# CURRENT STATUS OF TRAWL FISHERY OF MALINDI – UNGWANA BAY

# EXECUTIVE SUMMARY

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***EXECUTIVE SUMMARY***

The existence of the shallow water penaeid shrimps fishery in the Malindi-Ungwana bay was established during a survey undertaken by various fishing expeditions in the 1960's and 70's. The expeditions were carried out by the Kenya Government with assistance from UNDP and FAO. It was established that a reasonably equipped prawn trawler could land as much as 3 to 4 tones of marketable crustacean per day. Semi-industrial trawlers target the shallow water prawns and land on average around 400 metric tons annually (Anon 2001).

The prawn are restricted to the shallow areas of Malindi-Ungwana bay Semi-industrial prawn trawling has been going on in the area for the last three decades. The number of licensed vessels, licensed by the Fisheries Department has fluctuated between 4 and 20.

Inshore fishery output has been on the decline (Ruwa et al 2001 and McClanahan 1997). The artisanal fishery accounts of the 90% about 10,000 metric tons of the annual total marine fish landed. The catch is mostly made up of the fish families Scaridae, Siganidae, Nemipteridae, Lethrinidae and Lutjanidae. The Malindi-Ungwana Bay is a shared fishing ground with artisanal fishermen and commercial prawn trawlers. Artisanal fishermen have blamed prawn trawlers for the decline citing high levels of bycatch as a key concern and fishing gear destruction. There is a concern from environmentalists that the prawn trawling activities are also causing increased mortalities of sea turtles.

In order to resolve the conflicts and minimize socio-economic problems associated with resource use, a Consultative Meeting of Stakeholders was convened by the Government in Mombasa in February 2001, to deliberate on the issues and identify the causes of conflicts and recommend remedial action. The meeting recommended a closure of the Malindi-Ungwana trawl fishery to commercial fishing and a comprehensive survey of the resources and socio-economic issues. This was aimed at coming up with recommendations on sustainable fishing practices and better resource use.

The key issues raised by the stakeholders, included the need to develop a clear understanding of the impacts of prawn trawling on the fisheries dynamics, determine the abundance and distribution of prawns and fish stocks determine the viability of the prawn fishery within and beyond the 5nm limit and assess the problem of by-catch and its impact on the environment and our fishery. According to the existing Fisheries Act, trawling within 5nm is illegal. However, the criteria for delineating this 5nm no trawl zone is not documented, neither are there supporting studies for the area to provide evidence. The meeting therefore bestowed the responsibility of carrying out the research to Kenya Marine and Fisheries Research Institute. Four fishing vessels were availed by the commercial fishing companies operated by Basta and Sons and East African SeaFood to facilitate data collection. A one year research commenced in May 2001 focussing on the trawl surveys, environmental and socio-economic studies.

**Background on the study area**

Ungwana Bay extend from Ras Ngomeni in the south to Ras Shaka (north of Kipini) in the North Kenya Banks (Figure 1). The perimeter of the bay along the coast is about 100 km. The distance from south to north of the bay is 60 km and the maximum distance seaward is 20 km from the central position of the shoreline. The surface area is estimated at 1,200 $km^2$ making it the largest bay in Kenya. Tana river drains into the bay in its northern part at Kipini. However, there are several small distributaries of the Tana, which also discharge water into the central region of the bay during the rain periods when the flow conditions are high. These include Mto Tana, Sedani and Mto Kilifi. Mto Tana and Sedani also drain large mangrove-fringed estuaries and creeks. Sabaki River discharges into the bay at its southern most limit. The bay is shallow with a wide continental shelf whose extent ranges between 15 and 60 km. The mean depths at high spring tide is 12 m at 1.5 nm and 18.0 m at 6.0 nm. The depth increases rapidly to 100 m after 7 nm. Sediments within the continental shelf are mainly composed of sand and clay/mud.

**RESEARCH FINDINGS**

## *Fisheries*

- Inshore fishery output has been on the decline (Ruwa et al 2001 and McClanahan 1997). A clear decline of finfish fishery is reported adjacent to prawn trawling areas. Increased fishing effort, use of destructive fishing methods, and habitat degradation have contributed to the decline. Bycatch from the prawn trawling consists of high levels of juveniles of commercially important species, on average 25% of the total catch by weight. This in effect compromises the recruitment potential of the fishery. In addition to prawn trawling use of destructive beach seines (Ochiewo pers. Commun.) is continuing. Landing of juvenile fish by the artisanal fishermen is contributing to the threat facing the fishery and holistic mitigation measures are required to remedy the situation. The following measures were recommended:-

    a) Elimination of destructive fishing gears (beach seines etc)
    b) Elimination of fishing and landing of juvenile fish
    c) Demarcation fishing zones for the trawlers to protect the nursery grounds of fish
    d) Development of appropriate Bycatch Reducer Devices to reduce incidental capture of juvenile fish and reduce the quantity of bycatch.

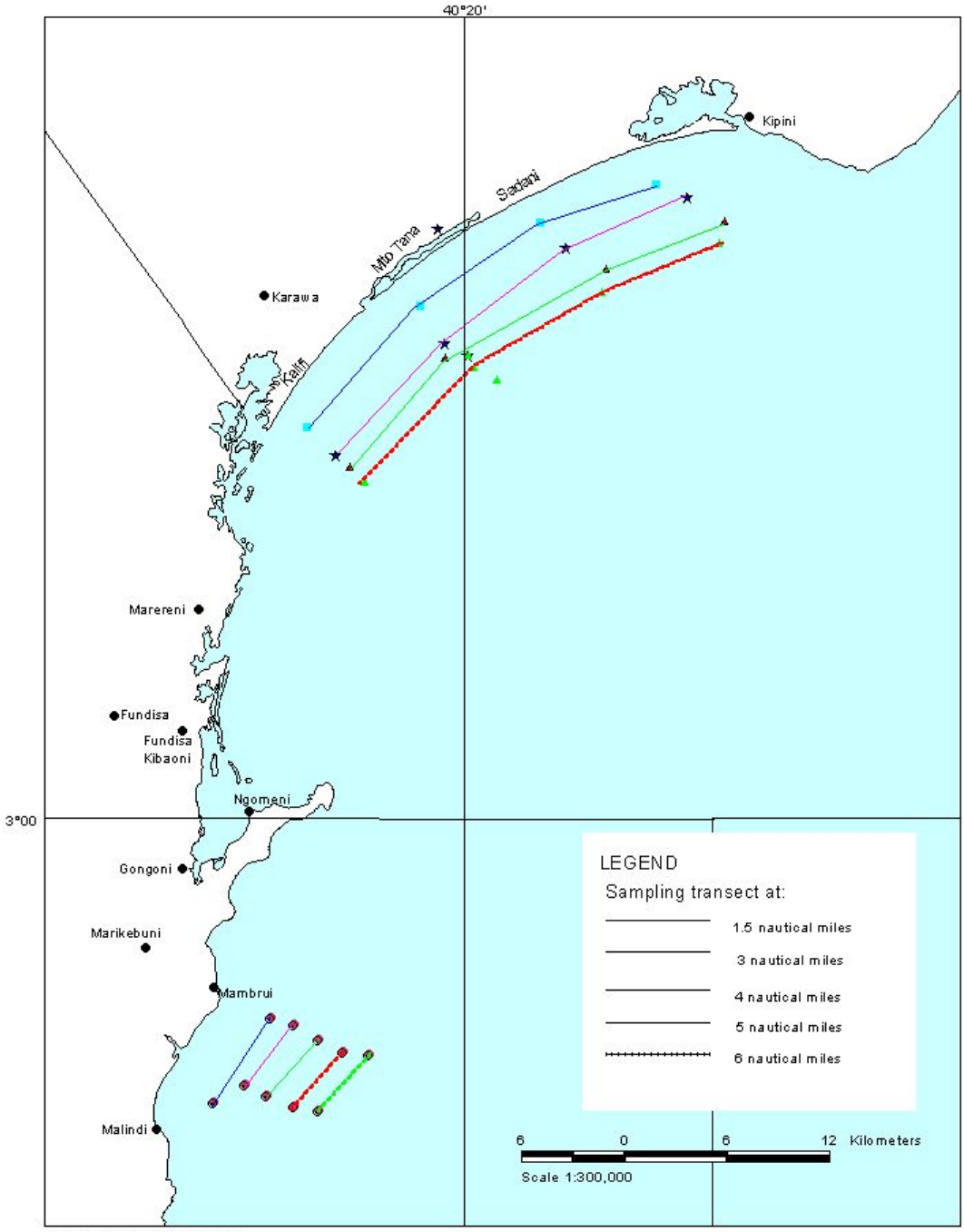


Fig.1. The study area

- Unlike the finfish the prawn fishery shows no clear indication of decline. Prawns are R selected. They have high reproductive potential and are short lived. They are therefore capable of maintaining a relatively good stock despite being faced with the fishing effort witnessed through time. However, we recommend that the effort should be limited to sustainably exploit the prawn resource. The estimated MSY for the Malindi-Ungwana bay prawn fishery is 433 tons per year with a corresponding $F_{msy}$ of 5.5 trawlers. However, we need to apply a precautionary approach when using the calculated MSY and $F_{msy}$ for management due to the fact that monitoring of the prawn catches has been poor and the actual fishing effort has not undergone very substantial changes over the years. Detailed analysis needs to be undertaken to calculate very accurate yields for the fishery. The current fishing effort of 4 trawlers should therefore be maintained in line with the calculated $F_{msy}$ of 5 trawlers. The size and number of gears should also be maintained so that we do not increase the effort indirectly.

**Using a precautionary approach, a maximum of four prawn trawlers was recommended.**

- The results demonstrate that prawn trawlers prefer to fish within 1.5 nautical miles from the shore. This area is very critical for the recruitment of crustacean and fin fish juveniles (Mwaluma, this survey; Mueni & Mwangi 2001). There must be a limitation on how close the trawlers can operate in order to have a refugia for both fish and crustaceans. A distance of 3 nautical miles from the shore was recommended from the study. During this survey, mature breeding prawns (all species) were encountered all year round. High abundance of mature breeding prawns occurred in December, February and March. Trawling should therefore be closed completely during this period to safeguard the stocks. Catches for the deep water shrimps are significantly lower (27 kg/hr) compared to the shallow water shrimps (47kg/hr). Obviously, with the low catches limited deep sea fishing grounds the high levels of prawn yields during the closed season is a clear indication illegal shallow water prawn trawling takes place during the closed season.

**A closed season should be sanctioned from the beginning of November to the end of March to allow for prawn breeding and replenishment of the stocks. Breeding of most fin fishes also occurs during the same proposed closed season (Nzioka 1979, Mwatha 1997 & Kulmiye 1997) and also for lobsters (Kulmiye pers. Comm.). There is need to consider whether any other license should be issued during this period. However, no license should be issued to fish in the shallow water during this period.**

- Prawn biomass reduces with increased distance from the shore. Prawn biomass at 5 nautical miles offshore is statistically different from that at 1.5 nautical miles. There is no significant difference between

catches in the other transects. The catch rate of discards at 1.5 nautical miles from the shore is almost the same as at 5 nautical miles offshore. The same is true for the catch of juveniles of commercially important species. This suggests that the whole bay is an important nursery ground for various fish species. Between 6 and 14 nautical miles offshore the "RV Ujuzi, 1979-1981, estimated the prawns biomass at 0.3 tons/$nm^2$ (Iversen 1984). This survey has estimated the prawn biomass between the coast and 5 nautical to be in the range of 0.38 to 0.87 tons/$nm^2$ at 5 and 2 nautical miles from the shore respectively. The R.V Ujuzi estimated biomass at 5 nautical miles from the shore compares quite well with the estimates of the current survey. Results from offshore surveys between 10-100 fathoms carried out by "RV Ujuzi" (1979-81), "RV Fridtjof Nansen" (1975-76; 82-83), "RV Prof. Mesyatsev" (1976-77), "RV Manihine" (1965-66) showed the area to be mainly untrawlable (Venema 1984). These results show that shallow water prawns are concentrated more towards the shore.

**Trawling should be allowed in Ungwana Bay from 3 nautical miles offshore. "Relatively good prawn biomass" exist between 3 and 5 nautical miles from the shore. Restricting the trawlers to this area will protect the resources in the bay nearer the shore for prawns and fish breeding which has been demonstrated in this survey. It will also separate the area of operations of the artisanal and trawl fishery. Good monitoring by the relevant institutions must be put in place to compel the trawlers to adhere to these regulations. Modalities of fitting the VMS need to be explored to ensure trawlers can be effectively monitored. The survey, clearly demonstrated that the destruction of artisanal fishing gears reduced significantly when trawling was restricted to day time and recommended that this should be made mandatory through legislation.**

- The ratio of prawn to discard is 1:7 in the Malindi-Ungwana bay. This could have been higher had the prawn trawlers not started retaining more of the bycatch after the research program started. The average discard per trawler is 340 kilogram per hour, each trawler makes an average of four hauls, each lasting two hours. The total discard for the trawlers is therefore approximately 340kg/hr x 4 hauls x 4 trawlers bringing the total to 7tons/day. The bycatch comprises high quantities of small sized fish (Leiognathidae, Clupeidae), rays and sharks, juvenile of commercially important fish (Scieanidae) and turtles among others. The fish species removed though not important for the artisanal fisheries have a very important ecological function in the ecosystem. Removal of huge quantities of bycatch can distort the food chain indirectly and make the fishery less productive. Efforts should be made to reduce the discards by appropriate bycatch Reducer Devices (BRD's). In this survey, the TED significantly reduced the large animals caught e.g. Rays and sharks but did not reduce the small sized fish. BRD's can reduce bycatch by between 30 and 40‰ (Fennessy and Groeneveld 2001, Fennessy 2002, Robins – Troeger *et al* 1995

and Richard *et al* 1995). In the meantime, procedures and principals must be developed to retain and avail the bycatch to the local markets.

**The industry should support the development and application of suitable Bycatch Reducer Devices (BRD's). Retaining the fish bycatch must be fully addressed. Available opportunities of availing the bycatch to the local markets need to be fully considered.**

- Prawns are known to prefer muddy/silty environments. The bay is shallow and receives sediment input from the Tana and Sabaki rivers. Within Ungwana bay, prawn fisheries do well at 1.5 and 3.0 nautical miles. This correlates well with distribution of muddy substrate. At Kipini, prawn fisheries does well upto 5.0 nautical miles. This correlates well with the distribution of the muddy substrate. The continental shelf is wider in Kipini – Kalifi area where it attains a width of 20 -30 km, with depths of less than 20 m. However, at Mambrui and Sabaki the shelf drastically decreases to a distance of 5-10 km and the depth doubles to 40 m. The bottom topography of the bay has not changed much between 1984 and 1993. The highest rate of sedimentation and erosion has been recorded at Kipini and Mambrui to be +1.4 myear$^{-1}$ and –2.0 myear$^{-1}$ respectively.

## *Socio-Economics*

- The socio-economic results indicate that fishing effort, especially the number of fishers, type of gear, and net mesh size are important determinants of fish harvest rates, and habitat modification. The production, sale and use of destructive fishing gears should be regulated. It may be necessary to introduce an incentive structure to promote the production and use of appropriate technology. Those who produce and use destructive fishing technology should be completely banned from doing so. It is recommended that, special credit schemes should be established to assist those who want to acquire appropriate fishing gears. Fishermen are forced by a number of reasons to use efficient but destructive fishing techniques. The appropriate fishing gears such as gillnets, are more expensive and only a few fishermen can afford them. In addition, demand for both mature and juvenile fish is very high in the local market. Interventions should therefore target the size of fish traded in the market. It is also evident that fishermen do not have incentives to use appropriate fishing techniques because the fisheries are characterized by open access and there are logistical constraints hindering the enforcement of existing regulations. Results have further indicated that direct contribution of prawn trawling to the government is so minimal since it currently contributes only about Ksh.2 million. This should be addressed so that the positive contribution of this important player is felt by all the affected parties especially the government, the local community, and the trawler owners. If the export levy is raised to 10%, part of this should be taken back to the local community to improve their living standards.

Therefore, it is recommended that export levy be raised on prawn export.

## *Environment*

- This study has established that the discharges of the Tana and Sabaki Rivers into Ungwana Bay are reasonably variable. In case of both rivers, the peak flows occur in May during the southern monsoon and December during the northern monsoon. The suspended sediment concentrations are also variable for both rivers. In case of the Tana River there is a phase lag between peak Tana River discharge in May and peak sediment concentrations in April. In case of the Sabaki River, there is no well-pronounced phase lag between sediment concentration and river discharge. In both rivers, most of the sediments in transport are inorganic in nature with very small organic component which increases during the dry season. The study also established that the movement of Tana and Sabaki plumes in Ungwana Bay changes direction in respect to changes in the monsoon wind direction. The plumes are usually confined along the coast and do not extend beyond the continental shelf where the coastal current systems operate. The heavy discharge of terrigenous sediments and huge volume of nutrient-laden freshwater from Sabaki and Tana Rivers probably explains why the Ungwana Bay is the richest and most productive fishery ground along the Kenyan Coast. This means that the management of the fisheries within Ungwana Bay cannot be successful without the management of landuse and water abstraction within the Tana and Sabaki River basins.

- Though the rivers discharging into Malindi-Ungwana Bay areas have large catchment areas and are expected to contaminate the marine environment, there was is no evidence of serious microbiological (bacterial) contamination of the fishing grounds. This is an indication that the area is safe for fishing and the seafood harvested from the area is safe for human consumption.

- The concentrations of Cu and Zn in prawn muscles were lower than previously reported. Cd concentrations were lower than previously reported, but higher than in the NE Pacific. Pb concentrations were higher than both previously reported and NE Pacific levels. Fe and Mn were generally lower than previously reported results. With reference to WHO and U.S. FDA guidelines, the concentration levels of Cd and Pb in the prawn muscles are within acceptable safe limits.

- Zooplankton were abundant during the rainy season due to high nutrient input into the bay. The plankton (phyto and zooplankton) are normally consumed as food for the early life history stages of caridea, fish and crabs. Consequently high abundance of these groups was found to occur during the same period. The distribution of these groups in Ungwana bay may be due to a combination of various factors like substrate type, salinity, plankton concentration and currents. Fish eggs

were abundant during the NE monsoon (November/ December) which is a period of comparatively high salinity and more stable waters indicating a peak spawning season. Similarly high abundance of Caridea (prawn juveniles) in November and May signals some spawning patterns. However they seem to prefer the muddy substratum which is found around 1.5 - 2.0 nautical miles. Abundance of Caridea beyond the 2.0 nautical miles declines as the area starts to become rocky. Brachyran larvae and Fish larvae seem to thrive during the rainy season (May) in nearshore areas 1.5 nm. Further offshore their abundance declines. Zooplankton in Ungwana bay are rich and abundant especially during the rainy season. For sustainable utilization of the Ungwana Bay fisheries, management guidelines must recognize nursery areas and the breeding season identified in this study.

- As regards benthic biodiversity trawling eventually reduces species diversity and abundance. This is the present situation in the Ungwana bay, exhibited by the low species diversity and low abundance. Trawling reshuffles bottom-dwelling communities at many levels. For instance, increased murkiness of the water column may cause a shift from species that hunt by sight to those that locate prey by sound or touch, or from filter-feeders to deposit-feeders. In Ungwana bay, predators and deposit feeders dominate with lack of suspension or filter feeders. This situation is found in disturbed areas and the community structure of this area has changed with a reduced structural complexity. In terms of biomass, bivalves and brittle stars dominate in Ungwana bay. These are organisms that are flat structured and covered by hard shell, which indicates a dominance by organisms much adapted to disturbance. Often in trawled areas, short-lived, rapidly-reproducing creatures (such as nematode worms) move in, tending to replace larger, longer-lived organisms (such as sponges or shellfish) that take longer to propagate and re-establish themselves. This is the situation found in Ungwana bay where short-lived organisms such as polychaetes and nematodes dominate. Typically, reducing structural complexity results in an increased abundance of opportunistic, more adaptable species that benefit from disturbance, at the expense of a richer variety of species and more fragile organisms. Although information on the benthic community in Ungwana bay before Trawling commenced is lacking, the present community recorded is similar the ones common in disturbed areas.

***TASK FORCE RECOMMENDATIONS***

Based on the scientific report, the Task force on prawn trawling. The meeting discussed the detailed scientific report and made the following recommendations:-

### *A. Resources And Environment*

1. A direct relationship between river discharge and prawns concentration and distribution was established. There is need to carry out an integrated river basin and coastal zone management of the entire Ungwana-bay-Sabaki-Tana river systems.

2. Ungwana water is very productive, however, it was clearly demonstrated that fish and prawn larvae were found concentrated between 1.5 - 3 nautical miles from the shore especially during the wet season. This area needs a management strategy. Trawling should not be allowed here.

   However, it was further felt that a test run of the proposed regulation be carried out to see if it is ecologically sustainable and economically viable. A period of 6 months to one year was suggested.

3. Prawns and fish larvae have been shown to be higher nearer the shore (1.5 – 3 nautical miles from the shore). It has been clearly demonstrated that good prawn biomass exist between 3 and 5 nautical miles from the shore, but reduces with distance from the shore. On this basis therefore, trawling should only be allowed beyond 3 nautical miles from the shoreline. The no “trawl area” will also act as biodiversity refugia.

4. Water quality (microbiological) and environmental (sediments) and food quality (prawns especially) were found to be within acceptable safe limits. However, continuous pollution monitoring is recommended, including heavy metal and pesticide residues.

### *B. Conflict Management*

1. Compensation for artisanal fishermen gears damaged by the trawlers should be mandatory. A special mechanism, such as beach management committee units, in compliance with fisheries regulations, should be put in place to oversee this process.

2. Fish discards are a big problem in the Malindi-Ungwana bay. Discards should be availed to the local communities. Mechanisms should be put in place to collect and avail the discards (and not bycatch). It was further agreed that a Committee comprising Fisheries Department (initiating action), KMFRI, Beach Management Unit of Malindi meet to discuss this further and report back in 3 weeks time.

3. From this survey, it was clearly demonstrated that the destruction of artisanal fishing gears reduced significantly when trawling was restricted to daytime. This decision should be upheld and be made mandatory through legislation.

4. A closed season should be sanctioned from the beginning of November to the end of March to allow for prawn breeding and replenishment of the stocks. Breeding of most of fin-fishes also occurs during the same period (Nzioka 1979, Mwatha 1997 & Kulmiye 1997) and also for lobsters (Kulmiye pers. Comm.). Therefore no trawl fishing licences should be issued for shallow waters (3 - 5 nautical miles during the closed season). This will also give time for the ecosystem to recover.

### *C. Regulations*

1. Good monitoring by the relevant institutions must be put in place to compel the trawlers to adhere to these regulations. Vessel Monitoring Systems (VMS) be installed in the trawlers to track their operations in the recommended area. Modalities of fitting the VMS need to be explored (including tuning them for monitoring by the Kenya Navy) and the cost of installations should be borne by the trawling industry.

2. Using a precautionary approach, a maximum of four prawn trawlers may be licensed to fish for prawns. The size of any trawler should not exceed 700 HP and must be 500 HP or less for new vessels.

3. TED application should be made mandatory. However the trawling industry should support the development and application of suitable Bycatch Reducer Devices (BRDs).

   While searching for suitable BRDs, KESCOM should provide tagging mechanisms for the monitoring of released turtles.

4. Enforcement is required in eradicating unlawful gears.

5. Review of the current fisheries act to accommodate suggested changes.

6. Introduce or increase heavy penalties for offenders.

7. The Malindi-Ungwana coastal area is susceptible to shoreline change, therefore the newly formed beach land and coastal dunes should be used for well-managed public recreational areas and not for permanent structures.

8. Increased budgetary allocation to the FD and KMFRI to enable them discharge their duties adequately.

### *D. Benefit Sharing*

1. Prawn fishery is very important to the economy. There is need to introduce royalties from catches. It is recommended that export tax earnings from prawns be reviewed upwards realistically for the management of the resource. These recommendations should finally reach the regional forum currently harmonizing export trade rates (action FD).

2. Mechanism to be developed to benefit community development projects.

### *E. Monitoring And Research*

1. On board monitoring of trawler catches and operations to continue (FD & KMFRI).

2. Monitoring and future research in the same area (Ungwana-Malindi Bay) to continue.

3. The fishery legislation needs to be reviewed to address the proposed changes.

### F. Recommended Further Research

1. Further work to study the influence of damming of the Tana River on Ungwana bay fisheries and shoreline stability.

2. Further research in the deeper parts (circulating patterns) in order to determine the importance of the coastal current systems.

3. Long term monitoring of Sabaki and Tana rivers (freshwater and sediment loads) to correlate to the changes in productivity and fisheries of the bay.

4. Further research on coupling between terrestrial, pelagic and benthic systems to understand the factors that influence the dynamics and viability of the fisheries.

5. Further studies and monitoring of pesticides and other potential pollutants.

6. Detailed studies of sustainable development of the Malindi-Ungwana bay should be undertaken in conjunction with long term monitoring of shoreline change.

7. Further socio-economic assessments and monitoring should be undertaken to follow up progress.

## *CONTRIBUTIONS BY THE DIFFERENT PARTNERS*

The project could not have been a success without the invaluable contribution of many organizations that gave their material and moral support.

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*(i) Kenya Marine and Fisheries Research Institute*
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(iii) National Environmental Secretariat
(iv) Kenya Wildlife Service
(v) Coast Development Authority
(vi) Kenya Navy
(vii) Kenya Police

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