Addressing the Overcapacity Issue in Small-Scale Fisheries

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COVER AND INSIDE COVER PHOTOS: Scenes from a fishing harbor in Ghana

PHOTO CREDIT: Pam Rubinoff (cover) and CRC (inside cover), CRC

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Introduction

World marine capture fisheries production has leveled off and declined slightly in recent years with approximately 80,000,000 MT produced annually (FAO 2012). Most believe this is due to the fact that human harvesting capacity has now exceeded the limits of what the world's oceans can sustainably produce. For instance, FAO (2013) has estimated that among 600 of the world's marine fisheries where stock assessments have been conducted, 77 % are either fully exploited, over exploited, depleted or recovering from depletion and only 23 % are considered underexploited or moderately exploited. However, a large majority of the world's fish stocks remain unassessed. Costello et al (2012) attempted to estimate the status of marine fish stocks where no formal assessments have been made and concluded that 64% of unassessed fisheries are overexploited and that 18% of un-assessed stocks are collapsed.

Typically, fisheries that recently achieve a harvest level status of fully exploited or over-exploited are already in a situation of overfishing and overcapitalization. The exception to this rule would be fisheries that have recovered or are recovering and where harvest levels have already been reduced to levels where overfishing and overcapitalization are no longer an issue.

In both of these global reviews, the trends are clear. Over the last few decades, fewer stocks have been found to be underexploited and more stocks have been found to be fully or overexploited. This problem of stock depletion suggests a worldwide problem of overfishing which in turns suggests a significant problem with overcapacity in the world's fishing fleets. While the overall trends appear to continue in the wrong direction, there are many cases, especially in high-income high-latitude countries, where the problem of overfishing and overcapitalization have been addressed or avoided. A few cases will be discussed later in this paper.

What is Overcapacity?

Fishing Capacity

Fishing capacity can be defined as: *"The amount of fish or fishing effort that can be produced over a period of time (such as a fishing season or year) by a vessel or fleet if fully utilized and for a given resource condition"* (FAO 2004). This definition captures both input (e.g. number of days fished) and output (economic efficiency) perspectives.

Excess Capacity

Excess capacity is a short term problem that should not be confused with overcapacity. For instance, if a fishery is in a rebuilding state, fishing effort may need to be substantially reduced temporarily until stock size rebounds to a level that can produce optimum yields. Once the stocks are rebuilt, fishing effort can be increased again, but unlikely to levels that caused stock depletion in the first place. In this example, some level of excess capacity is desired during the rebuilding period so that full capacity utilization can occur later to harvest at the desired optimum yields. A similar context can occur where fish stocks can be highly variable from year to year, such as can be found in upwelling systems that produce abundant supplies of small pelagics. In lean years when less biomass is produced by the upwelling system, there may be excess capacity in the fishing fleet that is underutilized as the available biomass can be harvested in a short period of time. In peak years, there may be a situation of under capacity, whereby the size and power of the fleet cannot harvest all of the available biomass in that year or season. If

fishing capacity were to grow to a size where it can harvest the entire available yield in a peak year, and whereby excess capacity exists in most other years, then overcapacity exists. A situation of repeated excess capacity from year to year or season to season then becomes an overcapacity problem.

Overcapacity

Overcapacity or overcapitalization can be defined as a long term problem in a fishery whereby the size of the fishing fleet, its harvesting ability or fishing power exceeds what is necessary to harvest an optimum yield. Since most fisheries are fully exploited or overexploited, existing fishing capacity exceeds what is necessary to harvest the maximum sustainable yield (MSY) and/or maximum economic (MEY). Optimum harvesting levels are set as part of the management objectives for a given fishery. For instance, food security objectives are best met at MSY, whereas profitability and economic efficiency objectives are met at MEY.

Causes of Overcapacity

Open Access

The problem of overcapacity is often viewed as a problem of open access, or conversely, as a lack of managed access or property rights in fisheries. As fisheries are a common pool natural resource, overcapacity will inevitability result where the resource is open access. This is the classic end result of Hardin's (1968) tragedy of the commons. It is a case of market failure. Each individual has an economic incentive to invest more in fishing effort - vessels, gear, or greater engine horsepower - in order to catch more fish and make more profits. However, the result over time of everyone investing means that all profitability in the fishery is dissipated and biological yields are also less than can be obtained if the collective total fishing effort was less. In most cases of marine fisheries, access to the resource is free (open access), so resource rent is not internalized either in an individual's cost considerations when deciding to invest in fishing equipment. The lack of a mechanism to internalize payments of resource rent by users is another way to explain the problem of overcapacity and the resulting overfishing.

Subsidies

Subsidies also play a role in fostering overcapacity by further reducing the total costs of fishing, attracting additional entrants into the fishery and pushing the open access equilibrium further down the yield curve. Policies that incentivize additional effort and purchase of fishing capability simply results in further depressing catches. Subsidies are often implemented with good intentions, either to encourage investment in fishing where fish stocks were considered underexploited, or as a way to improve incomes of fishers in open access situations where profits and catches become depressed. While these objectives may be achieved in the short term, the long term impact is quite negative, especially in open access contexts. Once such subsidies are instituted, it becomes politically difficult to remove them.

Consequences of Overcapacity

There are many consequences of overcapacity. These are categorized below:

Economic Profitability and Food Supply are not Maximized

Overcapacity causes overfishing, creating a situation whereby neither maximum yields nor high profitability can be achieved. Economists would argue that this is wasteful as both excess capital and labor is used where it is not needed to maximize profitability. Biologists would argue that it is also wasteful as maximum yield or food production is not achieved. Socially, overcapacity increases the vulnerability of fishers, their families and communities to an inevitable decline and possible collapse of their main livelihood.

Maximizing Employment and Household Resilience

The only possible positive justification for improving fishing capacity in small-scale fisheries, which must be weighed against many other negatives, is that an open access, overcapitalized fishery can serve as a social safety net and allow many more people to be employed than if capacity was strictly regulated to maximize economic or biological efficiency. This is a typical situation in many developing countries today. If entry and exit to a fishery remains open, then this can also be viewed as providing some degree of social resilience to poor and vulnerable coastal households. For instance, as many fishing households have multiple sources of productive and income generating activities, if farming should fail in one year due to drought, households can rely more on fishing in that year to compensate. If the fishery is poor in another year, they can often turn to farming or some other occupation to get by. Their degree of dependence on fishing can vary from season to season or year to year. This can also be a cause of increased overcapacity. For instance, repeated drought in Senegal has resulted in many farmers migrating to the coast where they have taken up fishing as a livelihood as the long-term viability of farming as an occupation has deteriorated.

Ecosystem Impacts

The quantification of the problems caused by overcapacity is often expressed in economic terms of lost dollars or poor efficiency, or in biological terms of lost yields, but there are other consequences as well. The effects on the ecosystem and its biological productivity merit considerable attention. Overfishing caused by overcapacity can result in changes in trophic structures and species composition, habitat degradation and incidental catch of non-targeted species, among other effects described below:

Species Extinction: When fisheries are severely overfished, some species may be threatened with extinction, such as the case of the white abalone (spp. *Haliotis sorenseni*) in California. White abalone is a broadcast species requiring high spawner densities in order to allow for fertilization. Without it, isolated animals are unable to reproductively sustain their population (Hobdey et al 2000). Serial fishing depletion led to adult populations falling below minimum densities needed to sustain the stock and led to the over exploitation of this fishery (Hobdey et al 2000).

Changes in Trophic Structure: A study conducted by Daniel Pauly et al (1998), entitled "Fishing Down Marine Food Webs" cautions of a decline in the mean trophic level (the position of an organism in the food chain) of the fisheries landings for both inland and other marine areas. They warned that if present trends continued, there will be significant changes to the marine food web which can affect the long term sustainability of fisheries and lead to widespread fisheries collapse (Pauly et al 1998).

Changes in Species Composition and Food Webs: Overfishing can result in alterations to species composition and its implications to the ecosystem are unpredictable. The loss or removal of apex predators, species occupying the highest trophic level with no other natural predators such as a great shark, can affect other prey-predator relationships and impact trophic dynamics throughout the ecosystem (Myers et al 2007). Species sustaining top predators are referred to as "forage fish," and include small pelagic species such as sardine, anchovy, herring and krill. Forage fish are a vital component in the food web and play a critical role in maintaining marine ecosystems goods and services, including fisheries (Pikitch et al 2012). Maintaining allocations of forage fish in the ecosystem in order to maintain higher trophic level species needs to be considered as part of small pelagic management plans.

Impacts on Endangered, Threatened and Protected (ETP) Species*:* Often caught as unintended by-catch are non-boney fishes such as sharks and rays as well as marine turtles, marine mammals, sharks and sea birds, also known as incidental by-catch (Alverson 1994). Fishing can therefore have negative impact on populations of these rare and vulnerable species.

Habitat Degradation: Overfishing further contributes to ecosystem damage through habitat degradation. Particular fishing gear and methods, such as bottom trawling can damage the seafloor, which hosts 98% of animal species known to live in the ocean (Morgan and Chuenpagdee 2003). Widespread use of bomb fishing and other destructive fishing is a major threat to marine bio-diversity and especially fragile ecosystems such as coral reefs.

Socio-Political Impacts

Social Issues: In places where overcapacity has resulted in low yields or the collapse of a longstanding fishery, there can be severe social consequences. Employment can be impacted of both fishermen if a fishery needs to be shut down for years in order to rebuild, such as has occurred in Nova Scotia (see case study) with respect to the cod fishery. This also impacts employment in the processing and marketing sectors of the fishing industry and secondary employment within fishing communities including engine repair, boat works, neighborhood shops, etc. If highly dependent fishing communities become economically depressed due to collapsed stocks, other social problems can creep in such as increased alcoholism, crime youth unemployment and even outmigration as people search for employment elsewhere. If population declines, local schools and other businesses may have to close, demonstrating cascading multiplier effects.

Political Issues: Overcapacity generates difficult political issues. Depressed fishing communities may demand more social services and welfare benefits to compensate for the loss of the fishing industry and a way of life. Additionally, calls to rebuild the fishery which in the long term can reinvigorate the local economy and communities usually requires a number difficult choices that inevitability will cause additional short term economic and social hardship before the situation can improve. These include strong measures such as a moratorium on fishing in order to rebuild stocks, or significant reductions in fishing effort or fishing licenses, whereby large numbers of fishermen would be forced out of the industry. High level decision makers and politicians may be risk-adverse and therefore reluctant to support or implement necessary capacity reduction strategies.

Compliance Issues: Lastly, as fishing stocks become more depleted, regulations more complex and restrictive, fishermen will race to catch the last fish. Increasing desperation to earn a living and maintain a way of life can lead to an upturn in illegal fishing activities. Enforcement systems alone will usually be unable to effectively counter high levels of illegal fishing as potential illegals gains greatly outweigh risk factors such as the likelihood of arrest or low levels of fines even if caught. The propensity to engage in illegal actions increases especially when deterrence factors are weak (low penalties and low probability of violations being detected). This situation is described for the New England ground fishery by King and Sutinen (2010) (see box below).

Liquidation of New England's Ground Fishery

New England's ground fishery has been a mainstay of the local fishing industry for hundreds of years. In the last few decades, overfishing caused by rapid increases in fleet capacity have led to severely depleted conditions for many species of ground fish. The management response was an increasing complex array of harvest input control regulations. These regulations have caused significant economic hardship in fishing dependent communities in New England, yet failed to result in a rebound of the targeted fish stocks. Under these conditions, fishermen do not see regulations as fair or effective and can benefit in the short term by non-compliance with rules. The extent of illegal fishing therefore creates a net drain on the ability of the fish stocks to redound. More recently, the New England ground fishery is moving to a property rights regime referred to as catch shares, where groups of fishermen form catch share cooperatives and jointly manage collective annual quotas. The early results of this program suggest that this system has ended overfishing and will allow fish stocks to rebound in the long term. However, opponents of this policy say it has resulted in many people being forced out of the fishery, losing their way of life.

This situation is also illustrated in Ghana. The canoe and semi-industrial fleets increased dramatically in number over the past decade, in part spurred on by a generous fuel subsidy. This accelerated the decline in landings of small pelagics, the mainstay of the canoe and semi-industrial fleets. Fishermen compensated by adopting more efficient capture and handling technologies including illegal fishing technologies such as light fishing, fine mesh nets and dynamite, especially in the absence of any effective deterrence by enforcement authorities, and even over the objections of most of the traditional authorities, the chief fishermen (Finegold et al 2010). Legal technologies also factored into increasing fishing effort with use of cell phones, improved nets and use of ice that allowed trips at sea to triple in duration. All of these factors have continued to ratchet down landings to near collapse levels today.

Magnitude of the Problem

More than a decade ago, Garcia and Newton (1997) estimated that world fishing capacity would need to be reduced by 25 percent for revenues to cover operating costs and by 53 percent for revenues to cover total costs and become profitable. A more recent study by the World Bank and FAO (2009) entitled "*The Sunken Billions*" estimated lost economic rent or benefits in fisheries to be on the order of $US 50 billion annually. The study identified depleted fish stocks and the massive fleet overcapacity as the cause of this loss, dissipated through excessive fishing effort. The report estimated that to maximize sustainable rents (maximum economic yield as the fishery objective), fishing effort globally would need to be reduced by 44 to 54 percent. This report points to open access and subsidies as the main drivers of lost benefits and that removal of

subsidies and improved governance including secure tenure as main pathways to recoup these benefits.

It must be pointed out that these global studies look at fish landings, effort and costs in the aggregate and the context of individual fisheries may vary considerably. One case described in the Sunken Billions report estimated that a demersal fishery in Vietnam was experiencing a 29% loss in the total revenues in the fishery valued at $US 178 million per year and a similar percent loss in the Peru anchovy fishery with gross revenues valued at $US 562 million per year. In the Philippines, fishing pressure in the Lingayen Gulf was estimated at 400% over capacity and harvest levels only one-fifth of what they were 15 years earlier (Yap 1997). Another study conducted more than a decade ago estimated fishing pressure overall for the country to be 30 % above what is needed to achieve maximum sustainable yields (World Fish 2001). In Vietnam, calls have been made years ago to reduce the fleet from approximately 64,000 vessels with engines under 45hp to 30,000 by the year 2010 (Pomeroy 2013). In Ghana, overcapacity in the various fleets is considerable. The Ghana Fisheries and Aquaculture Sector Development Plan (2009) estimated fleet size at 12,000 canoes, 84 trawlers and 600 semi-industrial trawlers, and estimated the overcapacity in each of these fleets to be 4,000 canoes, and 60 industrial trawlers, and 400 semi-industrial vessels. The plan called for *"the rationalization of the trawl and semi-industrial fleet and the disposal of surplus capacity from those sectors."*

As previously pointed out, direct subsidies for fishing inputs (e.g. subsidized fuel prices, low cost loans for vessels, subsidized prices for engines, etc.) exacerbates overcapitalization problems. Globally, these subsidies have been estimated at $US 10.05 billion annually with the largest proportion of these provided in developing countries $US 7.75billion (World Bank/FAO 2009).

What are the Approaches to Addressing Overcapacity

Since there are many dimensions to the overcapacity problem, solutions need to be multifaceted with actions requiring a mix of interventions spanning removal of subsidies, better regulation of fishing inputs, managed access, and establishment of property rights regimes as well as other measures to mitigate the social and political impacts.

Assessing Overcapacity

One of the first tasks to addressing overcapacity issues is to assess the degree of the problem by defining the ideal level of capacity desired by managers and then estimating the current capacity level in the fishery. The difference between these two values is the level of reduction in capacity that is needed. This information needs to become the basis for clear objectives as to what the optimum harvesting levels should be. Generally, most fisheries experts would recommend an exploitation level somewhere between MSY and MEY. However, most governments have multiple objectives for fisheries, including addressing local food security (maximization of yields) or improving profitability (MEY), maintaining employment (often effort well beyond MSY or maintained as open access), or for conservation (maintain stocks close to virgin stock biomass) and recreation purposes. These objectives often conflict with one another, resulting in policies that diverge considerably from what experts recommend. This discrepancy is often referred to as the fisheries management dilemma. Figure 1 illustrates this using the classic catch-effort bio-economic model also known as the Gordon-Schaefer curve. It shows the food objective at the MSY point, profit at MEY and the employment objective beyond MSY effort

levels and presumably at the open access equilibrium point where total cost of effort equals total yield (value).

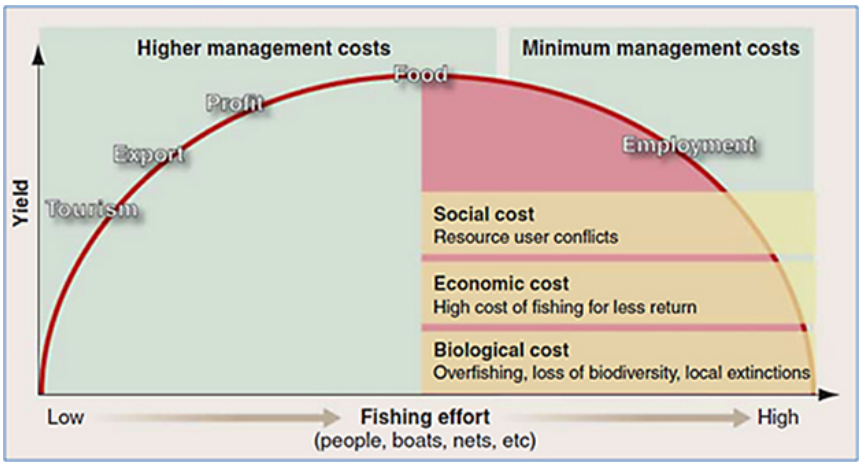

Figure 1. The Fisheries Management Dilemma (SOURCE: Beddington et al 2007)

Assuming the level of capacity can be measured accurately for a given fishery, and there are clear target reference points related to management objectives (e.g. target level of effort and/or yield), then management measures can be put in place to achieve the desired target levels of fishing capacity. Measuring capacity levels is often a challenge in of itself.

Quantitative Approaches

Quantitative approaches measure overcapacity as a ratio of potential to target levels. This requires quantitative techniques and models to measure both parameters. Typically, this approach needs detailed information that is often lacking in small-scale fisheries, especially in developing countries.

Qualitative Approaches

Qualitative approaches still require a level of information on the fishery, such as the biological status of the fish stock as under or overexploited, or require good information on landings relative to a target catch (aggregate quota or TAC) level. However, if a fishery is overfished, harvesting levels are already likely to be below a desired target catch level. Repeated harvest levels that turn out to be below a target would be an indicator of overcapacity.

Qualitative approaches are more likely to be used in data poor fisheries, a situation typical of developing country contexts. Other qualitative measures indicative of overcapacity problems include declining profitability of the fishery, increasing age of fishing vessels, a significant decline in catch per unit of effort. Other indicators include a large number of unused or latent fishing permits, and increasing conflicts between different gear users or fleet types. Qualitative measures may provide an indication that a fishery is experiencing overcapacity but may not be sufficient to quantify the magnitude of the problem (Ward 2004). In such instances, adaptive management regimes that can trial capacity reduction measures incrementally and quickly adjust if subsequent assessment indicates there are still overcapacity issues that need to be addressed.

Capacity Reduction Approaches

There are two main approaches to reducing overcapacity, or preventing it from occurring in the first place; (1) regulated open access, or (2) assignment of property rights. These two approaches are also described as incentive blocking or incentive adjusting instruments (Table 1). Additional information on management tools and approaches can be found in (USAID 2013).

Table 1: Management Instruments to Control Fishing Capacity

Incentive blocking instruments	Incentive adjusting instruments
• Limited entry • Buyback programs • Gear and vessel restrictions • Aggregate quotas • Non-transferable vessel catch limits • Individual effort quotas (IEQs)	• Individual transferable quotas (ITQs) • Taxes and royalties • Group fishing rights (CDQs, etc.) • Territorial use rights (TURFs)

SOURCE: (OECD 2013)

Regulated Open Access

This approach involves the imposition a number of regulatory or technical measures of harvest control which restrict fishermen's options on what they use to catch fish (OECD 2013). Regulatory approaches often involve input controls or output controls or a combination of the two. Examples are illustrated in the blocking mechanisms column in Table 1.

Input controls include measures such as such as gear restrictions, limiting the number of vessels (also a form of managed access), their size, engines used, or outright bans on fishing techniques or gear, as well as seasonal and area closures or establishment of marine reserves. Early fisheries management regimes in Northern countries and an overwhelming majority of the tools used in developing countries mainly rely on input controls.

Output controls include measures such as a seasonal cap on total landings for the fishery, such asan aggregate quota or total allowable catch (TAC), or individual fishing quotas. Even for output controls, fishermen race to catch as much as they can prior to the total catch limit being reached. This leads to fishing derbies and as in the case of the Alaska halibut fishery (see case study on this fishery). The TAC was caught within a matter of days, leaving much of the halibut fishing fleet and processing plants idle for most of the year.

A central problem with regulatory command and control approaches are that regulations become increasing complex as fishermen always look for means around the controls put in place. This tends to make fishermen highly frustrated as inefficiency is regulated into the fishery as a means to control effort and/or catch. It often leads to seeming irrational situations such as in some multi-species ground fisheries, where fishermen have to throw some fish that were caught and hauled up dead, back into the sea, as a catch limit on one species but not the other may have been exceeded. As the difficulty of compliance with complex fisheries increases, fishermen may just tend to ignore regulations they see as unfair, illegitimate, or ineffective, and enforcement authorities are often ill equipped to invest sufficient resources and provide adequate deterrence against such illegal activities.

Property Rights

Property rights confer a right on the owner of the permit or license to catch a certain percentage of an allowable catch of a fish stock. These rights are generally saleable or transferable, which means that the resource rent is internalized in the market price of the license.

Taxes and Royalties

Taxes or royalties are ways that the resource rent can be recuperated by the resource owner (typically the state) from those seeking fishing access or use privileges. This can be a fee per vessel license or a fee based on quantity of fish harvested. These serve as an added cost to the harvester and if high enough, can result in open access equilibrium at or near MSY or MEY levels. Of course in this situation, all private "profit" is dissipated but the state obtains rent that can help offset management costs such as for enforcement, monitoring of landings and stock assessments. If fees are linked to property rights as well, the state can still recoup resource rent for management, or can choose to force resource use license holders to pay such costs from their own revenues. For instance, in many places, costs of on-board observers are borne by the fishing vessel owner rather than the government. In another example from New England, a cooperative research project supported by the industry and the government was conducted to assess stocks for the Atlantic deep water red crab which achieved MSC status in 2009 (Chute 2006). Collaborative research initiatives are common in New Zealand. In response to limited observer coverage for particular *Hoki* harvest areas, industry and government have worked together with the purpose of ensuring that the resource is adequately assessed and managed by training vessel crew to government qualification standards to conduct the sampling themselves (Harte 2000).

An Integrated Approach

Pomeroy (2012) has recommended an integrated approach to addressing the over capacity problems in small-scale fisheries in Southeast Asia, and this approach can apply as well in other small-scale fisheries contexts around the world. This approach has four main pillars: (1) resource management, (2) resource restoration and conservation, (3) livelihoods and economic and community development, and (4) restructured governance arrangements. He argues for a people-centered approach that looks more broadly than an individual fisher but places an emphasis at the household level. In addition, this approach looks beyond the immediate resource management problems and considers broader economic development issues of poverty, vulnerability and marginalization of fishing households and communities.

The resource management aspect of this approach would incorporate the main harvest control approaches mentioned above including regulated open access, property rights and taxation policies. Resource restoration and conservation places emphasis on the use of MPAs as a management tool and pro-active efforts at habitat restoration of reefs and mangroves for instance. The livelihoods component is based on the premise that for fisheries facing overcapacity issues, reduction in the number of fishers will not succeed without provision of diversified and/or alternative livelihoods or other measures to ameliorate the social impacts. Governance refers to the need to promote co-management approaches as well as capacity development and empowerment of fisher and other stakeholder associations.

Challenges and Case Studies

There are many challenges to implementing the strategies mentioned above in order to address the overcapacity issue.

Limited information to assess the magnitude of the overcapacity problem: One critical issue is attempting to estimate the magnitude of the overcapacity problem, requiring good estimates of current capacity levels as well the optimum capacity levels desired. The use of quantitative approaches requires good information on various aspects of the fishery in question. Such information is often absent or limited in small-scale fisheries and developing country contexts. For instance, in many small-scale fisheries, even motorized vessels may not require a registration permit so the actual number of vessels may not be accurately known. In addition, reliance on the qualitative approaches may tell you if overfishing is occurring but may not provide much insight into how much capacity reduction is necessary to meet management objectives. Hence improvements in information and monitoring systems as well as establishment of vessel registration systems are often necessary preconditions for moving towards managed access and property rights approaches for managing capacity.

Ineffectiveness of regulating open access or reliance on incentive blocking measures: Jensen (2002) reported that implementation of regulatory measures such as limited entry, and/or gear and vessel restrictions, have rarely been effective in reducing capacity in the long run in small-scale fisheries. They may help to reduce capacity in the short-term, but fishers usually find a way either legally or illegally around the regulatory restrictions. In contexts where enforcement systems are weak and there is little fisher engagement in rule making, coercive measures and social factors that can ensure high compliance will be inadequate.

Ineffectiveness of buy-back schemes: Buyback programs are intended to reduce the number of vessels or licenses as a means to decrease fishing capacity. Similar to the problem of reliance on input measures as noted above, Holland et al. (1997) concluded that buyback programs are also not effective especially when the fishery remains open access. In addition, fishermen may compensate for having to limit the number of vessels by increasing vessel size, horsepower or using more efficient nets. This leads to what can be referred to as a "cat and mouse game" by the regulator and the fisher, each responding in kind with an escalated move counter the response of the other. In all of these input control approaches, any short term improvements in the fish stock leads in one way or another to fishers finding a way to increase effort as the individual economic incentive remains if the resource is still open access. Even in managed access or limited entry schemes, effort creep will inevitably occur.

Displacement of fishing capacity rather than elimination: If a management program is successful in reducing capacity in any given fishery, this may result in a spillover problem to other fisheries. For instance, vessels shut out of one fishery can retool and target another fishery, creating overcapacity problems in other fisheries or areas. If vessels are not fully retired by decommissioning or scrapping, the problem is just displaced. This problem of mobile capacity is well illustrated at a global scale by Worm et al. (2009) where many EU, Russian and Asian industrial fishing vessels that were displaced from their typical fishing grounds, wound up moving into legal and IUU fishing activities in Africa, creating overfishing and overcapacity problems in that region (see Figure 2).

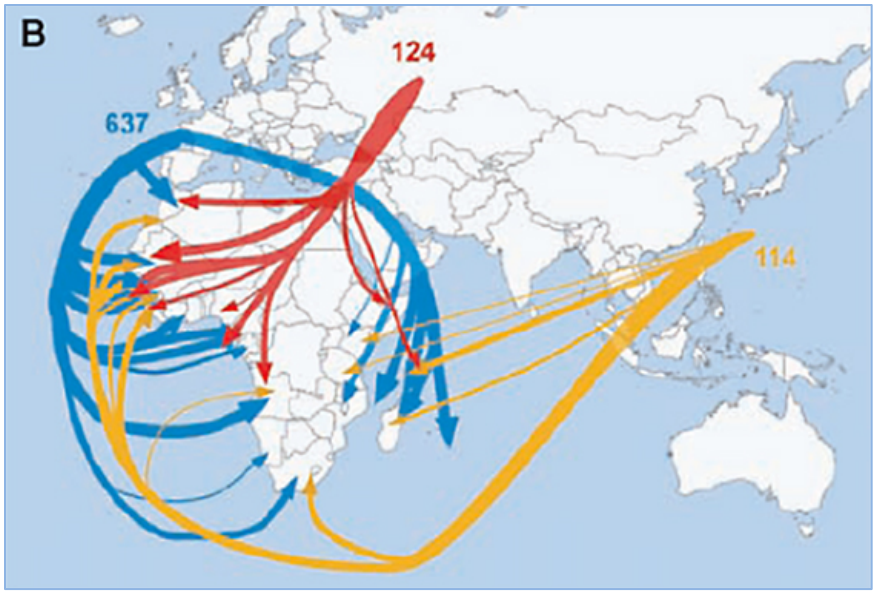

Figure 2. Displacement of Industrial Fishing Capacity from Developed Nations to Africa and IUU Fishing (Source: Worm et al. 2009)

Inadequate governance capacity to enable application of output measures: While there are increasing calls for movement to property rights in fisheries as a key approach to solving overcapacity problems, nations may not have the capacity to implement such a regime effectively. This could include the lack of a legal basis for instituting property rights in fisheries. This is illustrated in Indonesia where the Supreme Court recently threw out as unconstitutional, a provision of the national coastal zone management act that would have allowed marine property rights to be instituted. In some cases, national polices may promote the concept, but legislative changes have not yet been made to enable implementation of these policies. In other cases, output measures require a well-managed and updated registry of fishing vessels - absent in many places. It also requires good information and scientific assessments to establish annual TACs from which individual quota allocations are derived. Many fisheries, especially small-scale fisheries in developing countries, remain unassessed, so the information necessary to set a TAC is lacking. In addition, data collection systems to monitor catch of individual quota owners in a timely and accurate manner may also be absent. This is particularly challenging in small-scale fisheries where there may be hundreds or thousands of landing sites and tens if not hundreds of thousands of vessel owners. Mobile devices with web-based interfaces to centralized data bases may be a future solution to some but not all of these problems.

Absence of political will to implement required reforms: Many high level decision makers in the fishery are very much in tune to any policy choices and impacts on voter constituencies and therefore be unsupportive of making "hard" choices. For instance, in a recent election in Ghana, the winning candidate promised not to remove the fishery fuel subsidy if he was elected. He won the election by a narrow margin, pulled ahead by large vote counts in the coastal fishing communities. In addition, national objectives for fisheries are often conflicting – desiring economic efficiency, maximum yields and high employment. Priorities among these conflicting objectives may not be clear, but often the decision maker or a political appointee may be more

concerned about employment, or not increasing the ranks of the unemployed or under-employed via decisions to reduce capacity in a fishery in order to maximize yield or profitability.

***Magnitude of the problem is too severe**:* This also relates to the problem noted above in terms of political will and involves more than just that issue. In many of the cases of overcapacity noted above, it is evident that capacity reduction programs could result in massive displacement of fishermen out of the fishing industry. This could in some countries potentially be of an order of magnitude in the tens if not hundreds of thousands of fishermen. In such circumstances, decision makers may be averse to putting in the strict control measures that may save the fishery ecologically, but loose the people and communities that depend on them. Even if for instance, some form of welfare payment is provided in lieu of a fuel subsidy, the added costs to stretched government budgets and related increased costs for additional social services may make capacity reduction non-viable. In addition, if the capacity reduction strategy has a livelihoods element to it as recommended by Pomeroy, the magnitude of the opportunities for alternative livelihoods has to be scaled to the level of the people that will be displaced. This means identifying strategies and opportunities where massive numbers of displaced fishers can benefit. Fisheries that are not yet overfished and do not have high levels of overcapacity will likely be easier to solve or can avoid these problems as less social dislocation would be required.

Lack of alternative livelihoods for those potentially displaced due to capacity reduction or unwillingness for fishermen to want to give up fishing as a livelihood: Alternative livelihoods are sometimes introduced to reduce pressure in open access fisheries. The rationale is that alternative livelihoods will allow fishermen to reduce effort or give up fishing for better economic options. However, worldwide experience has shown that few fishermen leave fishing. Small-scale fishermen live at the subsistence level and have a short term survival strategy in which they prefer to earn wages on a daily basis. The fact that many enjoy fishing and feel that they do not have the appropriate skills for alternative occupations, contributes to making fishermen stay the course with fisheries as their primary livelihood for as long as they can obtain a positive return. Many fishermen that have tried alternatives return to fishing.

There are other challenges to the project logic of alternative livelihoods for fishermen. In open access regimes, if several fishermen give up fishing for a living, profits will increase for those who remain. This then attracts additional people into fishing, increasing effort until all profits are again dissipated and earnings remain at the opportunity wage. Alternative livelihoods, therefore, only work as an effective strategy to reduce overfishing when they are coupled with incentive - blocking or adjusting instruments to control harvest and manage or restrict access in the fishery

Another strategy is to promote diversified livelihoods. This paradigm, which focuses on households rather than just fishermen, maintains that broadening the livelihood options available to households will make them more resilient to and better able to adjust to management measures that restrict fisheries access or reduce fishing effort. Hence it can be viewed as a means of mitigating the socio-economic impacts that reductions in fishing effort or restricted access might have on households in the future. By providing access to savings and credit and training in technical and enterprise-related skills that help them diversify their income sources, fishermen and their households become less dependent on fishing. A diversified livelihoods approach can also be used as a conservation incentive, rewarding communities that create community-based marine protected areas and strictly enforce the no fishing rules, or communities that agree to stop bomb fishing and enforce the ban among their peers via social networks.

To sum up, alternative and diversified livelihood development strategies will only help reduce overcapacity in fisheries if they are part of a coordinated and integrated approach that includes a mixed strategy of managing and/or restoring resources, strengthening access rights, conservation, and community development. A recent review of experience demonstrated that many livelihood components of marine conservation programs fail, and an excellent primer on how to develop successful enterprises was developed by Torell and Tobey (2012).

Case Studies

A fishing derby: Characterizing the Alaskan Halibut Fishery prior to ITQs

The Alaskan Halibut fishery, operating under the TAC system, faced many harvesting challenges. The TAC system permitted an unlimited number of boats to participate in the fishery which characterized it as a so-called derby fishery. Under these conditions, fishermen raced to catch as much as they could prior to the total catch limit being reached, often jeopardizing the safety of their vessels, their crew and compromising the quality of their product. Additionally, if the TAC was caught within a matter of days, the halibut fishing fleet and processing plants remained idle for most of the year.

In an attempt to maximize efficiency, Individual Transferable Quotas (ITQs) were introduced to this fishery in 1995. Designed as a management measure used by governments to control fishing, ITQs are a type of permit that allow vessel owners to harvest specific quantities of a particular species of fish (Sumaila 2010). Unutilized and incidental by-catch that is not the target species remains an issue that fishery managers are working to reduce. As a transferable right, ITQs can be traded (bought and sold), granting access to a portion of the TAC of fish. ITQs have reduced the number of boats fishing and have prevented new entrants, serving as a means of addressing overcapacity. However, the concentration of quotas among few holders remains controversial and raises social and equity concerns.

For small-scale fisheries in developing countries, the challenge for implementing ITQs concerns access to accurate data, which is required to establish a TAC from which ITQs are allocated (Pomeroy 2011).

Sources:

Sumaila, U. R. 2010. A cautionary note on individual transferable quotas. *Ecology and Society* 15(3): 36. [online] URL: http://www.ecologyandsociety.org/vol15/iss3/art36/

Pomeroy, R. S, & Andrew, N. (2011). Small-scale fisheries management: frameworks and approaches for the developing world. Wallingford, Oxfordshire, UK: CABI

Group fishing rights in New England and Alaska: Collective action towards managing overcapacity

In addition to individual rights, collective action by groups, communities or tribes have shown promise. In New Hampshire, fishermen formed a group that legally binds one another to follow certain harvest and operating procedures. The rules aim to limit by-catch to zero and remain under the TAC which is established by the government on 16 ground fish stocks. In return for adhering to the harvesting rules, the fishermen are allocated a share of the TAC and collectively

manage it, allowing for trading and leasing within their group. This arrangement resembles the cap and trade model used to limit pollution (Wiersma 2014).

Similar community efforts were developed in the Gulf of Alaska. In response to the growing number of ITQs held by non-local residents, Alaska native communities were concerned for their fishing heritage and economic viability as many rely on commercial fishing for subsistence and income to maintain the coastal economies. In response, a Community Quota Entity program was created in 2002 by the government to enable local fishermen to acquire shares of a particular harvest. The CDQs are viewed as a means of providing income-generating opportunities beyond just fishing into the processing and support sector within a community. As a fishery management tool aimed to reduce overcapacity, CDQs complement ITQ programs and can minimize adverse economic impacts in the communities where a fishery operates (Langdon 2008).

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Costello, C., Gaines, S. D., & Lynham, J. (2008). Can catch shares prevent fisheries collapse? *Science*, 321(5896), 1678-1681.

Wiersma, J. New Hampshire Community Seafood introduction. New Hampshire Community Seafood. (Accessed February 3, 2014, from www.nhcommunityseafood.com/staff.)

Langdon, S. J. (2008). The community quota program in the Gulf of Alaska: a vehicle for Alaska Native village sustainability. In American Fisheries Society Symposium (Vol. 68, pp. 155-194)

Buy Back Programs: Are they worth the investment?

A buyback program is a government funded mechanism to reduce overcapacity. This form of direct purchase of a fishing vessel, a fishing license or a combination on the two is usually employed when a fishery is at a critical level. In New England, a buyback program was implemented for the ground fish trawl fishery with mixed results. While providing a short-term solution of temporarily reducing effort, it did not prevent fishermen from re-entering the fishery through the purchase of other vessels (Walden et al. 2003).

In 2005, the Australian government extended its largest and most ambitious "structural adjustment package" ever to the fishing industry (Minnegal and Dwyer 2008). The intention of the package was to buy back permits and boats with the aim of reducing overcapacity and increasing the economic value of its fisheries. While the program succeeded in removing a significant percentage (34%) of permits, many fishermen hold multiple permits and ultimately only 9% were cited to have abandoned the fishery entirely as a result of this program (Minnegal and Dwyer 2008). Similar to other case studies, program effectiveness depends on the ability to prevent re-entry into the fishery and whether the remaining harvesters who continue to fish can be constrained in increasing their effort and investments in order to obtain higher individual yields. Overall, the investments in buy-backs are regarded as costly and the results are mixed.

If alternative livelihoods are not presented and fishing is the only means of livelihood known, buy-back programs can easily fail. In Vietnam, a program aimed at small-scale fishers demonstrated this point. Referred to as "floating fishers," these boats serve to fish and provide a means of housing for fishing families. In an attempt to reduce this fleet, the government purchased these boats in exchange for land to resettle the fishers and their families. Within one

year, the fishers had sold the land and purchased boats to continue fishing. Without means to develop alternative livelihoods on land, the fishers returned to the sea (Pomeroy 2011).

Sources:

Walden, J. B., Kirkley, J. E., & Kitts, A. W. (2003). A limited economic assessment of the northeast groundfish fishery buyout program. *Land Economics* 79(3), 426-439.

Minnegal, M., & Dwyer, P. D. (2008). Mixed messages: Buying back Australia's fishing industry. *Marine Policy* 32(6), 1063-1071

Pomeroy, R. S, & Andrew, N. (2011). Small-scale fisheries management : frameworks and approaches for the developing world. Wallingford, Oxfordshire, UK: CABI. 239p.

TURFs: The Chilean Loco fishery

The artisanal *loco* fishery in Chile was heavily exploited despite efforts to regulate it through a limited fishing season. Overfishing led to a 3-year harvesting moratorium. In 1997, fisheries legislation implemented Territorial User Rights in Fisheries (TURFs), a form of exclusive access rights and an example of a co-management arrangement between the government and fisher organizations. TURFs certification is renewable based on compliance with regulations and performance of the fishery. The TURF system in Chile for the *loco* fishery is generally regarded as a positive solution to overfishing. Secure access rights and compliance have contributed to improved yields and biological sustainability of the *loco* fishery. Better economic returns are achieved through negotiating their harvest collectively rather than individually, benefiting thousands of artisanal fishers and hundreds of communities. Through TURFs, fishers are generally incentivized to protect their resource and help regulate the productivity. The sedentary nature of *locos* also facilitates enforcement over the resource via the TURFs (González et al. 2006).

Sources:

Gonzalez, J., Stotz, W., Garrido, J., Orensanz, J. M., Parma, A. M., Tapia, C., & Zuleta, A. (2006). The Chilean TURF system: how is it performing in the case of the loco fishery? *Bulletin of Marine Science* 78(3), 499-527

Gear restrictions: Perceptions from South-east Asia

A study conducted in three South-east Asian countries indicated that gear restrictions, or banning the use of certain gear types are perceived as acceptable measures to manage fishing capacity. In Thailand, Cambodia and the Philippines, restricting certain types of gear during certain times and in particular places to reduce effort and sustain fish stocks was favored by fishers over limiting their access or ability to fish. In the Philippines, some fishers proposed banning Danish seines due to the fine mesh size that catch juveniles. The use of dynamite and noxious substances for catching fish is collectively viewed as an unacceptable fishing method. Based on this study, gear restrictions are considered as a management option amenable to fishers and available to help reduce fishing capacity (Salayo et al 2008).

Sources:

Salayo N, et al. 2008. Managing excess capacity in small-scale fisheries: Perspectives from stakeholders in three Southeast Asian countries. *Marine Policy* doi:10.1016/j.marpol.2007.12.001

Overcapacity and its social implications in Nova Scotia:

Cod resources off Nova Scotia, Newfoundland and elsewhere in the North Atlantic were faced with near depletion by the early 1990s. A moratorium was issued in an attempt to recover the stock however it came at the expense of long-lasting social and demographic implications on land. Unemployment in the sector led to a population decline that correlated with resource depletion, affected community cohesion as a result of migration and created vulnerable local economies. Despite the government's efforts to financially assist and support those affected, the uneven distribution led to further social distress. Today, fishing efforts have been redirected towards other species however it does not benefit the same group of people, communities or businesses that had been formerly supported by cod (Hamilton and Butler 2001).

Sources:

Hamilton, L. C., & Butler, M. J. (2001). Outport adaptations: Social indicators through Newfoundland's cod crisis. *Human Ecology Review*, *8*(2), 1-11

Managed access, municipal licensing and alternative livelihood development in the Philippines

Lubang, an island municipality in Oriental Mindoro, the Philippines, is part of the Verde Island Passage (VIP)—a marine bio-region recognized by experts as the "center of the center" of marine shore fish biodiversity in the world, known to have the highest concentration of marine species found in the world's oceans, including whale sharks, giant clams and the iconic *Banggai* cardinal fish.

Fishing is the main livelihood of the residents of the Lubang Island. The municipality has 542 registered fishermen, 56 fish vendors, 207 registered motorized boats and 152 registered non-motorized boats. Here, the average family size is six to eight members. In order to feed these large families, there is indiscriminate harvesting of fishery resources. This places constant pressure on the VIP marine resources and affects the livelihoods of coastal communities and fisherfolks. Additional pressure comes from illegal fishing practices such as the use of fine-meshed nets, dynamite, and muro-ami all of which have led to reduced fish catch—previously abundant fish catch has been reduced dramatically. It has also led to reduced incomes and degraded habitats. Incursions of commercial fishers further exacerbate the fisheries problems.

To reduce fishing effort and illegal fishing, the Lubang Island Municipality adopted a municipal fisheries management plan. The municipality implemented a scheme whereby all boats registered in Lubang are painted in the same color and have their registration information visibly displayed. This made it easier for the *Bantay Dagat* (community fisheries enforcement patrol) to identify and fine boats that were not licensed by the municipality—in essence controlling the number of fishermen who are allowed to fish in municipal waters, and exclude outsiders. The *Bantay Dagat* were also trained in environmental law enforcement, including sessions on how to make arrests and file cases in court.

As an incentive for the community to be more engaged in sustainable practices and marine conservation, the municipality provided livelihood trainings for fishermen's wives in post-harvest fish processing as well as training targeting primarily youth—in how to turn solid waste into income generating ventures such as vermiculture for organic waste, and manufacture of re-usable and saleable items such as bags and key chains from plastic waste.

The Mexican Abalone Fishery: Fisher Concessions, cooperatives

Oral history and more recently baseline studies reveal the importance of abalone to the history and economy of Baja California. The Chinese and Japanese were among the first to commercially exploit abalone, followed later by the Mexicans. Catches have been declining since the 1950s as a result of overfishing, climate change, illegal and unregulated fishing. To improve management and regulation of this fishery, concessions were granted to fishermen by the Mexican government and cooperatives were formed to harvest and adhere to new production methods and controls. Measures determined by the government to regulate this resource included a minimum catch size and a temporal ban. Methods to improve this fishery included a new type of hook which increased the diver's mobility and helped to improve their productive efficiency (Fernandez and Sáenz-Arroyo 2012). Today, ecosystem degradation continues to threaten this resource, vulnerable to climate fluctuations, reproductive potential and given its high market value, illegal harvesting. Fishing cooperatives have helped to stabilize this resource through improved measures and methods and recently through product diversification. Abalone pearl and jewelry production have created an alternative livelihood option (Searcy-Bernal et al 2010).

Sources:

Fernández, D. A. R., & Sáenz-Arroyo, A. (2012). The Historical Ecology of Abalone (Haliotis Corrugata and Fulgens) in the Mexican Pacific. México y la Cuenca del Pacífico.

Searcy-Bernal, R., Ramade-Villanueva, M. R., & Altamira, B. (2010). Current status of abalone fisheries and culture in Mexico. Journal of Shellfish Research, 29(3), 573-576.

Additional references with case studies and information on overcapacity:

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OECD. 2013. The OECD Handbook for Fishery Managers: Principles and Practice for Policy Design. OECD Publishing. 103p.

OECD. 2012. Rebuilding Fisheries: The Way Forward, OECD Publishing. 105p. http://dx.doi.org/10.1787/978926417935-en

Take Home Messages and Success Factors from the Case Studies

The cases of successfully addressing over capacity are few and far in-between—usually involving fisheries in the northern hemisphere. Looking across the case "vignettes" presented above and building on OECD 2012, six lessons learned stand out:

1. The legislative and policy tools selected to address over capacity must be coherent and mutually reinforcing; Identify triggers that indicate which tool is most appropriate under what circumstances. For example, ITQs are appropriate when there is sufficient data to set a TAC; TURFs are good if the conditions are conducive to granting use rights.
2. Local stakeholders must be interested and engaged in the process of addressing over capacity. Joint planning creates shared responsibility. Without participation the measures might not be accepted and supported. Encouraging stakeholders to notice triggers and creating an environment (best suited to that circumstance) to confront it should be welcomed and accommodated.
3. Create a vision and plan for what will happen after the over capacity problem has been addressed. Determine how the fishery will be restructured--what should the fishing fleet look like in the future?
4. Invest in stock assessments to ensure that management measures are based on the best available knowledge, provide transparency, and help articulate the benefits of proposed management measures.
5. Apply adaptive management, where the effectiveness of management plans in achieving goals and targets are periodically evaluated. Do not wait for a perfect solution or complete information—waiting for the best policy may come at the expense of any policy. They will change as will the conditions they were intended for.
6. Consider compensation programs, alternative livelihoods, financial instruments, or market based incentives to help fishers transition and reduce capacity.

The Way Forward

It is easy to become discouraged in looking for solutions to overcapacity issues in small-scale fisheries after reviewing the many challenges noted above. However, as the case studies suggest, there are numerous examples of fisheries around the world where overcapacity issues have been resolved. Many of the examples illustrate how a transition from open access to managed access and the application of property rights regimes has been a fundamental reason for successful change. An overwhelming majority of these examples are in northern developed country and industrial fishery contexts. However, there are an increasing number of emerging examples for small-scale fisheries in low and medium income countries. While the numbers may be small, a more in-depth look across the portfolio of small-scale fisheries in low and medium income countries could provide more insights in how to successfully design such initiatives. In addition, it is clear that more "experimentation" with attempts at instituting managed access and property rights regimes and tailoring the basic concept to the unique context of these small-scale fisheries is in order.

There may be small-scale fisheries locations in low and medium income countries where the necessary enabling conditions may be in place or may only need some additional assistance to develop the adequate capacities to apply property rights approaches. In other cases, the path may be slower and require more time and investment before they are ready to implement such approaches at large scales. In most of these instances, other essential factors include a stakeholder based co-management approach, rather than an imposition of property rights by outside donors or national decision makers, where the approach may be viewed as unwelcome by fishers. In the case of managed access and property rights, more research on readiness factors

could help donors more effectively target locations where these approaches are more likely to succeed and be taken up quickly, while in other locations, investments may need to take a longer-term perspective, focusing on capacity development needed to put the enabling conditions in place and improve readiness for implementation of such approaches. In other cases there may be locations where managed access and property rights are not appropriate or wanted, Lastly as Pomeroy has noted, in most cases, integrated approaches will be needed including livelihoods development outside the fisheries sector and at large enough scale for success. The scaling of such livelihood interventions is probably the greatest challenge and is where more research and on-the-ground trials are needed. In addition, Pomeroy's four component program approach may be a useful starting framework, but may benefit from more research on ways to assess local context in within each of these areas, in order to ascertain the level of investment necessary in each component area as this likely will vary from place to place.

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