implications for Sustainable Development* (OECD 2006) but has not been part of a sustained communications plan since that time. *The OECD Review of Fisheries* publication is the natural home for ongoing GFT reporting, and could benefit from making better use of the GFT. This is an opportunity to increase the impact of the work of the OECD COFI.

3. A good deal of attention is being paid to the health of fisheries and how they are managed. The GFT could play a bigger role in improving understanding of fisheries policy issues, but some improvements are required. In particular the GFT could do better on:

- **Timeliness**. Media and public interest will be stronger when data is more current[1]. While the historical time series data in the GFT is valuable analytically, that value to researchers is enhanced when the data encompass more recent policy changes.

- **Clarity**. Developing a set of practical indicators reported on a regular basis will allow the data to tell a clear story. Good indicators are those with intuitive appeal and which are understandable by a broad audience.

- **Completeness**. A partial dataset is of limited utility. Useful indicators require that the scope of coverage be understood and appropriate to the purpose. Increasing the range of policies covered by the GFT will strengthen the message it sends and increase its analytical value to researchers.

4. The COFI decided at its 109th Session to undertake a review of the GFT. To get this process started, Dr. Stefan Tangermann, ex Director of TAD, has been engaged to provide a background paper that provides specific advice and recommendations to the COFI for its GFT work. In addition, Dr. Tangermann will help guide the discussion at the GFT Experts' meeting, to be held the day following the 111th COFI session.

1. The OECD PSE/CSE data are taken up by *The Economist* (http://www.economist.com/node/21563323) and get global media attention, largely by virtue of being up-to-date and carrying clear messages.

An Agenda for the GFT Experts' Meeting & Expected Outcome

5. The GFT Experts' meeting is an opportunity for experts from Member States to provide input into the review process. This meeting will provide information and advice to the COFI to aid its deliberation as the GFT review continues in the months that follow. Experts will have a number of important issues to consider. A draft agenda (see Annex) is proposed for the meeting. Each session will begin with an introductory presentation followed by a discussion.

6. The experts meeting is a stocktaking exercise that will advise the COFI regarding what GFT data could be part of fisheries monitoring by the COFI and how it may be used. A meeting report will summarise the discussion and list the possible advice for improvements in terms of data coverage and collection. This report will be made available by June 2013 and will be discussed by the COFI at its 112th session in October 2013. At that Session the COFI will decide in which direction it wishes to go in terms of data coverage and collection.

Action required at this stage:

7. The Committee is requested to decide upon the experts meeting and its agenda under item 6 of the draft agenda for the 110th Session. Members are also asked to identify experts to be invited to participate at the meeting. While delegates are welcome and encouraged to attend, a good representation of experts from member countries will be critical to success.

ANNEX

DRAFT AGENDA

GFT EXPERTS' MEETING 25 APRIL 2013

1.	**Introductions, GFT classification and presentation of data.**
	The classification should be reviewed with an eye to the economic relevance and utility of the categories of support, balancing the amount of support in each category, and whether the categories are detailed and specific enough to produce useful indicators. Indicators complement the classification by using GFT data to create statistics describing the scale, scope and impact of fisheries policy. The main indicator currently used is the share of support in each GFT category, but many others are possible. Indicators are a useful communication tool because they summarise and enhance the information in the GFT. *Introductory comments by Stefan Tangermann and the Secretariat*
2.	**GFT scope and coverage**
	The recent work on fuel tax concessions opens the door to improving the scope of policy coverage in the GFT. Other routes are also available to improve policy coverage. The more comprehensive the GFT, the stronger the message that can be sent using it. Increasing coverage of the GFT should pay attention to costs and benefits, and also have an eye to establishing common benchmarks for coverage across countries *Introductory comments Roger Martini*
3.	**GFT collection and processes.**
	Data collection can be difficult, requiring co-ordination across different government bodies. Government agents not familiar with the OECD and its work may resist the time and effort required to complete data requests. Finding ways to smooth and accelerate the process of data collection is critical to success. This is a particular challenge for fisheries because data are supplied by participating economies (while the PSE data are identified/data mined by TAD Secretariat staff) with a relatively small number of Secretariat staff and potentially multiple sources of official data within countries. The introductory comments will describe the PSE process and what lessons can be taken from that exercise. *Introductory comments by Vaclav Vojtech*
4.	**Summary and Next Steps**
	The Secretariat will summarise the outcomes of the meeting and identify some next steps in the process.

附件 5

2012 綠色成長與養殖漁業研討會議程

(12-13 December 韓國,麗水市)：

Green Growth and Aquaculture Workshop

Green Growth and Aquaculture Workshop

Yeosu, Korea, 12-13 December 2012

Host: Ministry for Food, Agriculture, Fisheries and Forestry, Korea

12 Dec (Wed)

Opening and welcome	
09:00-09:10	**Welcoming Speech** Chul-Soo Park, Deputy Minister, MIFAFF, Korea
09:10-09:20	**Congratulatory Speech 1** Philippe Ferlin, Chairman, OECD COFI
09:20-09:30	**Congratulatory Speech 2** Yong-Tae Bae, Vice governor, Jeolla-Nam-do
09:30 -09:35	* Photo session
09:35-10:00	**Keynote Speech 1** Aquaculture and Green Growth: What does it take? (Carl-Christian Schmidt, Head of Fisheries Policies Division, OECD) (Dong-Sik, Woo Project Manager, OECD)
10:00-10:25	**Keynote Speech 2** Aquaculture in Asia-Pacific Region (Ambekar Eknath, Director General, NACA)
10:25-10:50	**Keynote Speech 3** Aquaculture in Korea (Shin-Chul Park, Director of Aquaculture Industry Division, Korea)
* MC: Mr. Bundo Yoon (Director, Korea)	
10:50-11:10	Coffee Break

Session 1:
Green growth and Aquaculture: Dealing with Feed Challenge and Aquaculture Production Externalities (Philippe Ferlin, Chairman, OECD COFI)

11: 10-11:30	**1.1. Can we deal with the fishmeal/oil conundrum** (Growing Aquaculture sustainably with limited Marine Ingredients) (Maggie Xu, China Manager ,IFFO)
11:30-11:50	**1.2. Making a difference: how to handle shrimp disease** (Roy Palmer, BDM- ASIA-OCEANIA , Global Aquaculture Alliance)

11:50-12:10	**1.3. Aquatic biodiversity and the responsible use of aquatic genetic** resources (Halwart Matthias, Senior Aquaculture Officer, FAO)
12:10-12:20	**Session Wrap-up** (Chair)
12:20-12:30	Break
12:30-13:40	Lunch
13:40-14:00	Break

Session 2:
Green growth and Aquaculture: the Governance Challenge for further Growth (Chair, Ambekar Eknath, Director General, NACA)

14: 00-14:20	**2.1. Korea's Experience: Seaweed aquaculture and Green Growth** (Eun Kyoung Hwang, National Fisheries Research & Development Institute, Korea)
14:20-14:40	**2.2. Sustainable Aquaculture Production in Japan** (Joji Morishita, Counselor , MAFF, Japan)
14:40-15:00	**2.3 . Chile's Experience: Salmon disease case** (Eugenio Zamorano, Subsecretaria de Pesca y Acuicultura, Chile)
15:00-15:20	**2.4. China's Experience: Inland Aquaculture and Green Growth** (Leilei Zou, Fisheries Policy Analyst , China, OECD)
15:20-15:40	**2.5. The Vietnam's Experience in developing the Aquaculture Sector** (Nguyen Thi Minh, Official ,Aquaculture Department,Vietnam)
15:40-16:00	**Small Wrap-up**
16:00-16:30	Break
16:30-16:50	**2.6. Korea's Experience: Green Growth Aquaculture in Jeollanam-do Province** (Keun-Suk Yang, Jeollanam-do Provincial Government, Korea)
16:50-17:10	**2.7. The Thailand's experience: Aquaculture Development in Thailand: Balancing Green Growth and Good Governance** (Suttinee Limthammahisorn, Fishery biologist , Coastal Fisheries Research and Development Bureau, Department of Fisheries, Thailand)
17:10-17:30	**2.8 Indonesia's Experience in developing the Aquaculture Sector** (Dr.Ir.Tri Hariyanto, Secretary DG of Aquaculture, Indonesia)
17:30-17:50	**Small Wrap-up**
17:50-18:10	Break
18:10 -18:30	Move to the restaurant
18:30-20:30	Dinner

13 Dec (Thur)

Session 2: (resumed)

Green growth and Aquaculture: the Governance Challenge for further Growth (Chair, Ambekar Eknath, Director General, NACA)

09: 00-09:20	**2.9. Philippines' Experience in developing the Aquaculture Sector** (Nestor Denus Domenden, Bureau of Fisheries and Aquatic Resources-Region I, Philippines)
09:20-09:40	**2.10. Sri Lanka's Experience in developing the Aquaculture Sector** (A.R. Mundalige, Aquaculturist, NAQDA)
09: 40-10:00	**2.11. Bahrain's Experience** (Ibtisam Khalaf, Head of Planning Directorate of Marine Resources, Bahrain)
10:00-10:20	**2.12. From Past to Future: Does the development of aquaculture in Turkey sustainable?** (Dr. Atilla Ozdemir, Senior Aquaculture Officer Turkey)
10:00-10:10	**Session Wrap-up (Chair)**
10:10-10:40	Break

Session 3:

Green growth and Aquaculture: Dealing with externalities impacting on the Aquaculture Sector (Chair, Martin Bryde, Norway)

10: 40-11: 00	**3.1. Utilization of sea areas for aquaculture –Norwegian case** (**Martin Bryde, Norway**)
11: 00-11: 20	**3.2. Dealing with Externalities from other sector activities: The French Experience** (Philippe Ferlin, Chairman, OECD COFI)
11: 20-11: 40	**3.3. Dealing with Externalities from other sector activities: The Chilean Experience** (Jose Miguel BUSTOS, Head of Aquaculture Division ,Chile)
11: 40-11: 50	**Session Wrap-up**
11:50-12:00	Break
12: 00 -13: 30	**Lunch**

Session 4:

The Way Forward: Reconciling economic imperatives for growth with Environmental Concerns (Chair, Carl-Christian Schmidt, Head of Fisheries Policies Division, OECD)

13:30 -14:30	**A Round Table Discussion** (Philippe Ferlin, Martin Bryde, Shin-Chul Park, Halwart Matthias,

	Ambekar Eknath, Roy Palmer, Maggie Xu, Nguyen Thi Minh, Orok Rowena**)** *****Each participant is given 3-5 minutes to highlight key challenges, constraints and solutions. This will be followed by questions and answers from the floor and the panel.
14:30-15: 00	**Q&A**
15:00-15:10	**Closing and Photo Session**

附件 6

本次會議紀錄暨與會者名單：TAD/FI/M(2012)2

For Official Use **TAD/FI/M(2012)2**

Organisation de Coopération et de Développement Économiques
Organisation for Economic Co-operation and Development **08-Nov-2012**

English - Or. English

TRADE AND AGRICULTURE DIRECTORATE
FISHERIES COMMITTEE

TAD/FI/M(2012)2
For Official Use

SUMMARY RECORD OF THE 110TH SESSION OF THE COMMITTEE FOR FISHERIES

29-31 October 2012

This Summary Record was adopted at the 110th Session of the Committee for Fisheries held 29-31 October 2012.

Fur further information, please contact:
Carl-Christian SCHMIDT (Email: carl-christian.schmidt@oecd.org)
Gunnar HARALDSSON (Email: gunnar.haraldsson@oecd.org)

JT03330380

Complete document available on OLIS in its original format

English - Or. English

COMMITTEE FOR FISHERIES

Summary Record of the 110th SESSION

OECD Conference Centre, Room CC6
2, rue André Pascal, Paris 75016

29-31 October 2012

1. Adoption of the Draft Agenda for the 110th Session *[TAD/FI/A(2012)2]*

The Agenda for the 110th Session of COFI was approved.

2. Statement by Mr. Ken Ash, Director of Trade and Agriculture Directorate

Mr. Ken Ash was not available to attend the meeting this time.

3. Fisheries and Green Growth: Progress reports

Dr. Max Nielsen, Associate Professor at the University of Copenhagen, presented a paper, "A View of Green Growth in Fisheries and Aquaculture", highlighting the major issues incorporated in the Green Growth concept.

In the light of this presentation, COFI decided to develop the work on achieving Green Growth in fisheries and aquaculture respectively, starting with the development of an analytical framework focusing on economic aspects, and consisting of a document divided into three parts containing:

- An overarching clarification of the concept of Green Growth for the development and management of fisheries and aquaculture which would also address interactions between aquaculture and fisheries.

- Green Growth in Fisheries addressing *inter alia* governance, energy use (including tax exemptions for fuel), bycatch and discards, ecosystem-based management, stakeholder participation and indicators along the value chain.

- Green Growth in Aquaculture addressing aspects relating to governance, energy, inputs (feed composition, food/feed relations, drugs, vaccines, etc.), interactions with the environment (discharges, escapees, genetic interactions), stakeholder participation and indicators along the value chain.

i) Green Growth Perspectives on Fisheries Governance – new paper [TAD/FI(2012)15]

The Secretariat presented a new paper on Green Growth Perspectives on Fisheries Governance. This new paper has benefitted from inter-sessional input. The paper clarifies the main concepts and identifies the main governance issues related to green growth and the instruments available.

Delegates made several comments, both on the paper and the conceptual framework for OECD's work on green growth in fisheries. It was emphasised that governance plays an important part in all work done on green growth. Several delegations highlighted the importance of splitting up the discussion on fisheries on the one hand, and aquaculture on the other. Case studies, submitted by delegations, can be helpful in advancing the understanding of the many different issues related to green growth and governance.

Dr. Max Nielsen's paper, "A view of green growth in fisheries and aquaculture", will be made available on the Delegates Corner and will be used as an input into the project on green growth in fisheries and aquaculture.

ii) Energy and Green Growth [TAD/FI(2012)2/REV]

This work was presented in preliminary form at the 109th Session of the Committee for Fisheries. This revised version responds to the comments made at that meeting, in addition to being generally expanded. It paves the way for policy-focused work in this area as part of the 2013-14 Programme of Work.

Delegates discussed various issues related to this document such as updating of information and questions regarding diffusion. Furthermore, delegates pointed to the desirability of more coverage of aquaculture and other non-capture aspects. It was suggested to change the title of the document to reflect the fact that policy questions will be addressed in future documents.

It was agreed that delegates would send written comments before 1 December 2012. A revised version of the literature review would be produced and circulated for approval under the written procedure. The revised version will be circulated by 15 January 2013.

There are no immediate plans to publish the document under any of the existing OECD public channels. The future use of the paper will be taken under consideration by the COFI as part of the larger work on green growth in general and energy use in particular.

- Feasibility Study – Fuel Tax Concessions in Fisheries ***[TAD/FI(2012)10]***

Dr. Max Nielsen provided a review of fuel tax concession modelling efforts by the Nordic Council of Ministers.

The Secretariat presented a feasibility study concerning fuel tax concession in fisheries. This paper provides a look at the potential for the FISHRENT model to be used as part of an OECD investigation of fuel tax concessions (FTC), and discusses goals and potential work on FTCs generally.

Delegates decided that work on FTCs should continue in the context of the qualitative and analytical work foreseen as part of the Green Growth and Energy document already agreed in the 2013-14 Programme of Work.

Delegates also decided to continue to follow the work underway on quantitative analysis of FTC by the Nordic Council and in the OECD in 2013 with a view to incorporating this into future COFI deliberations.

Delegates finally decided that the OECD Secretariat would work with COFI delegates, and in particular the European Commission, to develop Terms of Reference which would define the scope, objectives and methods of quantitative analysis for possible future work which could be undertaken using voluntary contributions.

iii) Green Growth and Waste and Improved Use of Fisheries and Aquaculture Resources

This Agenda item was removed and will be discussed at the 111th Session.

iv) Aquaculture and Green Growth [TAD/FI(2012)11]

Based on discussion at the 109th Session, a revised version of the paper on Green Growth and Aquaculture has been developed. Several delegates expressed their satisfaction with this document and pointed to a number of possible avenues for future work. Case studies provided by Norway and Chile were appreciated.

Some delegations proposed to provide additional case studies focusing on specific issues. It was also noted that the analysis should be extended to a wider range of intensive and extensive aquaculture, such as seaweed, shellfish and inland water aquaculture.

Delegates were informed about the upcoming Workshop on Aquaculture and Green Growth to be held in Yeosu, Korea, 12-13 December 2012. The programme will be available on the Delegates Corner soon. The material presented at the Workshop may subsequently inform and be used for the COFI work on Aquaculture and Green Growth.

4. Draft Fisheries Managers Handbook *[TAD/FI(2012)12]*

The first complete draft of this document was presented to the COFI for approval. Delegates were generally of the view that this document was not ready for approval in its current form, needing significant editorial changes and corrections. In particular, the absence of an executive summary was regretted and the content of Chapter 9 was seen to be lacking. Also, the introductory part of the document was seen as insufficiently comprehensive.

Delegates also discussed the scope of the document, whether it should stick strictly to past work or whether it should present a more up-to-date view and synthesis. Also questions of intended audience and use were raised. It was proposed that external review by fisheries managers would help to improve its utility to this audience. The need to revisit and update the document periodically as OECD work progresses was also noted.

The possibility of splitting the document into one containing reviews of past work and another containing future looking issues was raised. A final decision regarding inclusion or exclusion of that part of the document (Chapters 9 and 10) will be made on the basis of the next version of the document. An introductory note will be added explaining the context of the report. The title of the report will be reviewed and a new proposal will be presented at the 111th session of COFI.

Delegates were asked to provide written comments by 1 December 2012. They were also asked to identify external reviewers and mediate their input to the Secretariat.

An updated version of the document will be presented to the 111th session of COFI.

5. FAO-OECD Agriculture Outlook: The Fisheries Module, data validation, modelling, review of the Fish Chapter

Wayne Jones, Head of Agro-Food Trade and Markets Division, OECD Trade and Agriculture Directorate (TAD/ATM) and Stefania Vannuccini from the FAO presented the work behind the FAO-OECD Agricultural Outlook. Their presentations were well-received by the Committee and several delegates underlined the importance of this work.

More data, both quantitative and qualitative, would be highly appreciated. Work is already underway for future runs and analysis. The baseline story will be presented on OLIS early March 2013 for comments. An expert meeting will be held 26-27 March 2013, and delegates are encouraged to engage in that meeting. A draft of the fisheries chapter for the next Outlook will be made available at the next COFI session in April

2013. The Outlook report will be presented at the Working Party on Agricultural Policies and Markets Meeting (APM) 21-23 May 2013 and it is envisaged that the official release will take place in Beijing, China 25-27 June 2013.

6. Government Financial Transfers (GFT) Review [*TAD/FI(2012)13*]

A document was presented containing a draft agenda and background introduction to the planned meeting of experts to be held back-to-back with the 111th Session of COFI. The meeting will lead to a report that will support subsequent COFI deliberations.

Delegates recognised the importance of this meeting and the GFT review process generally, and discussed some of the issues at hand. Delegates asked what background documentation would be available and for more information on what type of expert was envisaged for attendance at the meeting. COFI Delegates will also participate in the meeting. The question of how to facilitate data submissions by member states was raised, and compatibility with WTO definitions was mentioned in this context. The draft agenda was approved. A dedicated area of the Delegates Corner will be created and on which documents for the meeting will be posted.

7. Review of Fisheries

- ***General Survey [TAD/FI(2012)14/PART 1]***

A draft of the General Survey chapter was presented by the Secretariat. The first part of the General Survey is in line with previous editions. The forward looking outlook chapter is based on work and results of the OECD/FAO Outlook (Agenda item 5). It was noted that the emphasis of the chapter should be on economic issues rather than biology. Furthermore, information regarding rebuilding efforts is available from the International Council for the Exploration of the Seas (ICES). Delegates were urged to submit Country Notes in order to finalise the document.

- ***Special Chapter***

The Secretariat informed the Committee on various options regarding the special chapter for the next edition of the Review of Fisheries. It was decided to look into the possibility of using the fisheries chapter of the OECD-FAO Agricultural Outlook 2012-21. Using the Executive Summary of the document *Poverty and Food Security, and Fisheries and Aquaculture* [TAD/FI(2011)9] is under consideration for use as a second special chapter. It was decided that the paper *Managing Commercial and Recreational Fisheries: Issues and Challenges* was not appropriate at this time.

- ***Statistics [TAD/FI(2012)14/PART 3]***

- ***Country Notes [TAD/FI(2012)14/PART 4 to PART 34]***

The Secretariat asked delegates to submit information by 1 December 2012.

The Russian Delegation provided an overview of recent developments in the Russian fisheries sector.

8. Other activities

i) Report on other OECD activities related to Fisheries

The Secretariat informed delegates about projects in other parts of the Organisation that have relevance to the work of the Fisheries Committee.

Barrie Stevens, Head of International Futures Programme, Directorate for Science, Technology and Industry (STI/IFP), provided and overview of the International Futures Program on the Blue Economy. Many Delegations expressed a keen interest in this work and would contact Barrie Stevens for information sharing.

Myriam Linster, Principal Administrator, Environmental Performance and Information Division, Environment Directorate (ENV/EPI) provided information to COFI on the work currently being undertaken by ENV/EPI on Green growth indicators. Delegates pointed out that result based indicators might be preferable to input based indicators. Indicators that measure how scientific advice is followed can be very helpful, these include precautionary reference points. The World Bank Fisheries Performance Index (FPI) should also be considered. ENV/EPI will send a short note on the indicators that have already been considered for comments for delegates.

Nik Mohamed, Economist/Policy Analyst, International Co-operation and Tax Administration Division, Centre for Tax Policy and Administration, (CTP/ICA) gave the Committee an overview of the ongoing work on tax crimes in the fisheries sector. Many delegates welcomed this work. It was decided to receive Mr. Mohamed at the 111th session of the COFI to review the final version of the report.

ii) Report on activities of the Fisheries Secretariat

Raed Safadi, Deputy Director, Trade and Agriculture Directorate (TAD/DO) discussed enhancing OECD impact, and encouraged COFI to continue generating policy insights to support this. Reciprocally, COFI delegates requested that the visibility and dissemination of OECD documents and publications should be enhanced.

iii) Reports from member countries on activities of relevance to the COFI

The Korean Delegation reported on the Expo 2012 Yeosu Korea.

iv) Reports from Observers

Representatives from the World Bank and the FAO made presentations on some of their current work of relevance to the COFI. In particular, advancements in the World Bank's Global Partnership for Oceans (GPO) were described, noting the development of a framework document, identification of partners, etc.

9. Council Recommendation on Decommissioning Schemes

The Secretariat presented a draft report to Council on the implementation of the Decommissing Scheme. Delegations were requested to submit the requested country information related to the questionnaire before 15 November 2012. It was noted that paragraph 9 should be changed to reflect the fact that there exists a variety of funding mechanisms for decommissioning schemes. Also, paragraph 13 should be re-written to reflect the fact that decommissioning is not necessarily needed because of failed management as many other circumstances may lead to a situation where decommissioning is called for.

10. Russian Federation: Consideration of Committee for Fisheries formal opinion on the Russian Federation's accession to the OECD [CONFIDENTIAL Item] [*TAD/FI/ACS(2012)1/REV*]

A Summary Record for Items 10 and 11 will be issued separately.

11. Committee for Fisheries Global Relations Strategy

12. Election of officers to serve on the Bureau 2013

The Bureau to serve for 2013 was elected as follows:

Chair: Mr. Philippe Ferlin (France), vice-chairs: Brynhildur Benediktsdóttir (Iceland), Robert Day (Canada), Leon Lomans (Netherlands) and Joji Morishita (Japan).

13. Other business

The need for a systematic quality control process for documents was raised in the context of the document "Rebuilding Fisheries: The way forward". It was noted that the Fisheries Secretariat has limited resources and that other human resources of the OECD Secretariat, COFI Bureau or Delegations could support this process.

14. Adoption of the Summary Record of the 110th Session of the Fisheries Committee [*TAD/FI/M(2012)2*]

The Summary Record of the 110th Session of the Fisheries Committee was approved.

Dates of next meetings

22-24 April 2013	111th Session at the OECD Conference Centre
25 April 2013	Expert meeting on Government Financial Transfers (GFTs) at the OECD Conference Centre
23-25 October 2013	112th Session at the OECD Conference Centre
7-11 April 2014	113th Session at the OECD Conference Centre (to be confirmed)
27-29 October 2014	114th Session at the OECD Conference Centre (to be confirmed)

LIST OF PARTICIPANTS
LISTE DES PARTICIPANTS

Fisheries Committee (COFI) 110th Session
Comité des pêcheries (COFI) 110ème Session

OECD Conference Centre, CC6, Paris
29-31 October 2012

Président/Chairman

Dr. Philippe FERLIN
Inspecteur général de l'agriculture
Ministère de l'Agriculture, de l'Alimentation, de la Pêche, de la Ruralité et de l'Aménagement du Territoire
251 rue de Vaugirard
75732 Cedex 15 Paris
France

Tel: +33 1 4955 56 55
Fax: +33 1 49 55 52 12
Email: philippe.ferlin@agriculture.gouv.fr

OECD Member States or Permanent Delegations

Allemagne/Germany

Mr. Bernd KREMER
Head of Unit
Federal Office for Food and Agriculture
Haubachstrasse 86
22768 Hamburg
Germany

Tel: +49-40-306860564
Fax: +49-40-306860528
Email: bernd.kremer@ble.de

Ms. Ursula POSSELT
Fisheries Expert
Federal Ministry of Food, Agriculture and Consumer Protection
Rochusstr.1
D-53123 Bonn
Germany

Tel: +49 228 99 529 4660
Email: ursula.posselt@bmelv.bund.de

Australie/Australia

Mr. James BULLOCK
Adviser (Agriculture)
Permanent Delegation
4 rue Jean Rey
75015 Paris
France

Tel: +33140593370
Fax: +33140593394
Email: james.bullock@dfat.gov.au

Mr. Matthew WORRELL
Minister-Counsellor (Agriculture)
Deputy Representative to the Food and Agriculture Organisation
Australian Delegation to the OECD
Australian Embassy Rome
Via Antonio Bosio, 5
Rome 00161
Italy

Tel: +39 06 8527 2376
Fax: +39 06 8527 2346
Email: matthew.worrell@dfat.gov.au

Belgique/Belgium

Ms. Barbara ROEGIERS
Policy Advisor
Agriculture and Fisheries - Policy Division
Department of Agriculture and Fisheries
Koning Albert II Laan 35 Box 40
1030 Brussels
Belgium

Tel: +32 2 552 79 56
Fax: +32 2 552 79 21
Email: barbara.roegiers@lv.vlaanderen.be

Canada

Dr. Robert DAY
Director, Atlantic and Americas Regional Affairs Bureau
Fisheries and Oceans Canada
200 Kent Street
14W095
K1A 0E6 Ottawa
Canada

Tel: +1 613 991 6135
Fax: +1 613 990 9574
Email: robert.day@dfo-mpo.gc.ca

Mr. Barry GREEN
Policy Analyst, Global trade and Market Access Bureau
International Affairs Directorate
Fisheries and Oceans Canada
Strategic Policy Sector
200, Kent Street
K1A 0E6 Ottawa
Canada

Tel: +1 (613) 993 1898
Fax: +1 (613) 990 9574
Email: Barry.Green@dfo-mpo.gc.ca

Mr. Dale MARSDEN
Economist
Economic Policy Division
Economic Analysis and Statistics Directorate
Fisheries and Oceans Canada
200, Kent Street
K1A 0E6 Ottawa
Canada

Tel: +1 (613) 993 8618
Fax: +1 (613) 991 3254
Email: Dale.Marsden@dfo-mpo.gc.ca

Chili/Chile

Ms. Karin MUNDNICH
Senior Official
International Affairs Bureau
Under Secretariat for Fishereis and Aquaculture
Bellavista 168 Piso 19
2362656 Valparaiso
Chile

Tel: +56 (32) 2502836
Email: kmundnich@subpesca.cl

Ms. Varinia TROMBEN
Counsellor
Permanent Delegation
3 rue Alberic Magnard
75016 Paris
France

Tel: +33 1 45 27 97 47
Email: vtromben@minrel.gov.cl

Corée, République de/Korea, Republic of

Ms. Hyunjong JONG
Deputy Director
International Fisheries Organization Division
Korean Ministry of Food, Agriculture, Forestry and Fisheries (MIFAFF)
47, Gwanmun-Ro
427-719 Kwachon-city
Republic of Korea

Tel: +8225002412
Email: elliejeong@korea.kr

Dr. Do Hoon KIM
Professor
Dept. Of Marine Busines and Economics
Pukyong National University
608-737 Busan
Republic of Korea

Tel: +82 51 629 5954
Fax: +82 51 629 5953
Email: delaware310@pknu.ac,.kr

Danemark/Denmark

Mr. Lars B.F. POULSEN
Danish AgriFish Agency
Nyropsgade 30
1780 Copenhagen V
Denmark

Tel: +45 41 93 23 02
Email: labfpo@naturerhverv.dk

Espagne/Spain

Ms. María Isabel ARAGÓN CAVALLER
Sous-direction Générale d'Economie en matière de Pêche
Ministère de l'Agriculture à l'Alimentation et l'Environnement
Velazquez 147
28002 Madrid
Spain

Tel: +34 91 347 36 80
Fax: +34 91 347 84 45
Email: iaragonc@magrama.es

M. Sebastian FRAILE
Conseiller de l'Agriculture, Pêche, Alimentation
Délégation Permanente
22, avenue Marceau
75008 Madrid
France

Tel: +33 1 44 43 30 19
Fax: +33 1 44 43 30 18
Email: sfrailea@magrama.es

Estonie/Estonia

Mr. Hannes ULMAS
Head of the Market Organization and Trade Bureau, Fisheries Economics Department
Ministry of Agriculture (AGR)
39/41 Lai Street
15056 Tailinn
Estonia

Tel: +372 625 6264
Fax: +372 625 6522
Email: hannes.ulmas@agri.ee

Mrs. Tiina VARES
Counsellor (Agriculture)
Permanent Delegation
49, rue Galilée
75116 Paris
France

Tel: +33 1 56 64 04 65
Email: tiina.vares@mfa.ee

États-Unis/United States

Mr. Joseph JAMES
Trade and Agriculture Advisor
Permanent Delegation
12, Avenue Raphael
75775 Paris
France

Tel: +33 1 43 12 74 27
Fax: +33 1 43 12 74 84
Email: JamesJV@state.gov

Mr. Robert NEWSOME
Energy and Environment Advisor
Permanent Delegation
12 avenue Raphael
Paris
France

Tel: +33 1 43 12 74 41
Fax: +33 1 43 12 74 84
Email: NewsomeRC@state.gov

Dr. Lee G. ANDERSON
Policy Analyst, Professor
University of Delaware
College of Earth, Ocean and Environment
19716 Newark
United States

Tel: +1 302 831 26 50
Email: lgafish@udel.edu

Mr. Gregory SCHNEIDER
Senior International Trade Specialist
National Oceanic and Atmospheric Administration (NOAA)
Washington, D.C.
1315 East West Hwy
20910 Silver Spring
United States

Tel: +1 301-427-8378
Fax: +1 301-713-2313
Email: greg.schneider@noaa.gov

Finlande/Finland

Mme Jertta DE MAZIÈRES
Counsellor (Agriculture, Forestry and Fisheries)
Délégation Permanente
6 rue de Franqueville
75116 PARIS
France

Tel: +33 1 44 18 19 25
Fax: +33 1 45 51 63 23
Email: jertta.demazieres@formin.fi

France

Miss Anne-Charlotte ARMYNOT DU CHATELET
Chargée de mission OCDE-OMC
Direction des affaires européennes et internationales / Bureau des affaires globales
Ministère de l'Écologie, du Développement durable, des Transports et du Logement (MEDDTL)
Tour Pascal A
92055 La Defense cedex
France

Tel: +331 40 81 78 67
Fax: +331 40 81 16 10
Email: anne-c.armynot@developpement-durable.gouv.fr

M. Sébastien GOUPIL
Chargé de mission
Direction des Pêches Maritimes et de l'Aquaculture
Ministere de l'Agriculture, de l'Alimentation, de le Peche, de la Ruralité et de l'Amenagement du Territoire
Bureau de la Pisciculture et de la pêche continent
3 place de Fontenoy
75007 Paris
France

Tel: +33149555791
Fax: +33149558200
Email: sebastien.goupil@agriculture.gouv.fr

Mr. Charles GUIRRIEC
Direction des Pêches Maritimes et de l'Aquaculture
Ministere de l'Agriculture, de l'Alimentation, de le Peche, de la Ruralité et de l'Amenagement du Territoire
Bureau de la Pisciculture et de la pêche continent
3 place de Fontenoy
75007 Paris
France

Tel : +33149558253
Email: charles.guirriec@agriculture.gouv.fr

M. Jonathan LEMEUNIER
Chef de Bureau des affaires européennes et internationales
Direction des Pêches maritimes et de l'aquaculture
Ministère de l'Agriculture et de la Pêche
Sous-Direction des ressources halieutiques
78, rue de Varenne
75700 PARIS 07 SP
France

Tel: +149 55 82 38
Email: jonathan.lemeunier@agriculture.gouv.fr

Hongrie/Hungary	Mr. Krisztián KÓKAI Trainee Permanent Delegation 140, AVENUE VICTOR HUGO 75116 Paris France Tel: +33 (1) 53 65 65 00 Fax: +33 (1) 47 55 80 60 Email: krisztian.kokai@kim.gov.hu
Irlande/Ireland	Mr. Paschal HAYES Dept of Agriculture, Food & the Marine National Seafood Centre Clonakilty Co. Cork Ireland Tel: +353238859509
	Ms. Johanna O'SULLIVAN Sea Fisheries Administration Division Department of Agriculture and Food National Seafood Centre Clogheen Clonakilty Ireland Tel: + 353 (23) 88 59 558 Email: johanna.osullivan@agriculture.gov.ie
Islande/Iceland	Mrs. Brynhildur BENEDIKTSDOTTIR Special Adviser Department of International Affairs Ministry of Industries and Innovation Skulagata 4 IS-150 Reykjavik Iceland Tel: +354 5459700 Fax: +354 552 1160 Email: brynhildur.benediktsdottir@anr.is
Italie/Italy	Mr. Giuseppe CRISTIANO Trainee Permanent Delegation of Italy to the OECD 73, rue de Grenelle 75007 PARIS France Email: stagista3.ocse@esteri.it

Japon/Japan	Mr. Joji MORISHITA Counsellor Policy Planning Department, Fisheries Agency of Japan Ministry of Agriculture, Forestry and Fisheries 1-2-1 Kasumigaseki Chiyoda-ku 100-8907 Tokyo Japan Email: Joji_morishita@nm.maff.go.jp Mr. Kunimitsu MASUI Counsellor Permanent Delegation 11, avenue Hoche 75008 Paris France Tel: +33 1 53 76 61 95 Fax: +33 1 45 63 05 44 Email: kunimitsu.masui@mofa.go.jp
Norvège/Norway	Mr. Martin BRYDE Deputy Director General Ministry of Fisheries and Coastal Affairs Grubbegata 1 P.O. Box 8118 Dep 0032 Oslo Norway Tel: +47 22 24 64 78 Fax: +47 22 24 95 85 Email: Martin.bryde@fkd.dep.no Mr. Geir EVENSEN Deputy Director General Department of Marine Resources and Coastal Management Ministry of Fisheries and Coastal Affairs GRUBBEGATA 1 0032 Oslo Norway Tel: +47 22 24 64 67 Fax: +47 22 24 95 85 Email: Geir.Evensen@fkd.dep.no

Mrs. Anita Kjeilen STEINSEIDE
Head of Key Figures Section
Statistics Departement
Directorate of Fisheries
Strandgaten 229,
PO Box 185 Sentrum
5804 Bergen
Norway

Tel: +47 48 25 26 70
Fax: +47 55 23 80 90
Email: anita-kjeilen.steinseide@fiskeridir.no

Ms. Guri Hjallen ERIKSEN
Adviser
Ministry of Fisheries and Coastal Affairs
PO Box 8118 Dep
0032 Oslo
Norway

Tel: +47 22 246 515
Fax: +47 22 249 585
Email: guri.eriksen@fkd.dep.no

Mr. Ole-Jakob LILLESTØL
Executive Officer
The Norwegian Ministry of Fisheries and Coastal Affairs
P.O. Box 8118 Dep
0032 Oslo
Norway

Email: Ole-Jakob.Lillestol@fkd.dep.no

Nouvelle-Zélande/New Zealand

Ms. Jane WILLING
Director, International Fisheries
Ministry of Primary Industries
Pastorial House
Wellington
New Zealand

Tel: +64 4 47 02 651
Fax: +64 4 470 29 56
Email: jane.willing@mpi.govt.nz

Pays-Bas/Netherlands

Mrs. Carla BOONSTRA
Agricultural Counsellor
Permanent Delegation
12-14 rue Octave-Feuillet
75116 Paris
France

Tel: +33 1 45 24 99 71
Email: carla.boonstra@minbuza.nl

Mr. Leon LOMANS
Policy Officer
Fisheries Department
Ministry of Economic Affairs, Agriculture and Innovation
8 Prins Clauslaan
P.O. Box 20401
2500 EK The Hague
Netherlands

Tel: +31 70 378 46 40
Fax: +31 70 378 61 53
Email: l.r.m.lomans@mineleni.nl

Pologne/Poland

Mr. Piotr SLOWIK
Senior Expert, Fisheries Department
Ministry of Agriculture and Rural Development
ul. Wspolna 30
00-930 Warsaw
Poland

Tel: +48 22 623 27 64
Fax: +48 22 623 22 04
Email: piotr.slowik@minrol.gov.pl

Portugal

Mme Raquel Rosário DA SILVA
Técnica Superior
Direction Générale des Ressources naturelles, sécurité et services maritimes (DGRM)
Ministère de l'Agriculture, de la Mer, de l'Environnement et de l'Aménagement du Territoire (MAMAOT)
Av. Brasilia
1449-030 Lisbon
Portugal

Tel: +351 21 303 57 21
Fax: +351 21 303 57 01
Email: raquels@dgrm.min-agricultura.pt

Mr. Pedro LIBERATO
Conseiller
Permanent Delegation
10bis rue Edouard Fournier
75116 Paris
France

Tel: +33 1 45 03 31 00
Fax: +33 1 45 03 22 03
Email: pedro.liberato@ocde-portugal.com

Royaume-Uni/United Kingdom	Mr. Sasha MAGUIRE Economist Marine Analytical Unit Marine Scotland Area 1B - South Victoria Quay Edinburgh, EH6 6QQ United Kingdom Tel: +44 131 244 0563 Email: sasha.maguire@scotland.gsi.gov.uk
Slovaquie/Slovakia	Ms. Kristina GENDOVA RUZSIKOVA Third Secretary Permanent Delegation 28 avenue d'Eylau 75016 Paris France Tel: +33 1 56 26 50 96 Email: kristina.gendova@mzv.sk Mr. Jan SUKOVSKY Department of Animal Production Ministry of Agriculture of the Slovak Republic Dobrovicova 12 812 66 Bratislava Slovakia Tel: +421 2 592 66 553 Fax: +421 2 592 66 750 Email: jan.sukovsky@land.gov.sk
Suède/Sweden	Mr. Rolf ÅKESSON Deputy Director Ministry for Rural Affairs 103 33 Stockholm Sweden Tel: +46 (8) 405 11 22 Fax: +46 (8) 10 50 61 Email: rolf.akesson@gov.se Ms. Ida BJÖRKLUND Desk Officer Ministry for Rural Affairs FREDSGATAN 8 103 33 Stockholm Sweden Tel: +46 8 505 17 97 Email: ida.bjorklund@gov.se

Tchèque, République/Czech Republic	Ms. Helena CIZKOVA First Secretary Permanent Delegation of the Czech Republic to the OECD 40, rue de Boulainvilliers 75016 Paris Tel: +33146472954 Fax: _33146472944 Email: Helena.cizkova1@mzv.cz
	Mr. Jiri PONDELICEK Director Department of the Civil Service of Forests, Game Management and Fisheries Ministry of Agriculture of the Czech Republic Tesnov 17 117 05 Prague [1] Czech Republic Tel: + 420 221 812 980 Fax: + 420 221 812 980 Email: jiri.pondelicek@mze.cz
Turquie/Turkey	Ms. Ayse KESKINKILIC Commercial Counsellor Permanent Delegation 9, rue Alfred Dehodencq 75116 Paris France Tel: +33 1 42 88 50 02 Fax: +33 1 45 27 28 24 Email: ayse.keskinkilic@mfa.gov.tr
	Mr. Hasan KILIC Trainee Permanent Delegation of Turkey to the OECD 9, rue Alfred Dehodencq Gida Tarim ve Hayvancilik Bak. Balikcilik Gn. Md. lugu Eskisehir yolu 9. km. 06100 Ankara Turkey Tel: +90312 2873360 Fax: + Email: hsn_kilic@yahoo.com

UE/EU

Mr. Janusz BIELECKI
EU Presidency
DGB III (Fisheries)
Council of the EU
Rue de la Loi 175
B-1048 Brussels
Belgium

Tel: +32 2 281 6003
Fax: +32 2 281 6031
Email: janusz.bielecki@consilium.europa.eu

Mr. Angel Andres CALVO SANTOS
Policy Officer
European Commission
DG MARE A-3 (J-99-2/70)
European Union
1049 Brussels
Belgium

Tel: +32 2 29 90292
Fax: +32 2 2955700
Email: angel-andres.calvo-santos@ec.europa.eu

Mrs. Louise HEAD
International Affairs and Law of the Sea
European Commission
DG MARE-B-1 (J-99 3/30)
Rue de la loi 200
B-1049 Brussels
Belgium
Tel: +32 2 29 90292
Email: louise.head@ec.europa.eu

Dr. Dominique LEVIEIL
Deputy Head of Unit
European Commission
DG MARE - A3 (J99 2/84)
European Commission
1049 Brussels
Belgium

Tel: +3222966159
Email: Dominique-Philippe.Levieil@ec.europa.eu

ACCESSION COUNTRIES

Fédération de Russie/ Russian Federation

Mrs. Nadezhda SHEBINA
Deputy Head
Federal Agency for Fisheries of the Russian Federation
12 Rozhdesivenski Bd
107996 Moscow
Russian Federation

Tel: +7 795 9870591
Email: shebina@fishcom.ru

Ms. Olga ZINCHENKO
Specialist
Federal Agency for Fisheries
12 Rozhdesivenski Bd
107996 Moscow
Russian Federation

Email: o.zinchenko@fishcom.ru / olga.s.zinchenko@gmail.com

OBSERVER ECONOMIES

Argentine/Argentina

Mrs. Elisa CALVO
Director of Fisheries Economics Unit
Fisheries Economics Unit
Ministry of Agriculture, Livestock and Fisheries
Av. Paseo Colon 982-Anexo Jardín-Pesca
1063 Buenos Aires
Argentina

Tel: +54 11 43 49 24 76
Fax: +54 11 43 49 23 29
Email: elical@minagri.gob.ar

Mr. Roberto DUPUY
Ministère des Affairs Etrangères
Buenos Aires
Argentina

Email: rod@mrecic.gov.ar

Taipei chinois/Chinese Taipei

Mr. Benjamin HSU
First Economic Secretary
Economic Services, France
75 bis, avenue Marceau
75116 Paris
France

Tel: +33 1 56 89 81 05
Fax: +33 1 56 89 81 01
Email: benhsu@noos.fr

	Mr. Tzyh-Chung MIAW Director Aquaculture Division Fisheries Agency 2 chao-Chow Street 100 Taipei Chinese Taipei
Thaïlande/Thailand	Mr. Pongpat BOONCHUWONG Department of Fisheries Phaholyothin Road Chatuchak 10900 Bangkok Thailand Tel: +66 2 562 05 51 Fax: +66 2 562 05 71 Email: boonchuwong@yahoo.com

OBSERVER ORGANISATIONS

Banque mondiale/World Bank	Dr. Rebecca LENT Special Advisor AES/SDN World Bank 1818 High Street NW Washington DC United States Tel: +1 202 4732635 Fax: +1 202 5223308 Email: rlent@worldbank.org
Organisation des Nations Unies pour l'Alimentation et l'Agriculture (ONUFAO)/UN Food and Agricultural Organization (UNFAO)	Ms. Stefania VANNUCCINI Fishery Statistician (Commodities) Statistics and Information Service of the Fisheries and Aquaculture Department United Nations - Food and Agriculture Organisation (FAO) Viale delle Terme di Caracalla 00153 Rome Italy Tel: +39-0657054949 Fax: +39-0657052476 Email: Stefania.Vannuccini@fao.org

Organisation mondiale du commerce (OMC)/World Trade Organization (WTO)	Mrs. Vesile KULAÇOGLU Director Trade & Environment Division World Trade Organization Rue de Lausanne 154 CH-1211 Geneva Switzerland Tel: +41 (22) 73 95 187 Fax: +41 (22) 739 5620 Email: vesile.kulacoglu@wto.org

INVITED EXPERT

Danemark/Denmark	Mr. Max Nielsen Research Analyst Institute of Food and Resources Economics Denmark Email: max@foi.dk

OECD SECRETARIAT

Mr. Raed SAFADI	*Deputy Director* *Trade and Agriculture Directorate (TAD)*
Mr. Carl-Christian SCHMIDT	*Head of Fisheries Policies Division (TAD/FISH)*
Mr. Gunnar HARALDSSON	*Fisheries Policies Division*
Mr. Roger MARTINI	*Fisheries Policies Division*
Mr. Dongsik WOO	*Fisheries Policies Division*
Mrs. Leilei ZOU	*Fisheries Policies Division*
Ms. Alexandra DE MATOS NUNES	*Fisheries Policies Division*
Mr. Wayne JONES	*Head of Agro-Food Trade and Markets Division (TAD/ATM)*
Mr. Barrie STEVENS	*Head of International Futures Programme (STI/IFP)*
Mr. Jan SCHUJER	*Global Relations Secretariat (SGE/GRS)*
Mr. Nik MOHAMED	*Centre for Tax Policy and Administration (CTP)*
Ms. Gita KOTHARI	*Legal Directorate (SGE/LEG)*
Ms. Myriam LINSTER	*Environmental Performance and Information Division (ENV/EPI)*
Ms. Stefanie MILOWSKI	*Fisheries Policies Division*
Ms. Nathalie ELISSEOU LEGLISE	*Fisheries Policies Division*