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Foreign aid and sustainable fisheries management in sub-Saharan Africa

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Abstract

The fisheries sector in sub-Saharan Africa has benefitted from high and increasing amounts of foreign aid for over four decades. In the 1990s when evidence emerged that most stocks were overcapitalized and overfished, the effectiveness of fisheries development aid, particularly those directed at fishing capacity enhancement, came into question. This report examined the relationship between development aid and capture fisheries management in sub-Saharan Africa and found that, indeed, capacity enhancing subsidies can explain losses in the fisheries sector. Furthermore, we have argued that assigning and protecting fishing rights may not be sufficient to generate first best outcomes in practice. Development aid should, in addition to building fisheries institutions, be directed at fisheries research and development, tied to good governance, as well as be directed at protecting fish stocks.

Keywords: development aid, fisheries management, sub-Saharan Africa
JEL classification: F35, O55, Q22

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1 Introduction

Capture fish stocks, like other renewable resources, self-generate and could provide perpetual flow of benefits if catch rates are kept at a sustainable level. As a result, the fisheries sector is very important to coastal countries in Africa. It has been estimated that Africa currently produces around 8 per cent of total global fish landings, with fish protein supplying around 17 per cent of animal protein (Tidwell and Allan 2001). In addition, an estimated 10 million people in sub-Saharan Africa (SSA) are engaged in small-scale fishing, processing, and trading (Markwei et al. 2008). In countries like Senegal and Namibia, where fisheries activities are pronounced, fisheries account for around 7 per cent of total GDP (Béné 2006). The current revenue from the sector is US$2 billion and generates a multiplier effect of 2.5 times (US$5 billion) through trickle-up linkages (Chimatiro 2010). Notwithstanding the potential contribution of capture fisheries, most fishing areas in SSA are currently either fully or overexploited (NEPAD 2011).

On the other hand, available data shows that SSA countries have received high and increasing amounts of foreign aid, some of which are devoted to fisheries management over several decades (NEPAD 2011). In 2008 the sub-region received a total net official development assistance (ODA) of US$22.5 billion. Although data on development aid to fisheries management is scarce, available estimates show that between the period of 1973 and 2001, Africa benefitted from 1,988 fisheries aid projects, totalling US$4.6 billion in monetary value (NEPAD 2011). While some of these projects involve fishing-capacity enhancement, others were associated with research and development, training provision, and shaping fishing policy and management, and hence are considered beneficial. Beginning in the 1990s there has been growing concern within the aid community about the effectiveness of development aid to fisheries management.

Isolating the effect of development aid impact on the state of the fisheries in SSA is complex. This is because, in addition to the possible mixed effects of the aid, within the region, fisheries are typically managed as unregulated commons. With ill-defined rules and/or inadequate policies to regulate appropriation, such resources are bound to suffer depletion. It is not entirely surprising that at the current levels of harvest, the continent is losing annual resource rents of US$2.63 billion from capture fishery (Sumaila et al. 2012). As an objective, this report investigates whether or not there is a link between aid and the state of fisheries within the region.

To avoid the tragedy of rent dissipation, investment can be made in building institutions in order to clearly define use-rights or making and enforcing access rules. However, the efficacy of catch policies depends on several factors including: the extent of misperception and/or ignorance of stock dynamics (Moxnes 1998, 2000; Brekke and Moxnes 2003; Schnier and Anderson 2006; Sterner 2007; Akpalu 2009; Hey et al. 2009) and the political will to enact and enforce catch policies. We have therefore argued, based on empirical evidence, that investment in knowledge generation on stock dynamics, species diversity and ecosystem dynamics should accompany assignment of use-rights. Such knowledge is a global public good, hence should benefit from development aid (Arndt and Bach 2011).

Furthermore, aquaculture, although it has not seen much growth within SSA over a number of decades, presents a potentially viable option for easing pressure on capture fisheries and complementary supply of fish protein. We have argued that development aid can help generate and disseminate the requisite knowledge to promote investment in aquaculture activities.

Finally, it has been noted that corruption underpins illegal fishing activities by foreign fleets within offshore areas of the exclusive economic zone (EEZ). In addition, perverse policies (solely for political expediency) litter overcapitalized fisheries inshore. It is critical that development aid to fisheries be tied to good governance.

The rest of the report is organized as follows. The next section briefly discusses foreign aid in fisheries management. This is followed by a discussion on the state of fisheries in Africa. Section 4 provides empirical anecdotal evidence of the link between losses in fisheries and capacity enhancing subsidies. A basic theory of fisheries management as a common pool resource is presented in Section 5 and the following section explains why theoretical predictions may differ from practice, even if management institutions are well-defined. Section 7, discusses the potential role of development aid in addressing overfishing problems. Section 8 presents a brief discussion on Namibia as a successful fisheries management story, and the last section, section 9, presents concluding remarks.

2 Foreign aid and fisheries management in SSA

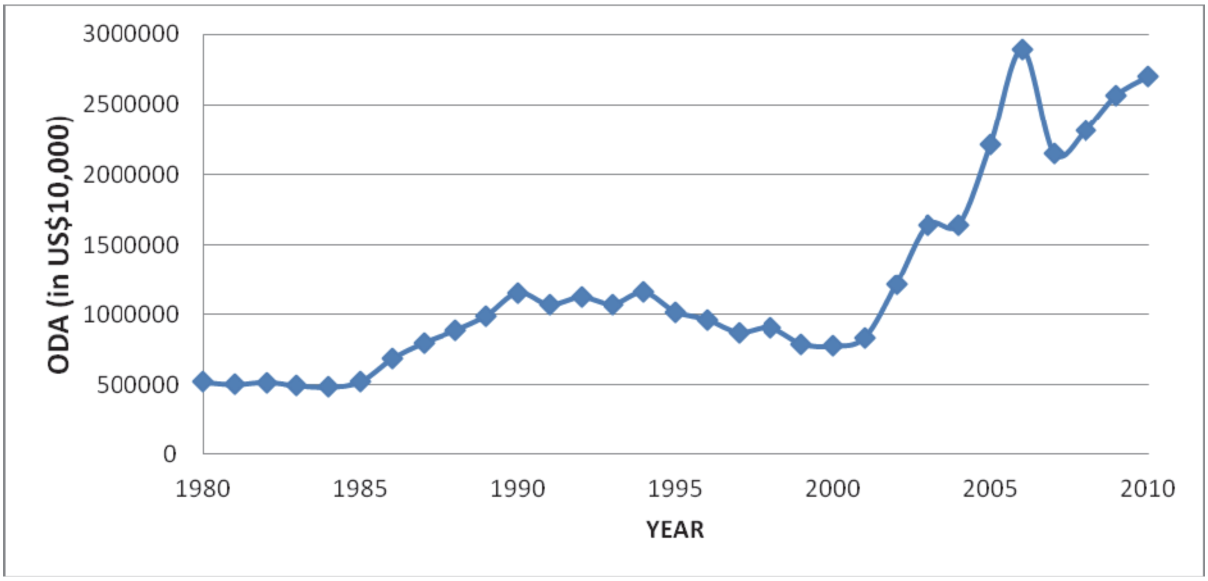
2.1 Foreign aid and aid effectiveness

Foreign aid is broadly defined to include ODA, Official Aid (OD), and Other Official Flows (OOF). The first category (i.e. ODA) is development aid given to developing countries for the purpose of economic development, while the second (OD) is development aid given to international organizations and developed countries. The third category refers to aid that cannot be classified under the two categories; either because it is not meant for economic development, or it consists of more than 75 per cent loan rather than grant (NEPAD 2011). It is noteworthy that the term development aid is often used to refer specifically to ODA, which aims at alleviating poverty in the long term.

Africa, particularly SSA, has received large and increasing amounts of ODA over the years. Figure 1 shows the trend of net ODA provided to SSA from 1980 to 2010. The total amount increased sharply between 2000 and 2006 reaching about US$28.9 billion. Although some decline was experienced in 2007, by 2008 the net bilateral ODA from Development Assistance Committee (DAC) of the Organisation for Economic Cooperation and Development (OECD) donation to Africa totalled US$26 billion, while US$22.5 billion went to SSA. The largest donors were the USA, Germany, the UK, France, and Japan (NEPAD 2011).

The paramount objective of foreign aid, particularly development aid, has long been to help enhance economic growth, and consequently lower the rate of poverty. However, the effectiveness of the massive international capital flows from bilateral sources and multilateral sources to African countries remains contentious. There is general consensus that aid directed at investments in clean water supplies, education vouchers for textbooks, suitable fertilizers and farm implements, among others have been found to develop and improve livelihood.

Figure 1: Net official development assistance to SSA



Sources: World Development Indicators (WDI) database.

However, several scholars have presented arguments against foreign aid effectiveness at all levels, i.e., projects, programmes and policy (Friedman 1958; Bauer 1972; Barder 2006; Easterly 2007; Birdsall 2008). Among the reasons provided for aid ineffectiveness is the focus on short- and medium-term projects with outcomes that are certain rather than long-term projects, and those with more uncertain outcomes, which could provide the recipient the opportunity to learn-by-doing. Second, aid can lead to appreciation of the recipient nation's currency (Barder 2006). Other reasons are unpredictability of aid flows, which inhibits long-term planning and investment spending; the side conditions of tied aid, which could lead to increased corruption or other impediments that hinder economic development; and the potential of aid resulting in postponements of necessary economic and democratic reforms (NEPAD 2011).

2.2 Foreign aid for fisheries management

Development aid, which comes as subsidies, were considered a good thing about fifty years ago when it generated economic benefits without depleting fish stocks (Schrank 2003). Annual Global fisheries subsidies are currently estimated at US$30-34 billion, which constitutes about 35-40 per cent of the value of total fisheries production (Sumaila and Pauly 2006; Sumaila et al. 2008). Data on the exact foreign aid directed at specific fisheries activities is difficult to obtain due to overlapping objectives of fisheries programmes, projects and policies (Milazzo 1998; OECD 2000; APEC 2000; Sumaila et al. 2010). Foreign aid to fisheries usually goes through governments of the recipient countries who in turn use them to support fisheries activities.

Although information from various sources indicates abundance of development aid organizations in Africa, the literature on the specifics of aid allocation to the fisheries sector within the continent is scanty (NEPAD 2011). Hicks (2007) constructed a database on fisheries development aid for the period of 1973 to 2001. Of the 4,396 fisheries aid projects, those concerning Africa were about 1,988 (NEPAD 2011). In terms of revenue, Africa's share was US$4.6 billion out of US$16.32 billion. Among the top 10 countries in Africa that benefitted from fisheries aid, 7 are in SSA (see Table 1). Mozambique received the highest aid in terms of projects and value.

Table 1: Fisheries development aid—SSA countries among Africa's top ten recipients (1973-2001)

Rank	Recipient	US$ millions	Recipient	No. of projects
1	Mozambique	385	Mozambique	147
2	Angola	366	Angola	106
3	Senegal	302	Senegal	103
4	Mauritania	203	Madagascar	75
5	Madagascar	190	Mauritania	69
6	Somalia	149	Tanzania	64
7	-	-	Namibia	60

Source: NEPAD (2011).

Fisheries aid, which subsidizes fisheries activities, can either protect or harm fish stocks. There are different opinions on the relative importance of fisheries subsidies as a factor stabilizing fisheries resources. In a recent study, Sumaila et al. (2010) put fisheries subsidies into three categories—beneficial, ambiguous, and capacity enhancing subsidy—based on their policy objectives; subsidy programme descriptions; scope, coverage and duration; annual US$ amount; source of funding; administrative authority; subsidy recipients; and the mechanisms of transfer. Aid that harm stocks are termed bad or capacity enhancing subsidies and those that protect stocks are known as beneficial or good subsidies (see e.g., Milazzo 1998; Sumaila et al. 2010).

Activities considered capacity enhancing subsidies are fuel subsidy; boat construction, renewal and modernization programmes; fishing port construction and renovation programmes; price and marketing support, processing and storage infrastructure programmes; fisheries development projects; and foreign access agreements (Milazzo 1998; Sumaila et al. 2010). Beneficial subsidies are fisheries management programmes and services, including monitoring and surveillance, stock assessment, fisheries habitat improvement, and stock enhancement programmes; fisheries research and development; and expenditure on marine protected areas. All other activities that could either enhance capacity or conserve fish stocks, but cannot be determined a priori are classified as ambiguous subsidies. This may include e.g., assistance to fishers to halt fishing temporarily; vessel buyback programmes; and rural fishers' development programmes.

Graph 3 in NEPAD (2011) shows that, paradoxically, 'fisheries development' projects in Africa, which are predominantly capacity enhancing, exceeded those of other categories for almost all the years until 1999 when 'fisheries policy and administration' projects took over. Since the data has not been updated, there is no telling whether or not the apparent increasing focus on fisheries policy projects towards the end of 2001 has continued. In addition, in terms of value, fisheries development dominated aid to fisheries policy and administration until 1995, with no clear pattern for the rest of the period.

Data compiled from FAO database and presented in Table 2 shows that several organizations are involved in fisheries management projects in SSA. Ghana had 9 organizations, which is the largest number within the region; and Angola and Djibouti had 1, the lowest. Of the total organizations (65), about 29 per cent and 49 per cent were engaged in capacity enhancing and fisheries conservation activities, respectively.

Table 2: Aid organizations subsidizing fisheries development in SSA

Country	Aid organization	No. of organization	Capacity enhancing	Ambiguous subsidy	Beneficial subsidy
Ghana	FSCBP, UNDP, Fish Export Sectors Initiative (EU), DFID,JICA,Fishing Nets & ropes for artisanal sector (CHINA), FAO, DANIDA, ICCAT	9	4	1	4
Nigeria	(AFDP-IFAD), ECOWAS, GEF /UNEO/FAO, Islamic Development Bank, Food security FAO TECH, Agriculture & Inland Fisheries FAO TECH, MSME	7	0	3	4
Liberia	FAO/KKG/FFDC, Catalyst/FFDC/USAID/LCIP	2	1	0	1
Angola	NORAD/FAO/UNDP/ AfDB & IFAD	1	0	1	0
Djibouti	AfDB	1	0	1	0
Eritrea	UNDP/GEF, AfDB, French Govt (ASD)	3	1	0	2
Gambia	Govt Japan, ADB/BADEA/GAMBIA GOVT.	3	0	1	2
Kenya	(EU/LVFO),LVEMP,GTZ-HIV MAINSTREAMING,GTZ-GIKOMBA FISH MARKET,WWF,FAO/GTZ/DFID/USAID, BOMOSA(EU)	7	2	2	3
Liberia	FAO/KKG/FFDC, Catalyst/FFDC/USAID/LCIP	2	0	2	0
Madagascar	COPEMED/FAO, FAO	7	0	0	7
Mauritius	FAO/UNDP,FAO,JAPANESE GOVT, MARICULTURE JAPANESE GOVT, AQUACULTURE INDIAN GOVT	5	3	0	2
Mozambique	JAPANESE GOVT, IFAD/OPEC, DANIDA/ICEID, NORAD/DANIDA/ICEIDA, 5YR(EU)	5	3	1	1
Namibia	NORAD, ICEIDA,NAMFI/EU, XUNTA DE GALICIA, GOVT MALAWI, GOVT CUBA, DFID(UK)	7	4	1	2
Sierra Leone	AFDEP-GOSL/ADB/MFMR,EU Certification, EU Support	3	1	1	1
South Africa	UNDP/FAO, UNDP/GEF/WORLD BANK, NORAD	3	0	0	3
Total		65	19	14	32

Source: FAO database (http://www.fao.org/fishery/countryprofiles/search/en)

3 State of capture fisheries and aquaculture in Africa

Although the fisheries sector employs about 0.8 per cent of the active labour force, on average, Africa's current fisheries management systems are best described as weak (NEPAD 2011). It is estimated that Africa accounts for 8 per cent of global fish landings, with a total annual production of 7.6 million tons. Of this number, about 67 per cent comes from marine fisheries (FAOSTAT). Although marine fisheries stock assessments reveal biological overfishing within the region's exclusive economic zone, aggregate catch levels have not shown significant decline due to effort intensification. In West African, for example, total annual marine fish landings increased from 0.6 million to 4.5 million tons between 1960 and 2000, creating a deception of stock abundance. However, within the past decade annual marine capture fisheries production has remained relatively stable (Sumaila et al. 2010).

The colour coded map of Africa designated Figure 1 in Srinivasa et al. (2012), provides a range of losses in capture fisheries, within the period of 1991 and 2000. The Atlantic coast countries recorded the highest losses, with Namibia topping the list placing it among the top 10 countries in the world. East African EEZs appears to have registered lower catch losses, but this is due to high levels of underreporting (Srinivasan et al. 2012).

Inland fisheries contribute about 2.5 million tons (33 per cent) of total annual fish landings in Africa. It is generally characterized as small scale spreading over a large area. The fisheries harbour about 3,000 species of significant economic and nutritional value (NEPAP nd). In landlocked countries like Burkina Faso, Central African Republic, Chad, Democratic Republic of Congo, Ethiopia, Guinea-Bissau, Lesotho, Niger, Rwanda, Uganda and Zambia, inland fisheries contribute about 90 per cent of fish production. Time series data on inland catches are scarce and sparse; however, estimates show most inland stocks are either overfished (e.g. Lake Chad) or are fully exploited (FAO 2002; NEPAD 2003).

Aquaculture is poorly developed in Africa, contributing as low as 3 per cent (0.76 million tons) to fish production in the continent (or <1 per cent of the global total). The corresponding global average is about 35 per cent, having almost doubled within a period of one and a half decades. There are however significant variations across countries in Africa, especially between countries in North Africa and their counterparts in SSA. The sector remains an area with remarkable potential that has made slow and disappointing progress over the past decades.

4 Empirical analysis of the impact of bad subsidy on capture fish loss

Despite clear evidence of overcapitalization and overfishing within the region, much of the aid focuses on fisheries development or capacity enhancement (NEPAD 2011). Indeed a number of concerns have been raised in international circles over the potential detrimental impact of subsidies on overcapitalization and overfishing (see e.g. Milazzo 1998; FAO 2005). Of the total subsidies to capture fisheries in Africa estimated by Sumaila et al. (2010), about 60 per cent are capacity enhancing or bad subsidies. In this section, we provide an insight into the question of whether or not capacity enhancing subsidies impact sustainability of fisheries within the sub-region, which are currently in dismal state (Sumaila et al. 2010).

We employed Ordinary Least Square (OLS) regression analysis to verify the relationship between catch losses and capacity enhancing subsidy, which is defined to include subsidies that increase fishing revenue or decrease the cost of fishing and thereby enhance fishing effort or capacity (Milazzo 1998). The data for the subsidies were taken from Sumaila et al. (2010) and those of catch losses due to overfishing are extracted from Srinivasan et al. (2012) (see Figure 1). The authors calculated the catch losses as the difference between maximum sustainable yield (MSY) and actual catch levels (Srinivasan et al. 2010; Srinivasan et al. 2012). The ad hoc empirical regression equation is:

$$Loss_i = \alpha + \beta Sub_i + \delta DATL_i + \varepsilon_i \quad (1)$$

Where i is country specific index, $Loss_i$ signifies catch loss per square kilometer of the exclusive economic zone; Sub_i is total capacity enhancing subsidy estimates (for 2003, and in US$1000); $ADTL_i$ is a dummy variable for countries bordered by the Atlantic Ocean; and ε_i is a normally distributed error term. We hypothesize that, all else being equal, countries with higher capacity enhancing subsidies, are more likely to record higher losses in catch per unit of its management area (i.e., $\beta > 0$). We decided to control for countries bordered by the Atlantic Ocean to account for ocean specific loss differences. Because the data on catch loss for each country is coded as upper and lower bounds, we estimated three separate regressions: for the lower bound, upper bound, and a simple average.

The results of the regressions are reported in Table 3. The coefficient of determination (R-squared) indicates about 23 per cent of the variability in catch losses have been explained by the regressors. The F-statistics indicate the lines are good fits. The coefficients of the explanatory variables are statistically significant in the three regressions at the 10 per cent level or higher. Moreover, our results conform to our hypothesis: i.e., countries within the sub-region with higher investment in capacity enhancement in their fisheries recorded higher catch losses. The corresponding elasticity ranges between 0.22 and 0.27, indicating that percentage increase in capacity enhancement or bad subsidies, all else being equal, will increase catch loss per square kilometer of the EEZ by 0.22-0.27 per cent. Finally, we found that catch losses are higher in countries bordered by the Atlantic Ocean than their counterparts.

Table 3: The impact of capacity enhancing subsidy on loss of rent in capture fisheries in SSA

Explanatory variable	High loss (per km of EEZ area)		Mean loss (per km of EEZ area)		Low loss (per km of EEZ area)	
	Coefficient	Elasticity	Coefficient	Elasticity	Coefficient	Elasticity
Log (Bad Subsidy (US$))	0.00035 (0.00018)*	0.224	0.00026 (0.00013)*	0.239	0.00017 (0.00008)**	0.274
Atlantic Ocean (1/0)	0.0019 (0.0006)***	0.855	0.0013 (0.00047)***	0.856	0.00076 (0.0003)**	0.857
Constant	-0.0027 (0.0016)*		-0.002 (0.001)*		-0.0014 (0.0006)**	
R-Squared	0.23		0.23		0.22	
Prob>F	0.027**		0.0314**		0.0403**	

Notes: Robust standard errors are in parentheses. *** significant at 1%, ** significant at 5%,* significant at 10%.

Source: own computations.

5 The fisheries management problem: the basic theory and practice

5.1 The commons problem

Capture fisheries in SSA are generally managed as open access (or unregulated commons), with some gear restrictions. It is well documented that fisheries resources managed as unregulated commons are subject to overuse (Gordon 1954; Hardin 1968). This is because due to congestion externalities, each fisher incurs a cost of harvest which is less than what it ideally ought to be, triggering rent dissipation. Hardin (1968) refers to this situation as 'the tragedy of the commons'. A basic fisheries model at the appendix is employed to illustrate the management of fisheries as a common pool resource. The model generates the following equation:

$$\left(1-\tfrac{1}{n}\right)AB+\left(\tfrac{1}{n}\right)MB=c \qquad (2)$$

where AB is *average benefit* and MB is *marginal benefit*. If the fishery is managed by a sole owner (i.e., $n=1$), marginal benefit equals average cost (i.e., $MB=c$), which is a well-known efficiency condition. On the other hand, if the community is made up of a very large number of fishers (i.e., $n\to\infty$) average benefit equals average cost ($AB=c$) or rent equals zero: an open access condition which is the inefficient. All else being equal, the number of fishers determines how close harvests are to efficient levels. Figure 2 illustrates fisheries management under CPR.

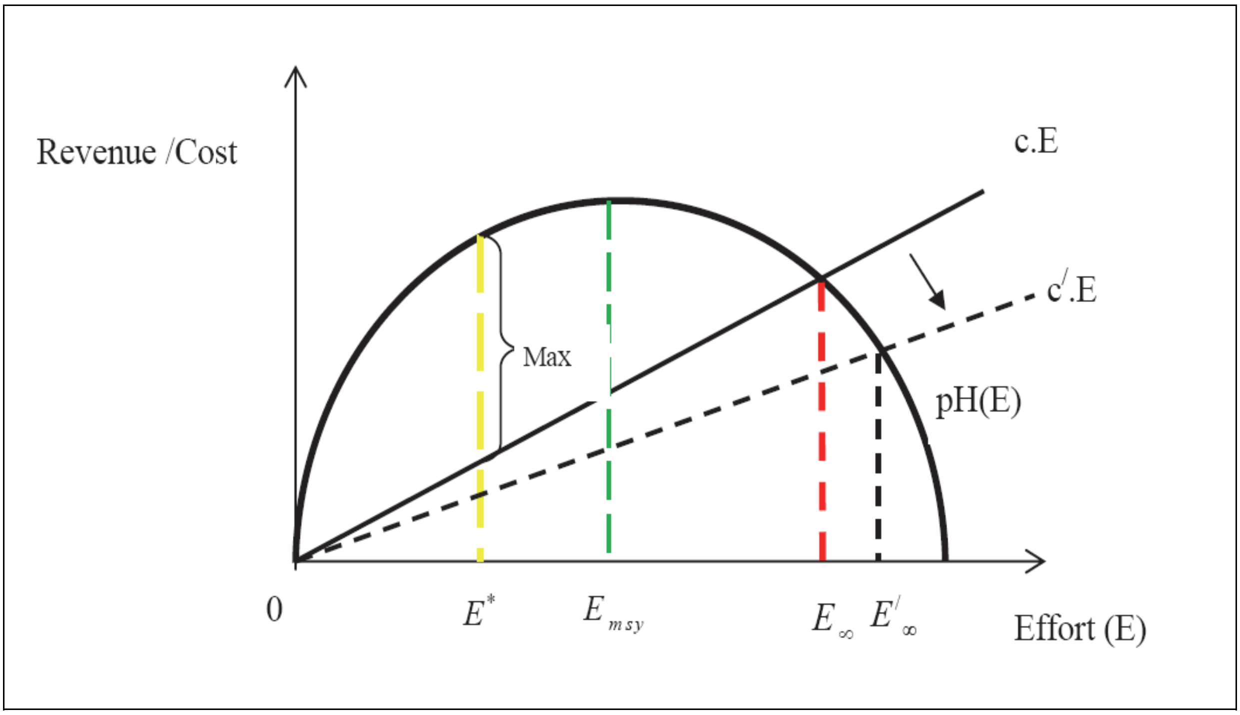
From the Figure, suppose the concave function is the benefit function (i.e., $pH(E)$) and the upward sloping straight line is cost of harvest function (i.e., $c.E$). The gap between the two curves measures profit or net revenue, so that profit is maximized if the gap between the two functions is biggest. A sole owner of the fish stock will, in theory, employ an effort level corresponding to E^{*}. On the other hand, if the stock is managed as an unregulated common, the level of effort will increase until rents are completely dissipated (i.e., profit is zero: the point denoted by the red vertical line). The corresponding effort level will be E_{∞}.

Since fish stocks are renewable, the maximum effort level that biologists recommend is E_{msy} -- where MSY denote maximum sustainable yield --, and any effort level exceeding this implies users are catching more fish than the rate at which the resource replenishes itself. Any activity or policy that subsidizes cost per unit effort (from c to $c^{/}$) obviously leads to higher fishing effort (say from E_{∞} to $E^{/}{}_{\infty}$), hence the tragedy of rent dissipation. A number of empirical studies have argued that such tragedies hardly befall CPRs as access is usually restricted to members of the community who organized themselves successfully and implemented harvest rules to prevent excessive overuse of the resources (see e.g. Wade 1987; Ostrom 1992; Bromley 1992; Ostrom 2010).

6 Fisheries management: why it is easy in theory but difficult in practice

In the preceding section, evidence of overfishing within SSA has been provided. It has also been noted that managing fisheries as unregulated commons could potentially result in biological overfishing. An outstanding question is whether or not a better defined use-right, such as granting communities territorial use-right, or devolving management to village committees could minimize or eliminate biological overfishing. To address this critical question, we present discussion on the possibility of (1) misperception of fish stock dynamics, and (2) ignorance of the nature of stock dynamics.

Figure 2: Sustainable extraction of a renewable natural resource



Source: own illustration.

6.1 Misperception of fish stock dynamics

Fish stocks, like other renewable resources, evolve according to some dynamic processes usually involving nonlinearities. Studies have found that even if the commons problem is eliminated through well-designed institutions, fish stocks are generally overcapitalized and overexploited. The reason attributed to this is misperception of stock dynamics or misunderstanding of bioeconomic systems (Clark 1985; Moxnes 1998, 2000; Schnier and Anderson 2006). It is not uncommon to find those who benefit directly from fishing regulations opposing them or fisheries managers sustaining perverse incentives, like capacity enhancing subsidies or guaranteeing soft loans, even when stocks are clearly overfished (Moxnes 2000).

For example, in Ghana, in spite of the declining catch per unit effort over the past two decades, which informed the design and enforcement of effort limiting regulations, the government still provides special fuel called ‘pre-mix’ at subsidized prices to the artisanal fishing sector (Akpalu 2013). The current subsidy is estimated at about 18 per cent. In addition, in 2012, for example, the government subsidized 1,000 40 HP outboard motors from US$4,000 to US$2,644 per motor; provided 2,000 fishermen with echo sounders; and ordered 100,778 metric tons of fishing nets for sale to fishermen (Daily Graphic, 18 April 2012). These contradictions are common within the sub-region, making a strong case for misperception of stock dynamics.

Moxnes (1998) employed a system dynamic experiment in a laboratory setting to investigate the notion that people (including fisheries managers) lack good mental models and the cognitive capabilities to comprehend more complex models, such as stock dynamics in fisheries model. His experiment eliminated congestion externalities by assigning private property right in the fishery. To encourage seriousness, the subjects were paid at the end of the experiment according to the points they made in the experiment. The participants were 82, with 59 (72 per cent) being professionals (fishers, managers, or researchers) and the remainder having varied backgrounds. The findings were conclusive and alarming: the subjects overinvested and overfished their stocks to a very large degree, with the median participant building a fleet capacity almost double (92 per cent above) the size required to maximize net returns. This was notwithstanding the deep concerns about the dangers of overfishing expressed by many of the subjects. This seminal finding lends credence to Clark's (1985) convictions that the apparent lack of concern over the long-term welfare concerns of the fishing industry could best be attributed to real misunderstanding of bioeconomic systems.

In a related study, Schnier and Anderson (2006) analysed resource (fish) extraction behaviour in environments of biological and spatial complexities. The spatial complexity relates to an environment where fish stocks are allocated in distinct regions with the distributions being heterogeneous. Like Moxnes (1998), the beneficiaries were assigned sole-ownership rights. The results showed that the participants who were confronted with the spatial complexity overinvested in the fishery indicating spatial misperception, and confirming Moxnes (1998). Moreover, subjects who are able to solve the non-spatial component were still subject to spatial misperceptions indicating that further complexities in stock dynamics exacerbate the misperception.

A recent study by Hey et al. (2009), which extends the work of Schnier and Anderson (2006), provided varying details of information on population dynamics in an experimental study to test the role of information quality in stock misperception. It was found that the knowledge of both the species growth model and accuracy of stock estimate improve efficiency (of over 20 per cent) in the dynamic decision task. Fisheries managers make decisions under limited information on biological and economic parameters. The results therefore seem to suggest that investment in research can significantly help to increase extraction decisions—see Brekke and Moxnes (2003), for similar conclusions.

6.2 Ignorance of nature of fish stock dynamics

In addition to misperception of the dynamics of fish stocks and the use of heuristics in fisheries resources management, fisheries managers may simply lack adequate information or be ignorant of the biological and ecological processes of aquatic ecosystems. In two recent studies published in Ecological Economics, Sterner (2007) and Akpalu (2009) showed that aggregating species belonging to different functional groups in a biomass model could lead to biological overfishing and stock collapse. From Figure 1 in Sterner (2007), suppose the average growth of two sub-stocks—one with a higher growth rate (A) than the other (C) —is D. If the stock belongs to a single functional group, the growth is B, which is higher than D. Overfishing and potential stock collapse is inevitable if the manager is ignorant of the existence of the sub-populations and allocates harvest quotas according to B.

Furthermore, there is evidence of commercial fishing gears destroying benthic (seafloor) habitats, resulting in changes to the physical and biological structures and composition of species in ecosystems (see e.g. Collie et al. 1997; Ratana et al. 2003; Armstrong and Falk-Petersen 2008). Fishing gears could plane off structures and upset the nutrient content and organisms in sediments if the ocean bottom is soft (Akpalu and Bitew 2011). This may result in reducing primary food (plankton) production capacity of ecosystems and negatively impact fish production. By extending the standard Schaefer (1968) model to account for species diversity and fishing impact on environmental carrying capacity, Akpalu and Bitew (2011) found that effort levels corresponding to maximum sustainable yield could collapse stocks if the two situations are ignored. Refer to Figure 5 in Akpalu and Bitew (2011), which depicts the equilibrium relationship between yield and effort if diversity is accounted for. The shift of the curve downwards results from intensification of fishing activities on the carrying capacity. At effort or quota levels considered otherwise efficient, the stock will collapse if the impact is so severe that the true yield curve is very low.

Namibia fishery, which is hailed as a role model for Africa, relies on a combination of economic incentives and penalties to regulate catches. The country employs a sophisticated method to estimate total allowable catch (TAC) and has corresponding harsh deterrent policies to avoid overcapitalization. Surprisingly, total catches have fallen over the years confirming that biological uncertainties can lead to overharvesting catch, even with seemingly effective catch policies.

7 Potential role of foreign aid

Development aid can play a critical role in addressing the overfishing problem in SSA. First, the aid should be tied to building fisheries institutions that define and enforce access rights to regulate the commons problem. Many of the fisheries are already managed locally but local authorities, such as chief-fishermen in Ghana, have limited powers to enforce rules including excluding outsiders from fishing within the local waters. Assigning management responsibilities to local communities or involving them in the management of the resource so that local fishers participate in decision making is highly recommended. In places where customary rights to fisheries are well-defined, communities regulate access by controlling methods, location, and timing (Sterner and Coria 2012).

Second, in addition to empowering local communities to exclude outsiders from having access to fishing areas, it is necessary to regulate off-takes. As noted earlier, due to misperception of stock dynamics assigning ownership rights may not guarantee predictable outcomes. Due to the large number of small scale fishers in many of the capture fisheries it is generally impossible to monitor landings and enforce catch quotas. As a result, effort limiting regulations—e.g., setting a minimum mesh size; banning the use of explosives and cyanide, and light aggregation equipment; and echo sounders—are necessary. Development aid could support research into determining desirable effort levels and expenditure on enforcement of regulations that seek to enforce effort-limiting policies.

Third, development aid is needed in research into species phenotypic diversity and ecosystems. Understanding the functional groups of species, migration paths and spawning behaviour of various species can significantly improve stock management and enhance inter-temporal benefits from capture fisheries.

Furthermore, inshore fisheries in SSA are facing fierce and increasing competition from foreign fleets fishing extensively within the offshore of the exclusive economic zones. Although offshore stocks generate much needed foreign exchange, coastal countries generate benefits that are lower than the catch rents. The fleets, which are predominantly European, employ sophisticated fishing gears and equipment like acoustic fish finders to maximize catch, hardly obey local catch restrictions, invade inshore stocks, and use fishing methods such as bottom trawling which plains off corrals, negatively affecting primary food production (Atta-Mills et al. 2004; Akpalu and Vondolia 2012). All these have led to stock depletion and destruction of ecosystems. Insufficient budgets for enforcement make it hard for the coastal countries to monitor the foreign vessels.

To ease pressure on capture fisheries, foreign aid can support research in aquaculture and/or dissemination of such knowledge products to minimize perceived risk and facilitate investment in the industry. Since the industry is highly developed in some developing regions in the word and some parts of the continent, the knowledge could be packaged in a cost effective manner and disseminated through organized training programmes.

Finally foreign aid aimed at effective fisheries management in Africa must look beyond the fisheries sectors. Perverse policies in the fisheries sector are usually associated with bad governance. Several countries within the region continue to subsidize fishing inputs for political expediency, even when evidence abound that stocks are overcapitalized. Moreover, corruption has been cited as an important factor leading to depletion of offshore and inshore stocks by foreign fleets. Foreign aid to the sector should be tied to good governments in the recipient countries.

8 Seeking a success fisheries management story: the case of Namibia

Evidence of successful management of capture fisheries in SSA is scarce. Namibia is uniquely lauded as a model for sustainable fisheries management in the sub-region, although the country recorded catch losses over the years (Srinivasa et al. 2012). The country is a part of the Benguela system, with a coastline of 1,300 km, which is one of the four eastern boundary upwelling systems in the world (OECD 2012). Prior to independence in 1990, Namibia’s waters were heavily overfished with rent from fisheries totally drained off. Hake, which is the dominant and most valuable species, was exploited by foreign fleets with little benefit to the country. Other commercial species include horse mackerel and sardines.

However, after independence, the country established its 200 mile Exclusive Economic Zone (EEZ) and the fishery sector went through a complete metamorphosis in order to rebuild stocks and the fishing industry. The changes included implementation of a policy called Namibianisation, by which the government sought to offer the citizens the opportunity to access ownership rights to the fisheries sector (Armstrong et al. 2004). Effort limiting and quota policies were also implemented. In addition, Monitoring, Control and Surveillance (MCS) systems were strengthened through various training programmes. The programmes were supported through development aid and various regional programmes (OECD 2012). Furthermore, technical management measures such as restriction on mesh sizes, vessel-specific fishing zones, and seasonal closures and closed areas were implemented. Perhaps, most importantly, the country avoided subsidization of the fishing industry.

Due to the success of the policies, Export receipts increased sharply from US$71 million to US$361 million from 1991 to 2003, respectively (Republic of Namibia 2007; OECD 2012). The figure for 1991 and 2003 constituted 4 per cent and 7.8 per cent of GDP, respectively. By 2005 the export of hake alone generated about US$256 million (OECD 2012).

It is noteworthy that Namibia's success story accrues to the absence of small-scale fisheries, which is rather predominant in other countries. In addition, the country has only two landing sites making it feasible to implement and monitor catch restriction regulations. Obviously, the prohibitive cost and resource necessary to replicate such policies in other countries in SSA makes them undesirables.

9 Concluding remarks

SSA has benefitted a great deal from foreign aid, including development aid to fisheries management, over several decades. Over the past three decades or so, when several countries began to clearly see evidence of fish stock depletion, the aid community started to question the effectiveness of aid to fisheries management. In this report we have provided evidence that capacity enhancing aid has lead to losses in capture fisheries in SSA, with countries along the Atlantic coast experiencing higher losses than their counterparts along other coasts.

Furthermore, several fisheries within the region are organized as open access or unregulated commons, with only some gear restrictions which are hardly enforced. We have argued that beneficial aid directed at fisheries institution building, such as granting communities territorial rights, is necessary but likely not sufficient to regulate catch to optimum levels due to misperception of stock dynamics. Investments in research and development is required to update knowledge on stock assessment and dynamics, species diversity and ecosystem functioning. It is important that foreign assistance is provided in advanced surveillance technology to monitor offshore fleets that have reputation of disregarding quotas, depleting stocks and damaging marine ecosystems with destructive fishing methods.

To reduce pressure on capture fish stocks, aquaculture has to be promoted by educating potential farmers on its opportunities. The cost of transferring and disseminating the requisite know-how could be financed by foreign aid.

It is strongly recommended that foreign aid to fisheries be tied to good governance. The quest for votes and rent seeking behaviour has significantly worsened the problem of overcapitalization of inshore stocks, through perverse incentives; and the rate of depletion of offshore stocks.

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Appendix A

Table A1: Data on the relationship between catch loss and capacity enhancing subsidy

Country	Loss (high estimate)	Loss (low estimate)	Loss (mean estimate)	Capacity enhancing subsidy	Atlantic Ocean
Angola	1000	500	750	63227	1
Benin	50	2	26	5370	1
Cameroon	6	2	4	4864	1
Cape Verde				9597	1
Comoros				137	0
Congo Rep.	6	2	4	5	1
Côte d'Ivoire	100	50	75	7269	1
Djibouti	2	0	1	534	0
Egypt	20	6	13	2020	0
Eritrea				312	0
Gabon	20	6	13	7315	1
Gambia	200	100	150	7247	1
Ghana	100	50	75	20733	1
Guinea	200	100	150	14496	1
Guinea-Bissau	200	100	150	3155	1
Kenya	2	0	1	3901	0
Liberia	200	100	150	221	1
Libya				0	0
Madagascar	2	0	1	2772	0
Mauritania	500	200	350	15269	1
Mauritius				1428	0
Morocco	500	200	350	58362	0
Mozambique	6	2	4	17362	0
Namibia	5000	2000	3500	71720	1
Nigeria	100	50	75	667	1
Sao Tome & Principe				554	1
Senegal	200	100	150	48246	1
Seychelles				23243	0
Sierra Leone	100	50	75	8155	1
Somalia	20	6	13	768	0
South Africa	1000	500	750	33524	0
Sudan				475	0
Tanzania	6	2	4	5671	0
Togo	50	2	26	1130	1
Tunisia	200	100	150	22350	0

Source: Srinivasan et al. (2010); and Srinivasan et al. (2012).

Appendix B

The CPR Model

Let a fish stock (x) grow according to a logistics function $g(x)$ with a constant environmental carrying capacity. In addition, let human predation of fish be defined by a Schaefer (1968) harvest function $H(x,E)$, where E signifies fishing effort (e.g., number of fishing trips), and harvest is concave in both arguments.[1] The stock dynamic equation is defined as:

$$\dot{x} = g(x) - H(x,E) \qquad \text{(B1)}$$

where $\dot{x} = dx/dt$ is the time derivative of the stock. In steady state $\dot{x} = 0$ and equation (1) generates $H(x,E) = g(x) \Rightarrow x = x(E)$. An equilibrium harvest function or yield function (i.e., equation 2) is obtained if $x(E)$ is used in the harvest function (i.e., $H(x,E)$).

$$Y = H(E) \qquad \text{(B2)}$$

Following Dasgupta (2005) and Akpalu (2013), assume the stock is harvested as a CPR and each individual i obtains a fraction of the value of the yield. Also, let c be cost per unit effort. The instantaneous net benefit of individual i is[2]:

$$\pi_i(E_i) = \left(E_i/E \right) pH(E) - cE_i \qquad \text{(B3)}$$

where p is the price per kilogram of fish. If equation (3) is maximized ($d\pi(E_i)/dE_i = 0$), assuming a symmetric Nash equilibrium, we have the following solution:

$$\left(1 - 1/n\right)\left(pH(E)/E \right) + \left(1/n\right)\left(dpH(E)/dE \right) = c \qquad \text{(B4)}$$

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1 The specific growth function is $g(x) = rx\left(1 - xK^{-1}\right)$, where K is environmental carrying capacity and r is the intrinsic growth rate; and the specific harvest function is $H(x,E) = \sigma xE$, where σ is an indicator of gear-efficiency (catchability coefficient).

2 Note that $E = \sum_{i=1}^{n} E_i$, $Y = \sum_{i=1}^{n} Y_i$