

***THE SOCIAL AND ECONOMIC
DIMENSIONS OF DESTRUCTIVE
FISHING ACTIVITIES IN THE
SOUTH COAST OF KENYA***

BY

Fridah Munyi

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ABSTRACT

The social and economic dimensions of destructive fishing activities were studied in the multi-gear fishery of the southern Kenya coast. The objectives were to determine causes and effects of destructive fishing activities, the extent of occurrence of these activities, the social and economic factors that explain the continued existence of destructive fishing techniques, and the measures to deter the destructive fishing practices in the area. Fishing gears identified to be destructive in order of abundance were beach seines which are used by 29% of the respondents, spearguns which are used by 32%, ringnets which are used by 5%, small mesh size nets used by 3%, small mesh size basket traps used by 1%, explosives and fishing poison especially traditional plant poison.

It was found out that 70% of the respondents use destructive fishing methods. 49% of those who use destructive fishing techniques were the migrant fishermen. In terms of age characteristics, 48% of those who use destructive fishing techniques are aged 18-35 years, 17% are aged 36-53 years and 5% are aged 54-71 years.

Major driving forces for the use of destructive fishing methods are; perceived efficiency of destructive gears, availability of cheap but destructive gears in the market, the influence of migrant fishermen and their "I don't care" attitude, age of a fisherman with destructive gears being dominated by younger fishermen, declining catches and desperation among the fishermen, passive acceptance of some destructive gears at localized levels and low levels of education among the fishermen. Some of the destructive gears lead to excessive bycatch and juvenile wastage thus threatening sustainability. In addition, dynamite fishing causes serious damage to coral reef habitat with long term impacts.

This study therefore proposes the need to strengthen enforcement of existing regulations and empowerment of local communities to effectively participate in the management of fisheries to boost compliance. The study also proposes the need to tackle the supply of destructive fishing gears at their sources and the sale of these gears should be banned in the Kenyan market.

ABBREVIATIONS AND ACRONYMS

BMU	Beach Management Unit
cm	Centimeters
DFMs	Destructive Fishing Methods
KWS	Kenya Wildlife Service
KMFRI	Kenya Marine and Fisheries Research Institute
kg	Kilogram
Kshs	Kenya Shillings
Km ²	Square kilometre
m	metre
MPAs	Marine Protected Areas
NEM	North East Monsoon
SEM	South East Monsoon
UNEP	United Nations Environment Program
US\$	United States Dollar

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1.0 INTRODUCTION

Fishing plays a critical role in the provision of livelihood and income to the coastal dwellers in Kenya. The problem of destructive fishing practices has remained a major concern (Kazungu et al, 2001) since elimination of these practices has not been easy despite efforts that are being put by the Government. For example, Ochiwo (2004) observed that the use of beach seines (*'juiya'*), spear guns (*'bunduki'*) and poisonous plant concoctions (*'sumu'*) have been banned but they still exist. In some cases these destructive fishing practices have led to conflicts between those who engage in them and those who are concerned with the sustainability of the fisheries. The indigenous elderly fishermen are more conscious about the destruction caused by these methods to the fishing environment and have time and again raised their concerns and frustrations. Those who are involved in destructive fishing practices on the other hand are only concerned with immediate short term gains at the expense of sustainability of the fisheries resources. The use of the spearguns in the coral reefs and ring-nets in the shallow inshore/lagoonal waters are rapidly spreading in Gazi, Msambweni, and Vanga.

Understanding the factors that influence gear use is vital in determining the interaction between social and ecological change as argued by Stergiou et al. (1996) and Glaesel (2000). Dynamite, small-mesh nets and nets that are dragged over the seabed, although illegal in many countries, are still used and cause widespread physical damage as well as removing or killing immature fish and other species of no commercial value (Wilkinson, 2004).

1.1 LITERATURE REVIEW

Most coastal communities around the world face a growing degree of insecurity as a result of poverty and high dependence upon natural resources. This vulnerability is often compounded by declining resources, high population growth, limited alternative livelihoods, limited access to land, economic and political marginalisation, unsustainable land use practices and development, competition and conflicts over natural resources (Pomeroy and Rivera-Guieb, 2006).

Livelihood strategies of coastal communities have been identified to be full time, part time, seasonal or migratory associated with either a commercial or subsistence orientation. Occupational diversity is not dependent on a single resource but on a whole ecosystem, marine and terrestrial occasionally accompanied with illegal activities such as dynamite fishing, smuggling or poaching inside MPAs. Many coastal communities undertake a range of activities in order to cope financially and reduce the risks associated with high economic dependency on natural resources.

A number of studies have identified the fact that destructive fishing activities are a problem not only in Kenya but in the entire Western Indian Ocean region. For example, Richmond (2002) has noted that rapid population growth and urbanization experienced in the Western Indian Ocean have led to increased pressure on traditional inshore fishery resources. In addition, destructive practices have resulted in the degradation of large areas of formerly productive coral reef ecosystems.

Different authors have identified different destructive fishing techniques. These include the use of fishing poisons that is an ancient fishing method which is effective in rock pools and small, semi-enclosed areas. Traditionally, extracts from the bark or roots of a number of local plants are prepared and poured into the water. The suffocating effects eventually result in the fish floating belly-up on the surface, where they are collected. Because poisons are indiscriminate, corals and many other benthic organisms may be severely damaged. Often these organisms and small fish, which are not desired, are much more vulnerable to the effects of poisons than the target fish (Ochiewo, 2004). The use of small mesh-size nets is also widespread due to its perceived effectiveness in catching juvenile fish. However, despite its use being illegal, the existing laws are not effectively enforced (Richmond, 2002).

Beach seines are also used widely despite being banned in many places (Ochiewo, 2004). The beach seines causes direct physical damage to the coral reef substratum (Carpenter and Alcala, 1977, and Gomez et al, 1987). The other destructive fishing gear is spears-guns which are mainly used by snorkellers and in some places scuba divers (Ochiewo, 2004) to catch slower moving species around coral reefs. It is widely used in Diani, Msambweni, Shimoni and Vanga and if left uncontrolled, its use around coral reefs has the potential to rapidly deplete local stocks of certain species of larger fish for example parrot-fish and triggerfish, resulting in a dramatic change in species composition on the coral reefs.

Overexploitation of the inshore and reef artisanal fisheries, including the non-selective and destructive practices of dynamite fishing, purse-seining and drag-netting, is a serious issue. Main challenges facing the sustainable use of coastal and marine resources are the loss of natural habitat and biodiversity and the consequent loss of any opportunity of exploitation of renewable living resources (UNEP/GPA and WIOMSA, 2004).

The Western Indian Ocean, compared to the other oceans, is not particularly productive with respect to fisheries. Approximately three million tones of fish, crustaceans and mollusks are caught in the Western Indian Ocean each year (Ngoile and Linden, 1998).The fisheries productivity is further reduced by the use of destructive practices and habitat destruction, particularly that of coral reefs. The countries of the Western Indian Ocean on the other hand have high marine biological diversity with unique habitats and ecosystems. Moreover, the region has the largest number of commercial fish species in the world because of the existence of these highly productive ecosystems. However, besides all these positive aspects regarding this region, habitat degradation and overexploitation of marine resources is today creating a large threat to marine biodiversity than at any other time in the history of our planet(UNEP, 2007).

Ray (1968) indicated that the cumulative effect of destructive fishing practices, primarily seine nets and dynamite, would render the fishing resources of Tanga non-productive within a decade.

The economic and ecological pressures on Tanzania's coastline are already great and yet continue to increase as a result of population growth and continued demands for economic development. Destructive practices, such as dynamite fishing have led to declining fish stocks (Torell et al, 2004).

In Tanzania fishing efforts is believed to have doubled in <20 years (McClanahan and Shafir, 1999), and destructive methods are commonplace (Jiddawi, 1997).Although surveillance is

conducted on a regular basis where illegal fishers are either fined or have their gear and boats confiscated, violations still occur (Kamukuru et al, 2004).

Lack of education, and in particular, lack of environmental awareness have no doubt led to the inappropriate use of the environment through destructive fishing practices and excessive mangrove cutting (Wagner et al, 1999).

However, there is concern over the rising problem of over-exploitation and the subsequent depletion of fish stocks in the coral reef. Interestingly, it has been reported in other studies that artisanal fish production in many developing countries is suffering 'Malthusian over fishing', whereby fishermen are driven by desperation to the use of destructive harvesting technologies. At the Kenyan coast where about 61% of the people living in rural areas are poor, artisanal fishermen tend to use effective but destructive fishing techniques, such as fine mesh-size nets that catch large quantities of juvenile fish, thereby threatening sustainability; beach seines that destroy the seabed and are associated with the by catch problem; dynamite that destroy fish habitats, traditional concoctions of poison that kill both fish and other organisms; and spear guns that destroy the coral environment (Ochiewo, 2004).

Excessive and destructive fishing in Kenya has been described as one of the major problems facing the reefs (McClanahan and Shafir, 1999; McClanahan and Obura, 1995).

Whereas it is already established that some human activities such as the extraction of beach sand for construction contribute to the problem of coastal erosion (Nyandwi, 1996), it has remained a strong speculation that destruction of coral reefs through dynamite fishing accelerates shoreline erosion.

Among the gears, beach seine cause the highest damage to fish and habitats and have the potential to over fish the reefs. Low cost gears were associated with highest environmental damage indicating that the need for cheap gears drives fishers to using more damaging gears. For example in Tanzania by far the most destructive type of fishing is dynamiting, which has been practiced since the 1960s (Wagner, 2004). Fishing with dynamite is also a common practice in the Comoros despite awareness campaigns; thus threatening coastal ecosystems (UNEP/GPA and WIOMSA, 2004).

The coastal and marine environment is increasingly being subjected to wide range of natural anthropogenic disturbances. The natural processes include coral bleaching and floods, while anthropogenic activities include destructive or improper fishing methods, overfishing, pollution, coral mining et cetera. These disturbances are exacerbated by rapidly increasing coastal populations and widespread poverty.

In Kenya the lack of effective management, by both formal and informal institutions, and the high dependence on these resources have been identified by fisheries stakeholders as important contributors to poverty in coastal communities. The prevalence of destructive fishing gear, small meshed nets, coupled with growing numbers of fishers, are key management issues to tackle.(UNEP, 2007).

1.2 OBJECTIVES OF THE STUDY

The main objective of the study is to determine the causes and effects of destructive fishing practices in the South Coast of Kenya.

1.2.1 Specific Objectives

The specific objectives of the study are to:-

1. Establish the extent of occurrence of destructive fishing practices.
2. Assess the social and economic factors that explain the continued existence of destructive fishing techniques in the area.
3. Determine the effects of destructive fishing practices on the fisheries of Gazi, Shimoni, and Vanga.
4. Suggest measures to deter destructive fishing in the area.

1.3 JUSTIFICATION

Comparative studies of areas of the seabed that mostly experience different levels of fishing activity demonstrate that chronic fishing disturbance leads to the removal of high-biomass species that are composed mostly of emergent seabed organisms. These organisms increase topographic complexity of seabed and have been known to shelter juvenile fishes, reducing their vulnerability to predation (Collie et al, 1997). Since artisanal fishing which contributes about 90% of all the marine fish landed in Kenya takes place in the fragile coral reef areas, it is important to note that destructive fishing activities pose serious threat to this habitat.

Apart from the fact that artisanal fishing takes place in the coral reefs, it is also known that corals perform several important functions like providing substrata for primary production, habitats for invertebrates and fishes, and often play a key role in protecting coasts from exposure and erosion. These important functions are threatened by destructive fishing activities such as boat seining, beach seining, spear-gunning and use of explosives which continuously destroy corals at an alarming rate thereby impacting negatively on coral reef fisheries. According to Kaiser et al, (1996) the destructive fishing techniques especially blast fishing are highly unselective killing post larva and juvenile fishes. The young fishes would be about to recruit to the reef habitat and repeated effect of blast fishing on a large scale reduce fish production from the reef.

Destructive fishing activities also lead to shifts in community structure that don't revert to the original condition upon the cessation of fishing pressure. From a recent observation, it was noted that there had been an increase in local migration especially among the fishermen living in the proposed study area namely Shimoni, Vanga, and Gazi. All this was brought about by the need to improve catch as fishermen search for better fishing grounds but when explosives are used, fish tends to relocate and the fishermen have to continue traveling long distance in an effort to maximize their catch.

In order to develop appropriate interventions to curb the problem of destructive fishing practices in the Kenyan coastal waters, this study therefore explored the causes and effects of destructive fishing activities so that interventions could be linked to the causes.

2.0 MATERIALS AND METHODS

2.1 Study area

The study was conducted at Gazi bay, Shimoni, Vanga and extended to Majoreni in the south coast of Kenya. Gazi is situated about 50 km south of Mombasa. Gazi village has a resident population of about 900 people and most of them have strong economic and cultural ties with the coastal and marine resources, which they depend on since they are fishermen, mangrove cutters and coral collectors among others (Daoudouh-Guebas et al, 2000). Shimoni on the other hand is a fishing village located on the Pemba channel and has experienced the influence of tourism. Vanga is a typical rural fishing settlement located at the southern end of the coast of Kenya. The map below shows the location of these five fishing villages.

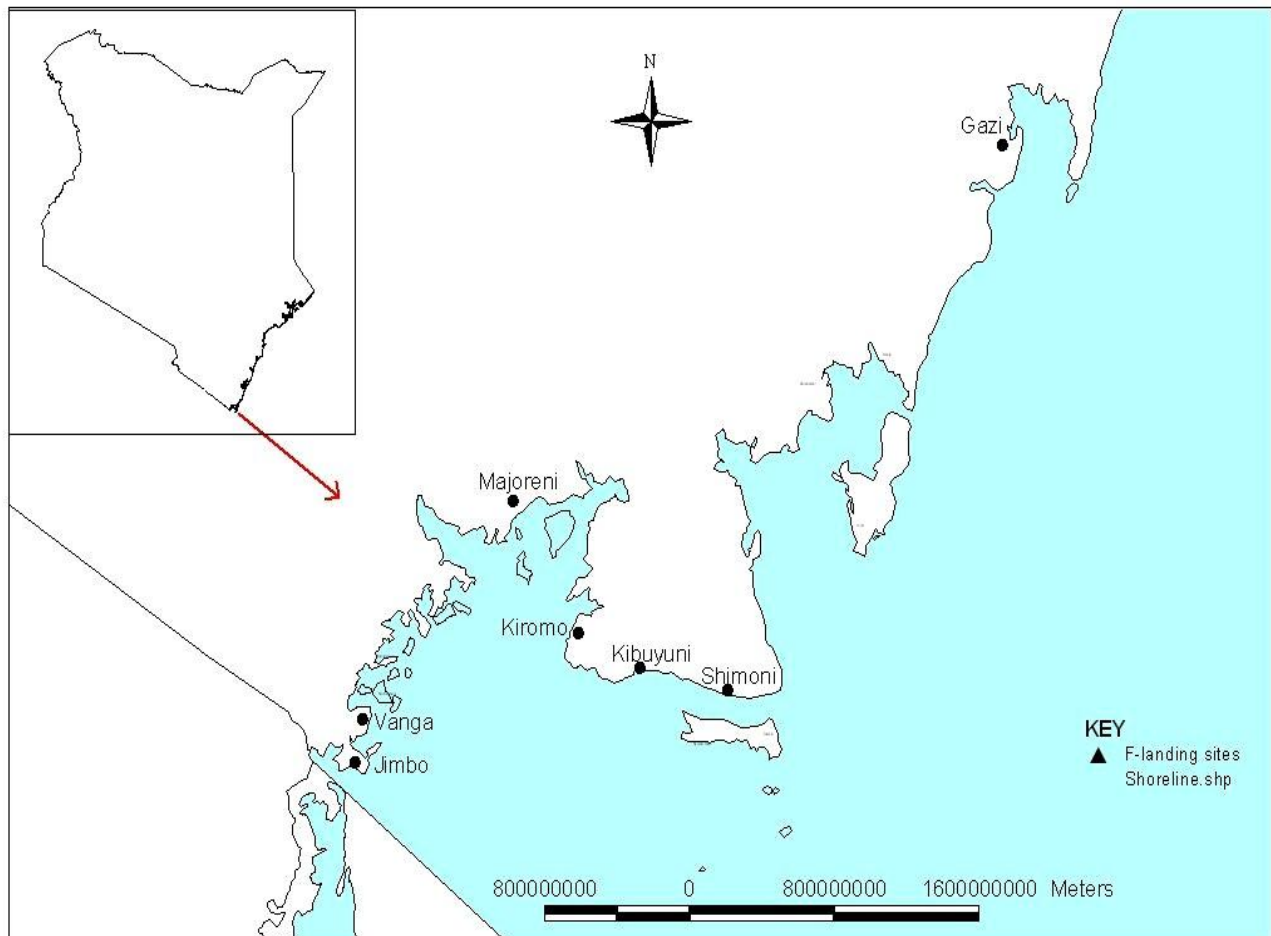


Fig. 1 Map of the Kenyan Coast showing the study sites

Data Collection

Data was collected over a period of one year and four months (July 2007 – October 2008) at Gazi bay, Shimoni, Vanga and extended to Majoreni and Msambweni. Data was collected during the north east monsoon season (NEM) and the south east monsoon season (SEM) to assess whether the use of gears changed with seasons. Primary data was collected using direct observation, semi structured interviews, key-informant interviews, focus group discussions. Direct observation was used by the research team to watch and record the fishing gears that were used by the fishermen and the events that took place in the surrounding. The research team consisted of the lead researcher and three research assistants. The research team was guided around the fishing areas by field guides who are residents of these areas. The direct observation provided first hand information about the type of fishing gears used in the artisanal fishery of the Kenyan south coast. Semi structured interviews were conducted using open-ended questions to generate qualitative information on specific issues related to the use of various types of fishing gears as well as the demographic characteristics of the fishermen. Key-informant interviews were used in obtaining information and data from officials in their respective villages. Focus group interviews on the other hand, involved groups of fishers who used different fishing gears as well as traders/fishmongers who were buying fish at the landing beaches. Using this method, the research team was able to probe respondents in order to obtain in-depth understanding of why people use particular fishing gears and not others. The team used knowledge gained to focus the interviews on particular topics and to ensure that appropriate participants were involved. The data was collected using both Kiswahili and English depending on the language that each respondent was conversant with.

2.2 DATA ANALYSIS

The data has been coded and descriptive analysis performed using Ms Excel and Statistical Package for Social Scientists (SPSS). Descriptive analysis was carried out hence giving comparison of frequency of cases found in the various categories of one variable across the different categories of another variable. Information from cross tabulation of the different categories was presented in form of tables.

3.0 RESULTS AND DISCUSSION

3.1 Demographic characteristics of the Fishermen

Majority (89%) of the fishermen who have been interviewed are youthful and the middle aged (18-55years) who constitute the economically active age in Kenya, while 11% are elderly (over 54 years old). Regarding the level of education, majority of the respondents (84%) comprised of those who had attained either primary education or no education at all (see table 1) thus explaining the low levels of awareness on the impacts of destructive fishing. Even in areas where people are aware of the impacts of destructive fishing, the low education levels contribute to the increasing dependency on destructive fishing methods since people lack alternative income earning opportunities and there is a tendency by the fishermen to continue using the gears which they are used to even if they are destructive. On the other hand, analysis shows that majority (75.2%) of the fisher folks are married while those who are single constitute 11.6% of those interviewed.

Table 1: Educational levels Vs Destructive fishing methods prevalence

		GAZI	MAJORENI	MSAMBWENI	SHIMONI	VANGA	
Education Level	None	9.9%	4.1%	4.1%	2.5%	9.9%	30.6%
	Primary	10.7%	5.0%	10.7%	10.7%	16.5%	53.7%
	Secondary	.8%	.8%	.8%	4.1%	1.7%	8.3%
	Other	4.1%	1.7%	.8%		.8%	7.4%
	TOTAL	25.6%	11.6%	16.5%	17.4%	28.9%	100.0%

3.1.2 Identification of destructive fishing methods

From semi-structured interviews and focus group discussions, the following fishing gears were identified to be destructive:

- Ringnets
- Beach seines (locally known as *buruta or juiya*)
- Spearguns (locally known as *bunduki*)
- Fishing poison especially traditional plant poison (locally known as *utupa*)
- Explosives
- Small mesh size nets (mosquito nets)
- Small mesh size basket traps

These destructive gears affect the marine ecosystem directly when in contact with for example the reef substratum or indirectly by altering the relationship between those communities of plants, invertebrates and fishes that determine rates of reef accretion and bio-erosion.

3.1.3 DESCRIPTION OF THE VARIOUS DESTRUCTIVE FISHING GEARS

3.1.3.1 RINGNET

This is a conical shaped fishing net, with floaters attached at intervals along the edge to keep it floating (see plates 1a and 1b); it has two sets of ropes tied on the top and bottom, pulled by the fishers from the boat or a pair of boats hence forming a ring like shape. Ring-net is used in deep sea to target migratory species in shoals. Because of its size, ring net is designed for use in the deep waters beyond the coral reef. Whenever it is used close to the reef, it has always generated conflicts.



Plate 1a. Ringnet being dried at Vanga



Plate 1b: Ringnet in a boat at Vanga

3.1.3.2 BEACH SEINE NETS

Beach seine is a long net with floats and weights designed for use in the inshore waters adjacent to the beach (see plate 2). It is locally known as *buruta* or *juiya*. It is usually laid in a semi-circle out from the beach, around a shoal of fish and then back to the beach. It is then pulled on both sides back to the beach. Since it is a long net, it is often pulled by 16 to 20 fishers at a time. The fact that it is dragged on the sea bed causes direct physical damage to the reef substratum (Carpenter and Alcala, 1977; Gomez et al, 1987) and by-catch hence its use discouraged in the Kenyan coastal waters.



Plate 2. Beachseine at Gazi

3.1.3.3 SPEAR GUN

Spear gun is a rudimentary gun made from wood with sharpened metal rod, and a mask consisting of window glass with metal and rubber (see plate 3 below). It is locally known as *bunduki* or *mdeti* and is more popular among the young fishermen compared to the elderly fishermen since it is mainly used by snorkellers and in some places scuba divers, to catch slow moving fish species around coral reefs. Its use is restricted to shallow reef areas and seagrass beds. It is widely used in Shimoni and Vanga and there is concern that if it is not controlled, its use around coral reefs has the potential to rapidly deplete local stocks of certain species of larger fish e.g. parrotfish and triggerfish, and this may result in a dramatic change in species composition on the reefs. Most of the fishermen who use it have defended its use saying it is the most selecting gear, a position also held by some scientists. The spear gun fishers hold the view that those who advocate for its banning are their enemies who are out to curtail their livelihood.



Plate 3. Elastic powered speargun

3.1.3.4 FISHING POISONS

It is an ancient fishing method which is effective in rock pools and small, semi-enclosed areas. Traditionally, extracts from the bark or roots of a number of local plants (e.g. *Derris* spp.) are prepared and poured into the water. Locally it is known as *utupa*. The suffocating effects eventually result in the fish floating belly-up on the surface, where they are collected by hand. Because poisons are indiscriminate, corals and many other benthic organisms may be severely damaged. Often these organisms and small fish, which are not desired, are wasted and the sustainability of the fishery is questionable. The use of poison is illegal in Kenya but unscrupulous fishermen still use it in hiding. The fish caught by the use of poison decomposes very fast and is often lost before it can be sold. In addition, such fish has always caused sickness when consumed.

3.1.3.5 DYNAMITES

Dynamite is used by unscrupulous fishermen to blast coral reefs and other shallow areas to stun fish, which are then collected from the surface or shallow waters. Because it explodes like a bomb, it is locally known as *bomu*. Its explosion is highly damaging to the benthic communities and branching corals. It converts hundreds of years of coral growth into broken rubble in a second. In addition, this method is indiscriminate and wasteful, killing fish which are not desired or cannot be collected because they drift away with the current. In Kenya, the use of dynamite is banned but the unscrupulous fishermen still use it through a hide and seek game.

3.1.3.6 UNDERSIZED NETS

The use of undersize fishing nets (*kimia*) (see plate 4) is a common practice among the artisanal fishermen. The undersize nets are indiscriminate and have a high effectiveness in catching juveniles. However, the use of undersize nets is illegal in Kenya. It has however been very difficult to enforce the law effectively since there are certain fisheries such as *simsim* and prawns that require the use of fine mesh-size nets (Richmond, 1997).



Plate 4. Undersize net

3.1.3.7 SMALL MESH SIZE BASKET TRAPS

Basket traps (*lema*) are hexagonal traps with a funnel entrance (from 15-20 cm in diameter) and are hand made from fronds or other pliable woods (Glaesel, 1997) (see plate 5 and 6).



Plate 5. Basket trap at Kibuyuni

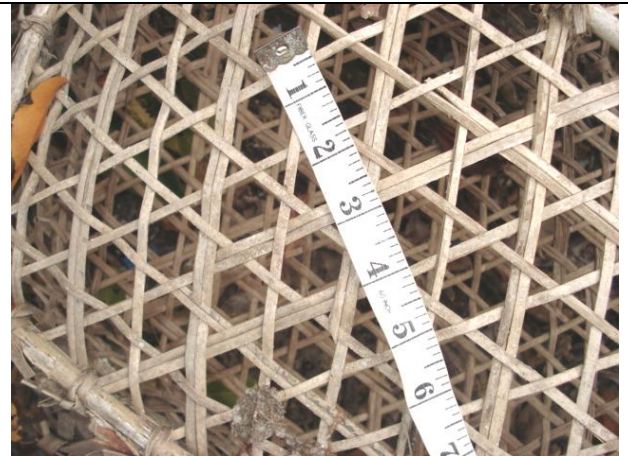


Plate 6. Basket trap mesh size (<2inches)

The basket traps vary in sizes from 50cm width to 2 meters width. They are set on the seabed and weighed with stones. Quite often they are left to stay over night and are recovered the following day during low tide. Smaller traps are used in shallow areas whereas larger traps are laid near breaks in the reefs at up to 30m (Glaesel, 1997). Basket traps are baited with terrebralia, seaweeds, urchins or trash fish, and usually set in seagrass beds or channels in the reef and mangroves. The use of basket traps is dominated by the elderly fishermen who inherited the technology from their predecessors. Many of the elderly fishermen make their own basket traps while some of them buy the traps from the professional trap weavers.

3.1.4 Gear prices and distribution in the study sites

Table 2: Gear Prices in KShs

Site	Destructive fishing gears			Non destructive fishing gears		
	Ring net	Beach seine	Speargun	Hook and line	Basket trap	Net
Vanga	35,507	20,538	682	57	750	25,000
Majoreni		16,522	500	0	275	
Shimoni		21,000	728	133		11,765
Gazi		24,094	515	663		19,050
Msambweni	30,000		225	242	925	15,800
Average price	32,754	20,538	530	212	650	17,904
Min	27,500	1,600	37.5	30	200	2,500
Max	41,210	100,000	3000	1,050	1,200	60,000

From the table 2 above, hook and line were the cheapest gear type with a average price of Kshs.212. Ring net is the most expensive fishing gear with an average price of Kshs.32,754 per piece and a number of pieces are required to be joined together to make a complete ring net. It is also evident that the non-destructive gears are generally cheaper than the destructive gears. Among the destructive gears, spearguns are the cheapest. This explains why the young fishermen opt to use it. The use of beach seines is widespread despite its high cost because beach seines came into the Kenyan waters much earlier and are normally purchased by entrepreneurs who in turn engage the fishermen to provide the labour. The fishermen who use beach seines are therefore labourers who work for entrepreneurs who rarely go to fish themselves. The use of ring net is not widespread because it is a relatively new gear in the Kenyan waters and its arrival has met with resistance from the local fishermen. It is amazing that the non-destructive fishing gears which are generally less expensive such as line and hook and basket traps is not popular among the young fishermen.

The use of destructive fishing gear is widespread in the study sites and was mainly driven by poverty that has rendered most fishermen to work as labourers to a few entrepreneurs who own the fishing gears and socio-cultural factors that influence gear choice. In addition, laxity in enforcement of existing regulations and the combination of moderate to high catch rates with minimum investment by the individual fishermen act as incentives for the use of destructive fishing gears in the southern coast of Kenya.

It is however important to note that most of the fishermen that use the destructive fishing gears did not appreciate the impact of these fishing methods on the fishing grounds. In fact most of those who use destructive fishing gears observed that those who are responsible for fisheries surveillance expose them to unnecessary harassment. The Pemba fishermen in particular stated that all fishing methods are okay provided that they can get their daily bread. However, they will accept alternative fishing methods if these are distributed to them in exchange for any fishing gear that is deemed to be illegal.

3.1.5 Extent of occurrence of destructive fishing practices

The prevalence of destructive fishing methods has caused conflicts among the fishermen. This was mostly noted at Vanga where the fishermen from Jimbo beach accused the regulatory authority of allowing the migrant fishers from Pemba to use ring nets with fine mesh sizes (0.45 and 1 inch in mesh size) in the intertidal. When the ring net fishers were asked where they normally fish, they reported the opposite. They categorically explained that ring nets are long, wide and heavy and therefore cannot be used in the intertidal areas. In stead ring nets are used to target migratory schooling stocks which ought to be spotted before a ring net is lowered into the water. On occasions when schooling stocks are not spotted, the fishers are forced to return home without lowering the ring net into the water. Despite the complaints from a cross section of the local fishers, the use of ring net is on-going at Vanga and has extended to Shimoni and Gazi.

The basket trap fishers at Jimbo beach of Vanga have also blamed the use of spearguns for the destruction of their basket traps and have stated that spearguns cause injury to some fish that eventually escape. In fact most of the respondents criticized the use of spearguns stating that even the fish caught using it does not last long in the shelf. This type of fish also has less market compared to fish caught using conventional fishing gears. Spearguns also cause destruction of habitats thus forcing fish to flee from their habitats and results in general decline in fish catch. The

use of dynamite was also reported to be rampant at Mijira fishing ground where its effects included relocation of fish; hence it is a wasteful form of fishing.

At Gazi, the use of beach seine is allowed by the beach management unit (BMU) but the fishermen who use them are required to fish in the deeper sub-tidal areas. However, these fishermen occasionally fish in the shallow lagoon waters especially during the south east monsoon (SEM) thus resulting in conflicts with other fishers. On the other hand at Mkunguni and Munje, traditionally made fishing poison (*Utupa*) was reported to be used mainly during low tide (*maji mavu*) period of moonlight and done at night in hiding.

At Shimoni the most common fishing gears include spearguns (craftguns), hook and line, and hooks that are mainly used for Octopus fishing especially by the young people who make up 53% of the fishermen who use the spearguns. In this area, the traditional craftguns are more abundant compared to the modern spearguns which is more widespread in areas such as Msambweni and Diani. At Shimoni spearguns are mainly used in hiding since the local BMU is against it. Therefore, fishermen who use spearguns are forced to use side routes to escape from the BMU. As a result, the fish caught using this method is not sold at the official fish market (*banda*) but is sold on the sides to fishmongers (*mama karanga*) at much lower prices.

On the other hand, it was noted that in other areas especially at Majoreni, the use of beach seines forms the main fishing technique constituting 72% of the gears used and has therefore been accepted by the local people. The fishermen who use beach seine argue that those who complain about its use are simply jealous of their income.

3.1.6 The social and economic factors that explain the continued existence of destructive fishing techniques in the south coast

From the interview results, a number of economic and social factors that explain the continued existence of destructive fishing practices were identified. These factors include:

i) Perceived relative efficiency of the fishing gear and associated high returns

From field interviews, most of the fishermen who use destructive fishing gears claimed that these gears are more efficient and thus able to land higher catches compared to the more acceptable fishing gears.

Destructive fishing techniques appeared to yield better earnings especially during the North East Monsoon (NEM) season. For example, it was noted that at Gazi each fisherman who uses a beach seine earns an average of KShs.514 (US\$6.85) while one who uses a speargun earns Kshs.860 (US\$11.47) per day during the north east monsoon. On the other hand, those who use basket traps earn an average of KShs.300 (US\$4), hook and line fishers earn Kshs.883(US\$11.77) and net fishers earn Kshs.514(US\$6.85) per person per day during the north east monsoon. During the South East Monsoon (SEM) season, a fisherman who uses a beach seine earns an average of KShs.381 (US\$5.08) while a fisherman who uses a speargun earns Kshs.269 (US\$3.59) per day during the south east monsoon. On the other hand, those who use basket traps earn an average of KShs.150 (US\$2) and net users earn Kshs.173 (US\$2.31) per day during the south east monsoon.

In Vanga the fishermen who use beach seines earn an average of KShs.358 (US\$4.77) per person per day during NEM while those who use spearguns earn KShs. 788(US\$10.51) per person per day during the NEM. This appears to be significantly different from those who use ring nets and earn KShs.1545 (US\$20.6) per person per day during the NEM. Fishermen who use basket traps earn Kshs.363 (US\$4.84), net fishers earn Kshs.467 (US\$6.23) and hook and line fishers earn Kshs.1025 (US\$13.67) per person per day during the NEM season. Fishermen using beach seines earn an average of KShs.138 (US\$1.84) per day during SEM while those who use spearguns earn KShs. 263(US\$3.51) per day during the SEM while those who use ring nets earn KShs.417 (US\$5.56) per day during the SEM. The fishermen who use nets earn Kshs.225 (US\$3) and hook and line fishers earn Kshs.175 (US\$2.33) person per day during the SEM season.

At Shimoni a fisherman who uses a speargun earns an average of KShs.803 (US\$10.71) and beach seine fishers earn Kshs.425 (US\$5.67) per person per day during NEM. Those who use hook and lines earn an average of KShs.660 (US\$8.8) and those using nets earn KShs.333 (US\$4.44) per person per day during NEM. During the SEM season fishermen who use spearguns earn an average of KShs. 325(US\$4.33) and beach seine fishers earn Kshs.300 (US\$4) per person per day, while those using hook and lines earn an average of KShs.242 (US\$3.23) per person day. From this it appears that the fishermen who use spearguns earn higher daily income at Shimoni compared to those who use hook and lines.

Fishermen in Majoreni using beach seines earn Kshs.419 (US\$5.59) per person per day during NEM while those who use basket traps earn an average of KShs.413 (US\$5.51) and net earn Kshs.600(US\$8) per person per day during the north east monsoon. During the South East Monsoon (SEM) season, fishermen using beach seines earns an average of KShs.306 (US\$4.08) per person per day during the south east monsoon.

ii) Availability of cheap but destructive fishing gears in the market

It was noted that some of the destructive fishing gears such as spearguns/craftguns, small mesh size nets, etc are more readily available in the market and therefore fishermen can access them without any complications. In addition, these gears are cheaper compared to the conventional fishing gears thus many fishermen prefer to purchase them in stead of the relatively expensive conventional gears. In most of the sites visited, it was noted that it is difficult for most fishermen to adopt alternative legal fishing gears as many of them have a low propensity to save.

iii) Migrant fishers and perceptions towards sustainable utilization

It was also observed that the use of destructive fishing methods is more common among the migrant fishers and is less common among the local resident fishermen who have a lot of attachment to their traditional fishing grounds. The migrant fishermen accounted for about 49% of those that use destructive fishing methods while the local resident fishermen accounted for 21%. Most migrant fishermen appeared to be less concerned with the negative changes that the use of destructive fishing techniques may cause to the fishing grounds in the long run. It was also established that most of the migrant fishermen were actually employed by an investor who owns the fishing boats and gears and were thus more interested in the quantity of fish landed and not the state of the fishing ground. To them a bigger catch means higher income and they do not care about the impacts of their activities on the fishing ground. After all, once a particular fishing

ground is degraded, the migrant fishermen are aware that they would simply move to another place. Therefore, once the stocks of fish appear to be declining, they take off to another place.

iv) Age of the fisherman

Age of a fisherman is a significant factor in choice of a fishing gear. There was evidence that the youth dominated the use of beachseines and spearguns. These are gears that require a lot of energy and the elderly fishermen definitely avoid them. On the other hand majority of the elderly fishermen concentrated on use of basket traps which they weaved by themselves making it cheap to acquire and require less fishing effort.

v) Declining catches due to increased number of fishermen

At Gazi, fishermen identified the increase in the number of fishers as one of the leading causes of the decline in fish catches. The decline in catches has resulted in economic desperation among the fishermen who time and again have complained of dwindling stocks. Some of the fishermen are therefore forced to use undersize nets or other forms of fishing methods that are destructive to the habitat for they can maximize their catch as they compete for the dwindling fish stocks even if it means compromising sustainability.

vi) Passive acceptance of destructive fishing gears at localized levels

Passive acceptance of destructive fishing gears by some of the officers who represent the regulatory authority in some sites has also contributed to the continued use and increase of the destructive fishing gears especially in places like Vanga and Majoreni. It is especially more complicated when the officers who are posted by the regulatory authority are originally from these areas since it is difficult for an officer to stop his uncle or cousin from using a fishing gear that he has been used to. This has mainly been the case at Majoreni. In addition, political influence was also sited at Majoreni to be a very important factor explaining the continued existence of beach seines in the area. When the officer concerned confiscates a beach seine then a local member of parliament comes in to protest at this arguing that it is his supporters who are being targeted while this is not the case. In addition, the Beach Management Units (BMUs) that were formed to help in managing fisheries sometimes lack adequate representation of fishermen in the committees and the composition of their offices. It also happens that some of the beach seines and spearguns are used and owned by some of the BMU officials. This makes eradication of these gears very complicated. The rent seeking behavior of some officials also promotes continued existence of these gears.

Furthermore it occurred that the use of some of the destructive fishing methods could not be eradicated as the numbers of those who use them have increased and surpassed the number of those fishermen who vote against their use in the area. For example the fishermen who use basket traps urged that speargun fishers have outnumbered them especially during casting of votes to curb speargunning hence a reason for there continued use.

vii) Low educational levels and lack of alternative livelihoods

In some sites such as Majoreni, most dropped out of school to join fishing to start earning income and ended up using destructive fishing gears which through observation they adopted after having been passed on from their parents. Such fishermen stick to these fishing gears because they do not appreciate the impacts of using these gears and they do not have alternative livelihoods.

Humanitarian reasons also explain the continued existence of some fishing gears that are perceived from some fishermen to be destructive. For example, it was pointed out that stopping the use of spearguns will affect the livelihood of many fishermen since many fishermen rely on them for their livelihood.

viii) Availability of market for different sizes of fish

The fish market in Kenya is to date not sensitive to the gear used to catch fish and the size and quality of fish being marketed. The market accepts fish of different sizes and quality and has only differentiated them by prices. Unfortunately, the market for small size fish as well as fish caught by spear guns and other destructive gears is growing so rapidly as poverty levels increase and it is becoming too large that controlling it may be difficult in future. Most sites visited had ready market for juvenile fish caught using beach seines and other undersize nets/basket traps. This has made the small under-size and low quality fish enjoy a strategic niche in the market. The market also has some sellers who serve these two categories of customers without consciously segmenting them (Ochiewo 2004).

3.1.7 Effects of destructive fishing practices on the fisheries of Gazi, Shimoni, and Vanga

Some destructive fishing techniques lead to excessive by-catch and juvenile wastage that threatens sustainability of a fishery. For example, at Vanga, juvenile fish was found discarded in the mangroves after the market was saturated and fishermen could not take them see (Plate 7) below. As the juveniles are wasted, they are not given a chance to breed and recruit into the fishery. Therefore, destructive fishing methods impact not only on the target resource but also on non-target species and the wider aquatic environment.

The use of efficient but destructive fishing techniques result in excessive fishing effort thus resulting in declining fish catches in the long run. From the interviews, about 61% of the fishermen have attributed declining fish catches to the use of destructive fishing gears.

It is worth noting that the use of dynamite in coral reefs results in serious damage to the habitats and the recovery of such a habitat is very slow and may take several decades before a complete recovery is achieved. We also met fishermen who had lost their arms due to the use of dynamite hence we concluded that errors of manipulation of explosives have often led to serious injuries and death of humans.



Plate 7 : A resident sorting discarded juvenile fish at Vanga

3.1.8 Fisheries management regimes and persistence of destructive fishing practices in the coast of Kenya

The fisheries resources in Kenya are managed by the Department of Fisheries. The department however does not have adequate surveillance capacity. For example, it was established that the department has banned the use of a number of destructive fishing gears such as beach seines and small-mesh size nets, but they do not have adequate resources including patrol boats that are needed for surveillance. It was established that only one boat is available at Shimoni and it is meant to serve the entire south coast. This is not practical because one boat cannot serve all the sites where fishing is a major activity. In addition, the department does not have adequate financial resources that could be devoted to fueling the boat. Consequently, it was noted that the boat is always anchored due to limited budgetary allocation for operations. The officials who are posted in the various sites have no means of patrolling their areas of jurisdiction and have to rely on the good will of the fishers. It is therefore important for the department to be empowered with adequate patrol boats and financial resources that could enable them patrol at least the inshore waters where most of the destructive fishing gears are used. In addition, there is need to increase the number of fish scouts and fisheries officers so that they are able to cover most of the fish landing beaches to manage what is landed.

The fisheries resources that fall within the Marine Protected Areas (MPAs) are managed by the Kenya Wildlife Services (KWS) which is responsible for all protected areas in Kenya. The MPAs play a major role in efforts to help restore depleted fish stocks and to protect coastal and marine habitats and biological diversity from the impacts of human activities. The KWS has a marine park (Kisite marine park that is 11km²) in the south coast which is a no take zone. It also has a marine reserve (Mpunguti marine reserve covering 28km²) where minimal fishing is allowed and regulations imposed on types of gears to be used. The gears that are allowed in the marine reserves include: nets with over 2.5” mesh size, hook and line, fence traps, and basket traps. The KWS unlike the Department of Fisheries has adequate resources for surveillance. Consequently, destructive fishing activities are never experienced in the marine protected areas because any offence cannot go unnoticed.

4.0 CONCLUSIONS

Destructive fishing practices are widespread in the south coast of Kenya. These practices have been a major source of conflicts among the fishermen. The main economic and social factors that explain the continued existence of these destructive fishing practices have been identified to include the perceived relative efficiency of some of the destructive fishing gears and associated high returns. This became evident especially when across section of the fishermen who use destructive fishing gears claimed that these gears are more efficient and thus able to land higher catches compared to the more acceptable fishing gears. Furthermore, availability of cheap but destructive fishing gears in the market also contributes to the continued existence of these gears in the Kenyan coastal waters. If a strategy was formulated to eliminate these gears at source or if a ban could be imposed on stocking and sale of some of these gears then their use will be eradicated. It may be better to tackle them both from the supply side as well as the demand side for good results. In addition, low level of awareness on the impacts of destructive fishing practices and an I don't care attitude among across section of the fishers are important factors that contribute to the continued existence of destructive fishing practices. Other socio-economic factors that explain continued existence of these practices include the age of the fisherman. The youth prefer spearguns and beach seines while the elderly fishermen prefer traditional traps and hook and lines. Low level of education, lack of alternative livelihoods and availability of market for different sizes of fish were also identified to be important factors.

In terms of impacts, some fishing gears such as beach seines and small mesh size nets lead to excessive by-catch and juvenile wastage thus threatening sustainability. In addition, dynamite fishing causes serious damage to coral reefs resulting in degradation that lasts for many years. It also causes injuries and death to humans when mishandled.

4.1 Recommendations

The need to control the use of destructive fishing gears has been realized and there is need to strengthen the capacity of the Fisheries Department to conduct surveillance in the inshore waters. Furthermore, there is need to empower the local fishermen (local communities) through seminars and awareness campaigns for them to be effectively involved in the management of fisheries resources through the BMUs that have been established. The BMUs should be strengthened through appropriate training so that they can serve the fishermen effectively. There is also the need to fully adopt and implement the new fisheries policy which aims at creating an enabling environment for a vibrant fishing industry providing optimal and sustainable benefits, alleviating poverty, and creating wealth.

The approach used to fight destructive fishing gears should be improved to make it sensitive to the plight of the fishermen whose gears are taken away. It may be more useful to confiscate the destructive gears and provide the fishermen with the accepted gears so that they are not left without alternative means of fishing.

The need for the Department of Fisheries to have adequate surveillance boats and financial resources cannot be over emphasized. It is important to have adequate surveillance capability to scare away those who may be tempted to use the destructive fishing techniques. It is also important to ensure that officials of the Department of Fisheries are not posted close to their homes because there is evidence that those who are posted close to their homes find it difficult to stop their relatives from using their gears of preference, even if these gears are destructive.

Rent-seeking behavior should be curbed by imposing severe penalties to deter those who are involved. In addition, impromptu spot checks should be carried out by senior officials to establish whether the officials who are on the ground are observing work ethics.

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6.0 FINANCIAL REPORT

Expenditure break-down is given below and the corresponding expenditure receipts and payment vouchers are attached.

<u>ITEM</u>	<u>AMOUNT OF EXPENDITURE</u>	
	<u>KSHS.</u>	<u>US\$</u>
Field Allowance		
Lead Researcher	74240	1160
Research Assistants(2)	75200	1175
Field Guides	10400	162.5
Sub-Total	159840	2497.5
Transportation Costs	42000	656.25
Sub-Total	42000	656.25
Postage Charges	4000	53.3
Sub-Total	4000	53.3
Stationery and Related Expenses		
Toner (printer)	8799	117.32
Toner (photocopier)	3500	46.66
Other Stationary	7585	118.5
Sub-Total	19884	282.48
Total	225724	3489.53