INCOME DIVERSIFICATION AND FISHING PRACTICES AMONG ARTISANAL FISHERS ON THE MALINDI-KILIFI COAST

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Abstract

The fishing practices of fishers at ten landing sites in Malindi and Kilifi Districts that were surveyed in 1999 as part of a larger research project are discussed in this article. The focus of the research was on income diversification among fishers, pressure on marine resources and the relationship between the two. It was hypothesized that fishers with additional resources strengthen livelihood strategies and improve household security, and those who succeed in diversifying their incomes can be expected to have a more positive attitude towards conservation measures and will exact less pressure on marine resources. Two types of income diversification were distinguished: 1) 'activity' diversification at the individual level where fishers had other income besides fishing, and 2) 'earner' diversification at the household level where fishers belonged to a household with more than one income earner. Key indicators were selected that represented four features of artisanal fishing, namely: 1) the number of fishers; 2) the fishing grounds; 3) the type of equipment; and 4) the frequency of fishing. There was no significant relationship between 'earner' diversification and fishing practices while 'activity' diversification correlated significantly with two selected indicators. Fishers with 'multiple' activities used more destructive gear and fished inshore grounds more often, while there was no sign that they were more willing to stop fishing in favour of alternative employment. It was concluded that an activity diversification of fishers did not reduce the pressure on the marine environment. Instead the opposite occurred, fishers who had other employment onshore fished less prudently.

Introduction

Kenya's coastal and marine environment is threatened by naturally occurring processes, the growing subsistence needs of the coastal population and increased economic activities (Hoorweg 1998). Examples of natural processes are coral bleaching, sea-level change and beach erosion. Growing subsistence needs are behind the over-harvesting of mangrove trees, illegal shell collecting and intensive fishing. Increased economic activities result in greater sewage and waste disposal from tourist hotels, the industrial pollution of the waters near Mombasa and siltation at river exits as a result of soil erosion upcountry. The first national environmental plan in 1994 listed many of these issues but efforts at Integrated Coastal Management since then have been limited to the Mombasa and Diani areas (MENR 1994; CDA 1996, 2001; McClanahan, Mwaguni & Muthiga 2005b).

Artisanal fishers also contribute to the degradation of marine resources, as intensive fishing can affect the ecological balance and result in a loss of local biodiversity (McClanahan & Shafir 1990; McClanahan & Arthur 2001). Destructive fishing practices, such as the use of seine nets, poison and explosives, alters the terrain as well as the ecological balance of the reef and seafloor. Local fishers generally do not approve of destructive fishing methods since they are aware that these will ultimately lead to lower

catches. Indeed, nearly all fishers were concerned with the degradation of marine resources and mentioned declining catches. Other reasons given by fishers included the increased number of fishers, gazettement of no-take areas, rough weather (notably the heavy El-Niño rains of 1997/98) and competing fisheries such as commercial trawling.

Faced with dwindling resources and more competition, not only from fellow fishers but also from tourism and human settlement, fishers have little choice but to adjust to the changing circumstances. One alternative is to fish more intensively, for example, by investing in vessels and gear, but this is beyond the means of most of them. Another alternative lies in livelihood diversification, i.e. engaging in economic activities other than fishing. Already, most fishers do not set out during the windy and rainy season when waters are too rough, using this period of seasonal unemployment for other economic activities instead.

Livelihood diversification is a widespread survival strategy employed by rural households in Africa (Ellis 2000). Most studies on household diversification have focused on farm households and pastoralists but little attention has been given to fisher households (Allison & Ellis 2001). Diversification is generally expected to improve income, if not resulting in increases in income then at least resulting in a wider income spread, although other researchers consider specialization as the more efficient way of improving incomes. It is important though to distinguish between 1) 'activity' diversification at the individual level, where the household head has income from more than one economic activity, and 2) 'earner' diversification at the household level where the household has more than one income earner (Ellis 1999).

Poverty has long been associated with an overexploitation of natural resources, and it was generally assumed that income improvements among the local population are needed to reduce the pressure on natural resources (Ellis 2000). The focus of the present research was on the income diversification of fishers and its impact on marine resources. The RDM[1] project studied the income diversification of fishers on the Kenyan Coast, the pressure on marine resources and the relationship between the two. The importance of diversification for fisher incomes and household poverty is discussed elsewhere

1 RDM is the acronym for '*Resource Diversification and Management among Coastal Fisher-folk in Kenya'*. This was a joint project of Moi University (Kenya), Ben Gurion University (Israel) and the African Studies Centre (the Netherlands). The project was funded by the Netherlands Israel Research Project under contract NIRP-97-145-7. Detailed descriptions of surveys, studies, methods and sample characteristics can be found in Hoorweg *et al*. (2003, 2008a).

(Hoorweg, Wangila & Degen 2008b). Fishers and crew members had higher incomes than non-fishers living in the same neighbourhood. And although fishers had higher incomes from fishing, their crew members compensated for this with income from non-fishing activities.

Modern methods of marine conservation attempt to minimize the impact of intensive fishing in various ways, notably by limiting the number of fishers, restricting access to fishing grounds and controlling the type of equipment used and the frequency of fishing. This paper explores these features in relation to income diversification. Since additional income sources should strengthen livelihood strategies and improve household security, these fishers might be expected to have a more positive attitude towards conservation measures and to exact less pressure on marine resources.

Study Area

The study area was situated in Malindi and Kilifi districts, extending from Ras Ngomeni (the Ngomeni Peninsula) to Takaungu Creek, a distance of roughly 125 km. The study locations consisted of five coastal tracts with two landing sites at each. From north to south these were the Ngomeni, Malindi, Mida, Kilifi and Takaungu coastal tracts, covering, more or less, the coast of Kilifi and Malindi districts (Map 1). The area of study was chosen for logistical reasons and to ensure cultural consistency.

- The *Ngomeni* coastal tract is characterized by the absence of a fringing reef, open access to the sea, mangroves, mud flats and sandy beaches. There are two landing sites: one opposite Robinson's Island and one at Ngomeni village.
- The *Malindi* coastal tract is near Malindi National Park. There is one landing site in Malindi town at the very end of the reef, which is polluted and covered by sediment from the Sabaki River. The second landing site, Mayungu, lies in the middle of the Malindi Reserve where the reef is relatively far out to sea;. it is a small cove surrounded by dry, rocky land.
- The *Mida* coastal tract consists of the Watamu and Uyombo landing sites. Watamu is situated within the Watamu Marine Park and while Uyombo is adjacent to this park, the fishers have to pass through it to reach their fishing grounds. Watamu is on a sandy beach with coral rocks nearby that tower over the sea. Uyombo lies at the entrance to Mida Creek, a large estuary that is mostly dry during ebb tide.
- The *Kilifi* coastal tract consists of two landing sites, Bofa and Kilifi Ferry, both of which are within easy reach of Kilifi town. Bofa is further up the coast with small rocky outcrops and Kilifi Ferry is at the mouth of the deep Kilifi Creek that serves as a harbour for coastal dhows and pleasure yachts.
- The *Takaungu* coastal tract is characterized by coral soils and palm cover and includes landing sites at Takaungu town and Shariani. The coral reefs at these sites are patchy in nature and further out to sea. Takaungu town is situated next to a deep creek that is largely dry at ebb tide; Shariani is on the sea side and has a steep rocky coast.

The coastal population is of mixed origin (Middleton 2000), with the Mijikenda being the largest group. They are agriculturalists who live inland on the hilly coastal range but have moved onto the coastal strip in large numbers over the last 150 years. The traditional inhabitants of the coastal strip were the Swahili and Bajun. The Swahili inhabited the 'stone' towns, were mainly involved in trading and dominated politically. The Bajun were the fishers *par excellence* but the Mijikenda have joined the fisheries in large numbers since the 1960s and they now pose considerable competition. The Mijikenda do not have a history of fishing, have little traditional knowledge of how to manage marine resources and do not provide apprenticeships for young fishers (Glaesel 1997).

Fishers are flexible in what gear they use although they usually have strong preferences based on past experience and the expected catches (Tunje & Hoorweg 2003). Equipment differs greatly in its effect on the environment, with some sorts being more destructive than others. There are different types of destructive effect: damage to the marine environment, the capture of non-targeted species and capture of immature targeted species. Not only the type of gear but also the area and the way it is used determine how destructive the gear is. Traditional equipment is generally considered more benign than its modern equivalent but the traditional gear appears to be on the decline.

In the past, there were traditional restrictions on fishing, such as the *sadaka*, but these have largely fallen into abeyance. The main restriction that is actively implemented today is that of the Marine Protected Areas (MPAs) that consist of marine national parks where marine resources are fully protected and marine national reserves where fishing activities are regulated. To reach fishing grounds in a reserve, fishers are allowed to pass through the park with their vessels. MPAs are managed by the Kenya Wildlife Service (KWS) under their regulations, and KWS wardens patrol the areas regularly. Fishers in unprotected areas were expected to follow general fishing regulations but there were few inspections by fisheries personnel. In 1997, there were four marine parks and six marine reserves along the entire length of the Kenyan Coast, together encompassing 100 km of seafront. The positive effect that can be expected from fishing restrictions is an increase in fish biomass, which should spill over into the reserves and the surrounding areas to the benefit of local fishers (Roberts *et al.* 2001).

Method

The data presented are from two surveys that were part of the larger RDM project, namely a Fisher Survey and a Household Survey (Hoorweg *et al.* 2008a). Supporting studies were by Versleijen (2001) and Tunje (2000).

The Fisher Survey was carried out between June and October 1999 and covered five tracts of coastline, each with two landing sites (described above). At each landing site, 20 fishers were randomly selected and interviewed, either on-site or in their homes. The sample consisted of boat captains, crew and independent fishers (who fished by themselves). In total, 199 fishers were interviewed about their fishing practices, catches and incomes, catch destination, crew and ownership arrangements and household characteristics.

The Household Survey was conducted between October 2000 and March 2001 at four landing sites that differed in distance from the marine reserves and the potential access to employment in nearby urban centres.[2] A group of fishers who landed catches frequently at the sites were contacted and accompanied to their homes. This group comprised 83 boat captains and independent fishers and they were interviewed about their living conditions, household composition, employment characteristics, farming activities, fishing activities, the income of the household head and other household members and about resource conservation.

Two types of income diversification were distinguished: 'earner' diversification where more than one member in the household had an income, and 'activity' diversification where the head of the household had income from more than one source. Fishing pressure was analyzed by examining the four features of artisanal fishing : 1) fisher numbers; 2) the fishing grounds; 3) the type of gear used; and 4) the frequency of fishing.

Results

Fisher Numbers

At the time of study, a fishing licence, costing Ksh 100 for a one-year period (about US$1.25 at the time), was required from the local Fisheries Office to fish on the Kenyan Coast. However, controls were lax and many fishers did not have a licence. At most landing sites there was a fisher committee headed by a chairman, and new fishers usually

2 The landing sites selected for the household survey were Ngomeni, Mayungu, Uyombo and Takaungu. .

had to be approved by the chairman before they could obtain permission to fish at the site. Reasons for denying someone permission to fish were mainly related to the type of gear used and the reputation of a particular fisher. Otherwise, they were generally allowed access to the fishing grounds. In addition, the role of the fisher committees was to deal with complaints, facilitate internal communication and represent fishers in negotiations with external parties such as the KWS concerning, for example, the Marine Protected Areas.

At the start of the research, the most up-to-date count came to a total of 1,000 fishers along the Malindi and Kilifi coasts (Dept. of Fisheries 1996). However, the respondents at the five coastal tracts in the Fisher Survey estimated that there were as many as 1,800 fishers. This number had to be increased to take into account the landing sites that were not covered in the survey, as well as for other smaller, unknown landing sites, giving a rough estimate of 2,500 to 3,000 fishers, almost triple the official figure.[3-4] The largest numbers of fishers were reported for Ngomeni (398), Malindi (492) and Mida (347). In Kilifi (330) and Takaungu (234) further south, the number of fishers was somewhat smaller. Based on the respondents who made the estimates, about half the fishers in the three northern locations were of Bajun origin.[5] In Kilifi and Takaungu, the large majority were Mijikenda (68%). About 85% of the latter were first-generation fishers, and only 15% were second generation.

Nearly all the fishers in the Household Survey (91.3%) were negative about current fishing trends and reported declining catches. The increased number of fishers was most frequently mentioned as the reason for this trend because of the sector's easy access and the lack of alternative employment. The fishers believed that anyone could fish whenever he wanted to and in the way he wanted to but many also felt that if there were other jobs available they would chose to do something else, but jobs were hard to find.

Asked about their willingness to stop fishing, 87% of fishers responded positively. This was an unexpectedly high percentage but somewhat deceptive because old age was mentioned as the foremost reason to stop fishing (71%). But, it is noteworthy that 54% of fishers were willing to take alternative employment, if available, although it is unlikely

3 Reasons for the lower official estimate of the number of fishers in Kilifi and Malindi were that only official landing sites were covered and that many fishers did not have a fishing licence.

4 Extrapolation of these figures to the whole of the coast, from Vanga to Kiunga, would arrive at roughly 10-12,000 fishers.

5 The Bajun group also includes a few fishers of Swahili origin that were found among the respondents. Similarly, the Mijikenda group includes a few fishers from other inland groups.

that they would stop fishing completely even if the opportunity occurred.[6] Only 1.2% mentioned low catches as a reason to stop.

Willingness to stop fishing was related to age and fishing income. Older fishers mentioned 'age' more often as a reason than younger fishers.[7] Younger fishers were more willing to try other employment than older fishers, who possibly saw fewer opportunities.[8] In addition, fishers with a low fishing income were less willing to exchange fishing for other employment, perhaps because they were realistic enough to know that, at best, they would only be able to obtain unattractive menial jobs.[9]

Fishing Grounds

Most fishers frequented two or three different types of marine habitats on their fishing trips. These included the lagoon and inshore grounds, the reef itself, the fishing grounds beyond the reef and deep waters. Nearly all fishers visited one or more of these habitats. Many ventured into the deep waters on occasion where they were outside the protection of the reef and more exposed to the sea and possibly inclement weather. For most fishers, the deep waters were their second or third choice because of their inadequate vessels. Regular deep-sea fishing was the domain of the larger, sturdier vessels as well as the sports fishers and commercial fleets.

During the low season (south-east monsoon) when the sea can be rough, fishers avoided the deep-water areas and the outer-reef areas. During the high season (north-east monsoon), they fished less in the lagoon and inshore areas, giving these grounds some respite. The pressure on the reef is more or less the same in the two seasons (Hoorweg *et al.* 2008a). Fishers from landing sites near the marine parks often mentioned the parks as no-go areas (80%). Artisanal fishers were aware of the important role of the reef as many species spawn and breed there.

The large majority of fishers from landing sites near a protected area mentioned that they did indeed avoid the latter.[10] However, marine parks offer advantages as well as disadvantages for fishers living nearby. Restricting access to fishing grounds by means of

6 Certain questions allowed for more than one answer by the respondent so that percentages may add up to more than 100%.

7 Household Survey: Fishers <39years (56%) vs. Fishers >40 years (91%).

8 Household Survey: Fishers <39years (65%) vs. Fishers >40 years (34%). X2, df=1, p=.008.

9 Household Survey; Fishing Income <sh.999 (32%) vs. Fishing Income >sh.999 (59%). X2, df=1, p=.04

10 In Mayungu and Uyombo, 80% of the fishers mentioned the parks as off-limits in both the high and low seasons.

a seasonal or all-year ban is an important conservation measure because of the increase in fish biomass that can be expected and the spill-over into the adjacent reserves, although this effect can be nullified by a greater concentration of fishers in a smaller area (McClanahan & Mangi 2000). Another disadvantage is that parts of the traditional fishing grounds are off-limits and almost three-quarters of the fishers at the Watamu landing site listed the Watamu Park as one of the main problems with which they had to cope. Fishers in Uyombo showed considerable resentment towards the park and the KWS wardens there (Versleijen & Hoorweg 2006).

Fishing Gear

Traditional gear included traps, fences, spear guns and poison. The portable fish traps *(malema)* were fairly light and could be used on the reef without adverse effects. Spearing was considered destructive to the corals and although the method is not damaging in itself, fishers often use long metallic rods *(mkonjo)* to break the coral where the fish take refuge. Sometimes, spears also damage the coral when fishers miss their target. Spear-gun fishers have to be in good physical condition to swim long distances and hunt moving targets and for this reason nearly all the spear gun fishers were younger than 39 years of age. Traditional fish poison (*mkanga* or *mchupa*) is destructive not only for fishery resources but also for other living creatures, such as the birds that eat the dead fish.[11]

Modern gear included nets and lines in almost equal proportions. The use of a gill net (*mpweke*) is destructive if it entails fishers trampling on the reef. When used in areas where coral is absent, it rarely causes damage although small fish easily get entangled in the nets. Beach seines *(juya*) are destructive because they have very small mesh sizes, and therefore net many young and immature fish as a by-catch. The net is dragged along the seabed, churning up the sea bottom and damaging underwater vegetation. Explosives (*baruti*) not only kill fish and other marine life indiscriminately but also damage the habitat.[12] Baited hook and line (*mishipi*) when used without breaking off the coral are not considered destructive.

Fishing vessels and gear differed considerably among coastal tracts. The differences

11 None of the fishers admitted using poison but reliable sources mentioned that it was used in the far northern parts of Malindi District near Mto Kilifi.

12 Again, none of the fishers admitted to this but it was understood that dynamite was used occasionally between Mayungu and Watamu.

related mostly to the local marine conditions and the abundance of fish. The most popular gear reported among fishers was the (gill) net with mesh sizes that vary from small (<1.0 inch) to large (>5.5 inch). The majority of net fishers use nets between 1.0 and 5.5 inches. More than half the fishers used lines (long lines were reported by 25% of fishers). Traditional gears were reported by less than 10% of the respondents (Table 1).

Table 1 Reported fishing gear by respondents in Fisher Survey (%; multiple response)

Fishing Gear *		*Net Mesh Size* **		*Use of Destructive Gear* *	
Nets	73.4	< 1.0 inch	3.4	Beach seine	}
Lines	62.8	1.0-2.5 inch	77.4	Net mesh < 1.0'	} 15.6
Traditional	9.0	3.0-4.5 inch	72.6	Spear gun	}
Other	9.5	> 5.0 inch	31.5		

* N=199 ** N=146

Only 30% of fishers limited themselves to one type of equipment; the large majority reporting two or more kinds of gear (Table 1). About 15% of fishers freely admitted to using destructive equipment – 9% reported using spear guns, 5% mentioned beach seines and 3% used a net mesh size of less than 1 inch. These gears were used more often by Mijikenda fishers than Bajun fishers.[13] The use of destructive gears was not related to age although it was found slightly more often among younger fishers because of their use of spear guns.[14]

Fishing Frequency

A final factor that affects the pressure put on the marine environment is the frequency of fishing, that is, the frequency with which fishers set out to sea. Fishers reported that they generally fished 5 or 6 days a week and rested for 1 or 2 days. Fridays were non-fishing days for many (57%), while others chose not to fish on other days of the week. Reasons that were given for taking a day off included religious observance, time for their family, maintenance of gear/craft and avoiding high tides and rough waters.[15]

Most fishers fished once a day for about four hours. Six times a week was mentioned most often, namely by 40% of the fishers, with a large variation among the other 60%. About a third of the fishers reported eight or more trips a week and, thus, either went out

13 Fisher Survey: Mijikenda (25.0%) vs. Bajun (2.4%): X2, df=1, p=.00.
14 Fisher Survey: Fisher <39years (18.0%) vs. Fisher >40 years (11.3%): X2, df=1, p=.21.
15 Some fishers preferred to set out at weekends because the frequency of government patrols was reportedly lower then.

more than once a day or combined day and night fishing.[16] This occurred particularly among fishers in Takaungu.

Table 2 Reported fishing frequency by season (average/s.d.) *

	High Season	*Low Season*
Duration season No. of months	5.4 (1.9)	3.9 (1.2)
Fishing frequency No. of trips/week	8.2 (2.9)	7.2 (2.5)
Fishing frequency No. of trips/season	193.1 (99.8)	121.1 (58.9)

* Fisher Survey (N=197)

Table 2 provides further information on fishing frequency during the high and low seasons, notably the duration of the fishing season and the number of trips per week. The duration of the high season averaged about 5.5 months and the low season almost 4.0 months, which left about 2.5 months with no fishing activities. Many fishers did not go out at the height of the *kusi* season. The frequency of fishing trips differed slightly between 8.2 trips per week in the high season and 7.2 trips a week in the low season. The average number of annual fishing trips was estimated at 315 although there was considerable variation. About 25% of fishers made an estimated 210 trips or fewer, while 25% made 360 trips or more.

Frequency of fishing was related primarily to the type of vessel used. Motorboats generally went out more often. During the low season, fishers with large vessels (*jahazi* and *mashua*) went out more than fishers with smaller vessels (*dau* and different canoes). The fisher's age was also a factor; younger fishers went out more often than average.

Income Diversification and Fishing Practices

Further analysis focused on the four environmental features discussed thus far, namely fisher numbers, the type of fishing ground, the fishing gear used and the intensity of fishing. For each environmental feature, an indicator was selected to test the relationship with income diversification: 1) willingness to stop fishing for alternative employment (indicating possibilities of reductions in number); 2) frequenting the lagoon and inshore grounds which are heavily utilized; 3) the use of destructive gear such as beach seines,

16 An interesting phenomenon that was noted in Mayungu was that of 'joy' fishing (analogy of 'joy' riding). Since most fishers at this landing site lived inland, their boats were left largely unattended at night and other fishers sometimes used them then without the owners' permission.

small-mesh nets and spear guns; and 4) the frequency of fishing, that is whether the number of annual trips was above or below average (or 300 trips to be more exact). In addition, these indicators of fishing practices were examined among fishers with and fishers without income diversification.

Table 3 Fishing practices by earner diversification

	Single Earner	*Multiple Earner*	*Chi Square Stat. Test*
A. Fisher Number (%) ** Willingness to stop fishing if alternative employment opportunities available	57.8	45.5	p=.28
B. Fishing Grounds (%) * Mentioned lagoon and/or inshore grounds	43.4	42.5	p=.92
C. Fishing Gear (%) * Mentioned use of damaging gear	17.6	7.5	p=.12
D. Fishing Frequency (%)* Number of annual trips above average	49.0	48.7	p=.97
* Fisher Survey	N=159	N=40	
** Household Survey	N=45	N=33	

Table 3 presents the results of 'earner' diversification, comparing fishers who are the sole earners in their households with fishers in households with more than one income earner. No significant relationship was found between earner diversification and any of the fishing practices examined.

Results for 'activity' diversification, however, did reveal differences (Table 4). Of the four indicators, two were significantly different between fishers with a single economic activity and those with multiple activities. The fishers with multiple activities mentioned the lagoon and in-shore grounds more often as their fishing grounds.[17] These fishers also reported using destructive gear significantly more often.

The two remaining indicators, concerning fisher numbers and fishing frequency, were not significantly different between single and multiple activities. There was, however, a small difference: fishers with multiple activities were slightly less willing to search for alternative employment than those with single activities. Although not significantly different, the opposite was certainly not the case, that is, there was no indication that fishers with multiple incomes were more willing to exchange fishing for other employment than fishers with single incomes.

17 There was also a significant difference in the number of landing sites frequented. Fishers with multiple activities reported fewer landing sites, which is understandable if they had other work to do onshore (ANOVA, df=1, F=14.0, p=.00).

Table 4 Fishing practices by activity diversification

	Single Activity	*Multiple Activity*	*Chi Square Stat. Test*
A. Fisher number (%) ** Willingness to stop fishing if alternative employment opportunities available	58.8	51.2	p=.50
B. Fishing grounds (%) * Mentioned lagoon and/or inshore grounds	33.3	57.3	p=.00
C. Fishing gear (%) * Mentioned use of damaging gear	8.5	25.6	p=.00
D. Fishing frequency (%)* Number of annual trips above average	50.0	47.5	p=.73
* Fisher Survey	N=117	N=82	
** Household Survey	N=34	N=43	

Discussion

Poverty has often been associated with the overexploitation of natural resources (Ellis 2000) and it has been widely agreed that environmental degradation worsens the degree of poverty in marginal groups, which in turn leads to more intensive exploitation of accessible resources. The implicit assumption is that improvements in income will reduce the pressure on resources and halt further damage to the natural environment. Poverty itself has to be addressed; the poor, in particular, have to be provided with access to other sources of livelihood. However, the expectation that improvements in income will halt environmental destruction has not generally been confirmed (Ellis 2000). People show great flexibility in finding and utilizing new opportunities while state and commercial interests are equally, if not more, responsible for the overexploitation of resources.

Efforts to halt the downward spiral of poverty and resource degradation among fishers depend on the possibilities of improving the efficiency of small-scale fisheries, enforcing restricted access to some fishing grounds to conserve fish stocks, and offering incentives to reduce fishing activities (Allison & Ellis 2001). State-imposed regulations to limit access reportedly have a high failure rate and there is tension between the two objectives of modern fishery policies, namely increasing efficiency and regulating the catch. The weakness of the enforcing institutions in many developing countries also plays an important role. Most fishers in the study area were aware of the degradation of marine resources and mentioned declining catches, attributing this mainly to an increased number of fishers. This paper has discussed the latter feature and three other elements of fishing

activities that affect the marine environment, namely the number of fishers, the fishing grounds, the type of gear, and the frequency of fishing.

The number of fishers has been increasing over the past decades with the entry of many Mijikenda into the arena, a group not known for its fishing until now (Glaesel 1997). The reasons for their entry into this sector were: the open and easy access of the resource, the lax enforcement of licence regulations and the need for employment. Half the fishers expressed an interest to opt for alternative employment, if it was available, although it is doubtful whether they would abandon fishing completely if they found other employment. It is more likely that they would try to combine the two, as was the case with many of the new entrants. Fishers with a low fishing income were less willing to choose alternative employment, which is in line with the finding that families with higher incomes are usually in a better position to diversify than poor families (Ellis 1999).

In developing countries, fisheries management depends mainly on two sets of instruments (Allison & Ellis 2001): controls to limit access (operating licences, vessel capacity, closed seasons, closed zones) and technical measures to restrict efficiency or selectivity (prohibited gear, mesh size regulations). On the Kenyan Coast, traditional restrictions on fishing grounds have largely fallen into abeyance, although they are still reported to exist on the south coast (McClanahan *et al.* 2005b). Their role has been taken by the marine parks and marine reserves. Integrated Coastal Management is still in its infancy. The Marine Protected Areas have posed effective restrictions on fishing grounds and were often mentioned by fishers at nearby sites. However, they also had distinct disadvantages for the fishers and often occupied good fishing grounds. The fishers thus showed considerable resentment towards these authorities (Versleijen & Hoorweg 2008).

The majority of fishers used nets with approved mesh sizes and hook and line (including long lines). Traditional equipment (such as traps and fences) has become less popular with time (Glaesel 1997) and was used by only 10% of fishers. Generally, methods, which involve walking or standing on the shallow reef crest, turning over rocks and dragging gear over the reef or sea bottom are destructive. This leads to a loss of diversity in the benthic substrate, resulting in fewer places for concealment and less habitat diversity for fish species. Gear that is destructive includes spear guns, beach seines and other nets with very small mesh sizes. Nets with small mesh sizes are particularly harmful as they capture non-targeted species and juveniles of the targeted species. Although these methods are illegal, 15% of fishers, mainly from Mijikenda

origin, reported using them, but the true figure was probably higher (recently McClanahan, Maina & Davies [2005a] reported a much higher figure).

Frequency of fishing differed greatly and there were differences in the duration of the fishing season and the number of weekly trips made. Fishing was divided into a high season of about 5.5 months and a low season of about 4 months, which left about 2 to 3 months without fishing (generally the height of the *kusi* season). The term 'high' season was ambiguous and this probably contributed to the large variation that was found. The high season is most commonly referred to as the season with the largest catches and this may differ for fishers depending on their specialization. The high season can also be defined as the season with the highest prices and for popular species this can be the time when catches are low, and demand-supply interaction can affect this definition. The average number of annual trips was estimated at more than 300.

Further analysis focused on four indicators, one for each of the selected features: willingness to stop fishing, inshore fishing grounds, destructive gear and annual number of trips. There was no significant relationship between earner diversification and any of the fishing practices. The reason may well be that income in rural households is in general not pooled and not under the direct control of the fisher himself. The income of other household members, therefore, offered the fishers little incentive to alter their dependence on fishing and to change their fishing practices. However, activity diversification (fishers who reported more than one economic activity) correlated positively with two of the four selected practices: use of destructive gear and inshore fishing grounds. Fishers with multiple activities less often went on (long) trips outside the reef , presumably because they had work commitments onshore. They also reported using destructive gear more often, probably because they had less time than that needed for regular boat trips. Fishers with multiple activities were slightly less willing to stop fishing for alternative employment probably because they already had alternative employment and were used to combining this with an income from fishing.

Conclusion

Neither earner nor activity diversification provided fishers with the feeling that their fishing incomes had become any less important for survival. Instead, what emerged was that fishers with multiple income-generating activities fished in a smaller area of water, used destructive gear more often and did not show any more willingness to stop fishing

for alternative employment.

The results can be interpreted in different ways. It is likely that fishers who take up additional economic activities need to stay inshore and are tempted to use illegal gear. However, it may also be the case that fishers who are active inshore and fishers who use illegal gear tend to take up additional employment more often, although this is a less likely scenario. It can also be speculated that the catches of inshore fishers are insufficient and this forces the fishers to find other work. Alternatively, fishers with only a fishing income need to travel far out to sea to realize a sufficient income. But this overlooks the issue of 'new' fishers who do not have the equipment or the experience needed for offshore fishing and who lack knowledge of the traditional dos and don'ts. Whatever the correct interpretation may be, activity diversification of fishers correlated with more destructive fishing practices. This is not only contrary to expectations but also lowers the positive environmental effects one might expect from policy initiatives aimed at generating employment opportunities.

Woodhouse (2002) postulated that diversification at the level of an individual's activity is likely to provide the advantage of flexibility in a context of risk. In this case, fishers with activity diversification indeed showed adjustments to changing circumstances. However, Woodhouse also claims that diversification at the level of household not only has the advantage of flexibility but also offers the possibility of specialization for individual household members. In the case of earner diversification, fishers indeed appeared to behave in this way and were not showing any signs of changing their fishing practices.

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Map 1 Map of the Kenya Coast showing study locations