Artisanal Fisheries of Kenya´s South Coast

A transdisciplinary case study of a socio-ecological system in transition

By

Okeyo Benards, M.Sc.

A doctoral dissertation submitted to the University of Bremen

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Declaration

I herewith confirm that I have elaborated this thesis titled:

ARTISANAL FISHERIES OF KENYA’S SOUTH COAST
A transdisciplinary case study of a socio-ecological system in transition

single-handed and without using sources other than those mentioned.

Sign:                                            Date: May, 2010
The art of dealing in fish
ACRONYMS AND ABBREVIATIONS

1. ANOVA: Analysis of Variance
2. CANOCO: Canonical Community Ordination a FORTRAN program for by [partial] [distended] [canonical] correspondence analysis, principal components analysis and redundancy analysis
3. CDA: Coast Development Authority
4. CFLI: Canadian Fund For Local Initiatives
5. CORDIO: Coastal Research Development – Indian Ocean
6. CPRs: Common Property Resources
7. CPUE: Catch Per Unit Effort
8. DCMT: Diani Chale Management Trust
9. EAME: East Africa Marine Eco-region
10. EEI-U-K: Eco-Ethics International Union-Kenya Chapter
11. EEZ: Exclusive Economic Zone
12. EIA: Environmental Impact Assessment
13. EMCA: Environmental Management and Coordination Act
14. FAO: Food and Agriculture Organization of the United Nations
15. FGI: Focused Group Interviews
16. GOK: Government of Kenya
17. GPS: Geographical Positioning Systems
18. ICAM: Integrated Coastal Area Management
19. ITK: Indigenous Traditional Knowledge or TEK: Traditional Ecological Knowledge)
20. IUCN: International Union for Conservation of Nature
21. KMFRI: Kenya Marine and Fisheries Research Institute
22. KWS: Kenya Wildlife Services
23. LOA: Length Overall
24. MEY: Maximum net Economic Yield (MSY: Maximum Sustainable Yield)
25. MPAs: Marine Protected Areas
26. MRAG: Marine Resources Assessment Group
27. MT displacement: Metric Tones
28. NEMA: National Environment Management Authority
29. PRA: Participatory Rural Appraisal
30. SPSS: Statistical Package for Social Science
31. UFT: Umwelt Forschung und Technologie University of Bremen (Center for Environmental Research and Technology)
32. UNEP: United Nations Environment Program
33. UNESCO: United Nations Educational Scientific and Cultural Organisation
34. VHF: Very High Frequency
35. WCED: World Commission on Environment and Development
36. WWF: World Wildlife Fund
SUMMARY

This study examined the artisanal fisheries along the Kenyan south coast in the face of two major challenges: need to sustain the fishery resources on one hand and dependency of livelihoods of the coastal population upon the fishery resources on the other hand. At the Kenyan south coast a large number of people, mostly artisanal fishermen, have been displaced from their homesteads and fishing grounds to give way to other infrastructural developments – mostly tourism facilities. This has brought a severe competition for space and resources either for consumptive use by the local population as is the case of artisanal fisheries exploitation or non-consumptive use by the tourism development proponents. There is also the shift from local traditional management of the fishery to national government policy oriented management. This shift has evoked resentment by the local elders who for a long time used traditions, taboos and culture anchored on the belief systems to control exploitation of the fishery, relations amongst the fishers as well as conserve critical fish breeding and spawning grounds. These challenges have not been helped by the rapidly increasing population mostly due to immigration from the neighboring lands, lack of proper management policy derived in a participatory manner and not least, effluent disposal and pollution of inshore waters – fishing grounds for the artisanal fishers.

The study was divided into two main components: the natural component that examined the biological dimensions of an artisanal fishery and socio-cultural studies. The latter looked at the various strategies of exploitation of the fishery, rules and institutions that presided over the fishery exploitation as well as mediated conflicts amongst the users.

To realize the biological component of the study the nine fish landing sites of the selected study area were monitored over two years. These sites spread from the tourist area of Ukunda to the remote bay of Mkunguni down the Shimoni area. The distance between the first landing site on the north (Mwakamba) and last landing site towards the south (Mkunguni) was roughly 50 km. These sites were representative of the general artisanal fishery along the Kenyan south coast and fishing was done almost exclusively by artisanal fishermen using a limited number of relatively simple gears. All sites were visited by two observers twice a month. During each visit records of the total number of fishers, number of fishing vessels, gears used, weights of the fish catches; scientific and local names of the fish up to a genera or order level were captured. Other observations in regard to preparation of fishing expeditions, weighing and portioning of catches were recorded during the visit.

Methods for socio-economic and cultural studies started by building of trust: on one hand between myself and my two assistants and on the other hand with the community. This was followed by the mobilization of participation of the artisanal fishers in the study aspects i.e. undertaking a sea spirits appeasing ceremony. Other tools involved the use of social science descriptors like use of PRA (participatory rural appraisal), digging into traditional knowledge systems, observations, semi-structured interviews, focus group discussions, oral histories, surveys and visualization techniques. Though listed differently, in many occasions they became handy simultaneously or sequentially and investigations took full advantage of all available opportunities.

Major findings from the natural fisheries biological component showed that there were a total of eight gears used within the study site. Four of them (lines, gill nets, traps, and spears) were
common to all the sites. The other four (beach seine, set nets, cha-cha and ring nets) were only in use in certain landing sites where they had been recently introduced. Fishers also showed a degree of specialization in use of a certain gear. Of all the gears sampled, traps were the most abundant with a count of 545 of all the 1928 gears. The next most abundant gear was the spear, while the expensive ring net was the least with its use being restricted to only one landing site of Gazi. Even here, only the migratory Pemba fishers used it. Artisanal fishers were found more in those sites that were far away from the urban centers, where perhaps many fishers had converted to other more paying jobs. Fish catches were influenced by the seasons, with least catches coming from the northeast monsoon period of rough seas commonly known as the ‘kusi’. Fishers shifted gears depending on season’s as well i.e. they predominantly used traps during rough water seasons and Gill nets during calm water seasons. In terms of catches, introduced gears showed higher yields. There was phenomenal increase of catches by use of ring-nets at Gazi. In terms of local management, fishers had banned by the use of what was perceived to be destructive gears by local agreement and consensus e.g. the use of beach seines was prohibited in most of the landing sites and their users rebuked. Comparison of CPUE for different gears for different landing sites showed that those sites to the south were more productive than the sites close to the urban centers which were fished all seasons. Fishing was undertaken throughout the seasons especially fishing in sites closer to the urban center of Ukunda perhaps due to constant demand for fresh fish and good prices. Gear selection was not necessarily out of the reward capacity of the gear; since there was no pattern for preference for well rewarding gears – an indication that artisanal fishery was a social undertaking more controlled by habit and attitude. The estimation of the catch per unit area of the study area gave a figure of 14t/km of coastline per year. This estimation is agreement by that given by UNEP (1998) which put the fish productivity of the entire Kenyan coast between 12 – 18 tones per Kilometer per year.

The socio-cultural studies showed that all fishers were male and 80% of them were married, an indication of strong family bond. Households had high number of dependants, mostly from close relatives and children, those with over 6 persons constituted 30% of the total sample, followed by those with 5-6 constituting 25%. The level of literacy was very low with barely 25% of the sampled population of fishers having basic literacy skills of being able to read and write, 10% having some vocational education skills and the rest (65%) being illiterate. In terms of incomes, fishing generated an average of 32% of total household income – this figure did not take into account the amount of fish used for household consumption and an important source of proteins. Other income sources included operating small businesses. Household expenditures were limited to food (79%), medication (10%) and school related expenditures (10%). Fishers engaged in different occupations – they changed from fishing to more of farming during the rough fishing seasons.

Leadership of the fishing villages was mostly in the hands of the elders. Traditional resource control strategies were mostly enforced by the elders and lack of cooperation was slapped with sanctions and reprimand. Awareness of the controls was fairly high (52%). Fishery controls revolved around fishing days and seasons, gear restrictions, fish species and cohorts, fishing grounds with emphasis on avoidance of breeding and spawning grounds which were associated with the spirits i.e. the ‘mzimus’ in the sea and ‘kayas’ on land. Studies found well entrenched use of indigenous knowledge in the assemblage of gears and their maintenance, on the sea-state conditions especially as influenced by the moon and on fish species and their life histories. The study also unearthed misunderstanding between the fishers, government agencies and tourist
facility owners especially on the attempted setting up of a marine protected area. Fishers also abhorred governments disregard to their traditional management systems especially on the beliefs and respect to sea spirits and gods.

The study found out that there are teething problems facing artisanal fishers within the study area: infiltration by foreign fishers using destructive gear and reducing the productivity of their fishing grounds, overwhelming government presence that is ignorant of their traditions and way of life, cultural change which is not only an upfront to the established way of managing the fisheries but which disregards their beliefs, customs and taboos.

As concerns possible recommendations from the study, there is the need to reduce fishing pressure within the lagoon waters by facilitating acquisition of better gears to reach beyond the reef flats. Introduction of marine protected areas should be anchored on the local beliefs i.e. they should be located around the ‘mzimus’ locally believed to hosting the sea spirits and gods and hitherto protected by traditional beliefs. Lastly there is need to enact a kind of precautionary policy of fishery resources management. This shall take care of the diminishing traditional management systems, anticipate emergence of new introduced gears like the ring nets and be sensitive to global trends like climate change with its attendant sea level rise, high acidity levels and increased temperatures.

This thesis might be used among others as a basis for the development of this preemptive policy as it provides basic cultural, social and biological insights not only into the fishery but also the struggles of the local artisanal fishers to live on the fishery sustainably. Also, it provides a valuable documentation about the traditional fishery exploitation and management strategy that will become useful once these unwritten practices are long gone.
Diese Untersuchung befasst sich mit der handwerklichen Fischerei an einem 50 km langen Streifen der Südküste Kenias an der Grenze zu Tansania. Ziel der Arbeit ist die Analyse der natur- und gesellschaftswissenschaftlichen Aspekte dieser noch immer traditionellen, lokal kontrollierten Fischerei. Im Mittelpunkt steht die Rolle der sozioökonomischen und kulturellen Faktoren auf die Ausübung der Fischerei und die nachhaltige Nutzung der Fischbestände in der langen Lagune zwischen dem Strand und dem Saumriff. Über zwei Jahre wurden zweimal monatlich die eingesetzten Boote, Fanggeräte und Anlandungen an den neun Anlandungsplätzen des Küstenstreifens registriert und regelmäßig in den zugehörigen, landeinwärts gelegenen Fischerdörfern die demographische, soziale und ökonomische Struktur der Fischerbevölkerung erfasst. In eingehenden Interviews konnten die religiös-kulturellen Hintergründe für die Fangregulierungen und damit für die Nachhaltigkeit der Fischerei aufgedeckt werden.


Die Haushaltsumfragen ergaben, dass die Einnahmen aus der Fischerei pro Woche und Fischer 7,14 US$ betragen. Sie machten etwa ein Drittel des monetären Gesamteinkommens der Familie aus (21% aus der Landwirtschaft, 31% aus dem Handel, 18% Sonstiges). Hinzu kommt der Direktkonsum eines Teils des Fanges innerhalb der Familien. 80% der Fischer waren verheiratet, 30% der Haushalte bestanden aus mehr als 6 Personen. Das Durchschnittsalter der Fischer war – gemessen an der mittleren Lebenserwartung – recht hoch. Zwei Drittel der Erwachsenen in den Fischerdörfern waren Analphabeten, was die Einführung moderner Management-Strategien erschwert.

Eingehend wurden die spirituellen Grundlagen des traditionellen Fischereimanagements untersucht. Obwohl die Küstenbevölkerung formell muslimisch ist, spielt der Glauben an Götter und Geister eine vielfach beherrschende Rolle. Bei der Ausübung der Fischerei gibt es zahlreiche Tabus und Rituale. An heiligen Stätten darf nicht gefischt werden. Schonzeiten sind zu respektieren, die effektiven Strand- und Ringwaden sind bei den konservativen Fischern verpönt. Die den Göttern und Geistern verbundenen Ältesten ordnen Ruhestage und anderem Fangbeschränkungen an, kontrollieren deren Einhaltung und verhängten Sanktionen,
um die Geister zu veröhnen.. Ihre Autorität beziehen die Ältesten aus ihren Kontakten mit Göttern und Geistern.. Diese über lange Zeit gewachsenen Strukturen bildeten die Basis für Management-Systeme, welche die Fischereiausübung und die Beziehungen der Fischer untereinander kontrollierten. Normen, Tabus, Überlieferungen, Glauben wurden zu Werkzeugen des Managements. Der reiche Schatz mündlich tradierten Wissens über Naturphänomene und über die Fische ergänzt die genannten religiösen und hierarchischen Strukturen und hat deren Tabus stark beeinflusst.

Heute erodiert dieses traditionelle System handwerklicher Küstenfischerei im Untersuchungsgebiet. Nur noch 38 % der Fischer bekannten sich in Ehrfurcht zu dem traditionellen religiösen System, 28% glaubten nicht mehr daran und 34% gaben Unwissenheit vor. Am verbreitetsten war noch die Wertschätzung der alten, weisen Männern, die als Vermittler zwischen Gemeinden und Geistern sowie den Ahnen fungieren.


Die Liste möglicher und notwendiger Maßnahmen zur Erhaltung der Fischerbevölkerung und ihrer Ressourcen in der Lagune enthält u.a. Verbesserung des Transfers von Entschädigungen an die handwerklichen Fischer und ihre Gemeinden; Richtlinien, Gesetze und Vorschriften bezüglich der marinen Ressourcen - sie müssen sensibel gestaltet werden, indem sie traditionelles Wissen einbeziehen (hierzu ist das Zusammenwirken von Forschern mit den Fischern und ihren Gemeinden erforderlich); Einrichtung eines Informationssystems zur Erfassung und Bewertung von Fischereiressourcen und der rasch wachsenden touristischen Infrastrukturen.

Die andernorts in Kenia bereits frühzeitig und erfolgreich praktizierte Einführung von Meeresschutzgebieten ist bisher im Untersuchungsgebiet am massiven Widerstand der Fischer gescheitert.

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1 INTRODUCTION

1.1 The study problem: sustainable artisanal fisheries within their socio-cultural setting

There exists a huge challenge in making artisanal fisheries sustainable. This challenge manifests in two folds: the need to sustain the fishery resources for posterity and future generations' on one hand and the desire to contain the wellbeing of the people dependent upon these resources. Fishing and agriculture provide 6% of the total protein and 16% of the total animal protein annually consumed by humanity. Worldwide, the fishing sector indirectly gives employment to 50 million people in services, transformation, transport and commercialization (FAO, 2009). Artisanal fisheries contributes in a crucial way to human nutrition and to social and economic progress

Several scientists (Ruddle, 1996b; McCay & Acheson, 1987; Diegues, 2001) have emphasized the need to undertake studies that enhance understanding of socioeconomic and cultural factors that influence the value coastal people attach to “their” fishery resources. This understanding is essential in the development of an efficacious conservation strategy that address the root causes of resource degradation and also to generate interventions that complement the complex livelihood strategy of stakeholders such as the artisanal fishers. The situation along the Kenyan coast probably presents one of the best scenarios for such a study mainly due to the following reasons:

- presence of a large number of displaced local people, mostly to pave way for the development of tourist infrastructures. These developments along the Kenyan coastal strip ignore the lifestyles of the local people and their dependence on the fishery and other coastal resources (Alidina, 2005)
- shift of governance from local to national systems which in many instances are less sensitive to local conditions and ways of life i.e. neglect of traditional ownership rights which were formerly guarded by traditional management and social mechanisms. Alidina, 2005, mentions weakened local institutions with little authority to exert power on control over the use of fisheries within the study area.
- lack of government policy to support indigenous and local ownership of property. Marine fisheries in Kenya are common property resources, defined as those resources that no individual or firm possesses exclusive rights to exploit (Ochiewo, 2004)
- effluent disposal and pollution on the lagoon waters mostly exploited by the local communities
- rapid population growth and expansion of coastal cities - worsened by the influx of many displaced people running away from the war ravaged neighboring countries like Somalia, Rwanda, Congo, Sudan among others .
- attempts by the Kenyan government to alienate some fishing grounds as marine protected areas and the accompanying loss of access to these sites by artisanal fishers as documented by Glaesel (2000b).
Similar studies by Ruddle (1996a), McCay and Acheson (1987) and Cochrane (2000), in other parts of the globe show that when faced with such challenges several solutions have been adopted. These include privatization, ownership and control by the national governments. Small-scale management by users themselves based on shared interests and cultural beliefs has been historically the dominant form of management by humans. It is increasingly being replaced globally by other modern forms of governance like co-management (Gadgil 1987; Klooster, 2000). This is however in sad contrast to the situation along the Kenyan coast where this paradigm of small-scale management is still at its infancy.

The search for this understanding of the relevance of socio-cultural factors in sustainable artisanal fisheries has not been helped by the nature of fractured research undertaken based on various disciplines, for instance; ecologists involved in the management of living coastal resources tend to focus on changes in the ecosystem with increasing exploitation, resource managers or trustees pay more attention on the yields and sustainability of the resources, and the social anthropologists emphasize on the cultural adaptations of the resource users (Clayton & Radcliffe, 1997). Further, in a study of perceptions of resource users and managers towards fisheries management options in Kenyan coral reefs, McClanahan et al. (2005) adds that the management of fisheries is likely to be complicated in ethnically diverse nations with multi-species fisheries, numerous types of gear, and different levels of governance, ranging from traditional to national governments.

As stated by Jones (2003), a rigorously applied science in fisheries resources has to be combined with community participation that incorporates cultural beliefs and involves traditional knowledge. Such a combination may provide the needed tools to accurately assess the status and resilience of the fishery resources and their sustainable exploitation. Such an assessment has the potential to contribute to the determination of baselines, which form the building blocks of a long-term community-based management program and that can assist to understand the socio-economic-cultural predicament of the local fishers involved. This is useful if participatory sustainable management of artisanal fisheries is to be achieved.

Further, sustainable artisanal fisheries management requires the use of diverse fishery information types; data which is not always applicable in more biological, numerically-driven models and analyses, such as traditional ecological knowledge on spawning and feeding habitats. Faulkner and Silvano (2001) have discussed the importance of realizing that traditional fisheries knowledge hold the collective wisdom of fishing communities and can be extremely important in establishing new scientific knowledge or verifying western scientific findings. Thus, the understanding of components of traditional knowledge like the cultural attributes and the way fishers perceive their work and the resources can help re-focus scientific findings to become more useful in designing an effective sustainable management of artisanal fisheries.

In supporting the need to understand and incorporate socio-cultural attributes of the resource users in sustainable management of fisheries, Pauly (1999) postulates that regardless of the fishery management program, whether market-based, co-management or specific types of governance arrangements, the local communities living in real places and exploiting local fishery stocks must be included in any research and management initiatives. This inclusion can best be achieved only after their social, cultural and economic perspectives are understood.
Other examples of works that show the relevance of appreciating socio-cultural elements in sustainable fisheries exploitation is the one put forward by Diegues (2001). He examined the relationship between traditional fisheries knowledge and contemporary Brazilian fisheries management. He describes spheres of local knowledge which can include valuable information on classification of aquatic species, fish behavior, taxonomy, patterns of reproduction and migration, and the feeding ecology of different species. He also documents knowledge of habitats, local weather patterns and the differential use of fishing techniques and gears in different habitats. These aspects provide some of the most important components needed to institute sustainable artisanal fisheries management that takes care both of the resources as well as demands of the local persons dependent on these very resources.

Moreover, the World Bank (1997) has further underscored the need for understanding the coastal resource use systems by local indigenous groups. This has been well captured and propagated through the Convention for Biological Diversity which recognizes that biological diversity is not only about plants, animals, microorganisms and their ecosystems – but also about people with their need for food security, medicines, fresh air, water, shelter, and a clean and healthy environment in which they live. This recognition of the people living with these resources as an integral part of conservation of biological diversity reinforces the need to understand people’s interactions with these resources and their attendant cultural attributes that more or less determine the use of these resources.

The coral reef belt along the coast of Kenya is exploited by a substantial artisanal fishery. Recent estimates by Tuda et al. 2008 amount to 23,000 fishers catching over 16,000 tons of fish and invertebrates per year. Apart from its great socio-economic importance on the local level, the Kenyan artisanal fishery is ideal for the study of coastal zone management striving for sustainability. The Kenyan reef systems have been the subject of several ecological studies, in particular dealing with the impact of fisheries on the overall species composition and pointing to the key role of sea urchins as ecological link between fish populations and the coral communities. Heavy exploitation of the fish stocks turn the system from being fish grazer dominated to sea-urchin dominated communities (e.g. McClanahan & Muthiga, 1988).

The artisanal fisheries at the South coast has attracted the attention of several non-governmental organizations (e.g. WWF/IUCN, CORDIO, Eco-Ethics, DCMT) engaged in developmental aid and Nature conservation. In the course of those projects the fisheries were assessed from a technical and socio-economic point of view. Those assessments – largely by local visits and interviews by different groups - were carried out partially in parallel. There was, however little coordination and cooperation between the various teams sponsored by different organizations. While a good number of data is published, much is still not publicly available or buried in reports. The majority of the papers published so far focuses on the technical aspects of fishing gear and fishing effort in relation to its costs and catches. For instance, Tuda et al. 2008 surveyed the fishing effort in the Diani region in 2003 to 2006 (independently from our field studies in 2003 and 2004 in the same area). A group of British socio-economists (Mangi et al. 2007) analyzed the financial and ecological costs attached to various fishing gears in use in the Diani region. Beach seines and spear guns with their severe ecological impact are illegal in Kenya but in wide use in the Chale/ Gazi reef fishery (Tuda et. al 2008)
Fewer papers are dealing with socio-economic and cultural aspects. In particular contributions by Ochiewo (2004), Alidina (2005), and McClanahan et al. (2005) address fisheries management in relation to socio-cultural issues like movement of inland fishers into the coast, weakened traditional systems of management and the arguments revolving the establishment of national parks. Ochiewo (2004) analyzed the interrelationships between price, fishing effort and yield at Gazi and south of it. He found a vicious circle: the lower the price the more effort, i.e. fishers tend to compensate a drop in price by fishing more.

My thesis has a holistic approach as I view situation of the artisanal fisheries of the area primarily from a point of social ecology – how the people’s lifestyles are influenced by resources, why they employ the gears used and they struggle to cope in the midst of prevalent challenges.

1.2 Research objectives and questions

1.2.1 General objective
1. To examine how cultural, social and traditional knowledge systems influence the use of local marine resources, with emphasis on artisanal fisheries along the Kenyan south coast.

1.2.2 Specific objectives
1. To examine the nature and distribution of traditional gears, allocation of fishers across landing sites, fish catches and the influence of seasons on the catches and the activities of artisanal fishers.
2. To examine the culture, norms, traditional knowledge systems and social organization of artisanal fishers along the Kenyan south coast and how these have influenced, both in the past and present, the use of fisheries resources.
3. To explore, investigate and document traditional knowledge systems among the artisanal fisher folk along the Kenyan south coast, especially as they influence resource extraction and sustainability.
4. To conceptualize a mechanism for sustainable artisanal fisheries management that harmonizes extractive uses of marine resources as advocated for by the fishermen and locals and conservation of biodiversity and beach protection, as is the need for tourism development - the latter being a rapidly emerging phenomenon within the study area. Or alternatively put: To illustrate approaches for internalizing environmental benefits for sustainable and all integrative artisanal fishery exploitation.

1.3 Significance of the Study

The results on the nature and distribution of the traditional gears, spread of fishers across the landing sites, corresponding fish catches across the landing sites, influence of seasons on the catches and activities of the fishers, provide an important data set that can be used in planning of effective and sustainable management of artisanal fisheries along Kenya’s south coast and other similar areas.
Insights into indigenous knowledge systems especially as exhibited and employed by the artisanal fishers within the areas of study make it possible to evolve a sustainable artisanal fisheries management that incorporates both modern and local scientific knowledge.

The component on the culture, norms, traditional knowledge systems and social organization provides insight about the role of human organizations on coastal marine resource use systems. Additionally, it helps understand the influence of culture, norms, traditions and way of the life of the artisanal fishers along the Kenyan south coast on the use of fishery resources. Also, it expounds how these socio-cultural attributes impact on decision making processes of individuals and by extension local artisanal communities.

Over and above, the understanding gained from this work can be used to propose strategies of sustainable coastal artisanal fisheries management that enhances the sustenance of the resource base while being sensitive to the demands of the local resource users – artisanal fishers.

1.4 Major conceptual considerations

This study was divided into two major components, namely: a). the natural component that details biological dimensions of the artisanal fishery and b). the socio-economic and cultural studies.

1.4.1 The social ecology of coastal resources
Ecology remains the study of complex interactions between living systems and their environments (Bradshaw, 1983). This implies that organisms are not only ‘shaped’ by their surroundings but that their ‘active systems’ also influence those environments as well (Wuketits 2006). Humans remain an active influence on the ecosystems particularly technology; thus making them have dramatic impact on the natural environment. However, this very human cultural evolution cannot be divorced from the ecological factors under which they were developed e.g. the availability of the resources, climate among others. Horn (2006) and Wuketits (2006) both contend that cultural activities have been constrained by these factors and that the differences between cultures could be to a certain extent results of environmental factors.

Murray Bookchin first mooted the word ‘social ecology’ in 1964 with the intent of emphasizing that the idea of dominating nature had its origins in the real domination of human by human i.e. the system of hierarchical order common within human societies. By that time, this was mainly as a reaction to failure by emerging school of New Left in early 1960s to explain the existence of huge differences within human societies and coupled with the eminent failure of Marxist ideals to bridge the divide within the human societies (Bookchin, 2006 in Social Ecology at www.social-ecology.org/harbinger/vol3no1/reflections). He probably had no idea that it would later develop into a larger field of scientific inquiry that it has since become. Later, development of this reasoning has been further supported by Lawrence (2006). He has further traced the use of the term human ecology by sociologists at the Chicago School of Sociology in
1921, which involved the use ecological principles to study human behavior and community organization.

Thus far, social ecology currently analyses how the natural conditions have strongly acted upon the lifestyles of the people and shaped their attitude towards different kinds of plants, animals, seasons, distributions and alignments in regard to physical conditions like waves, tides and currents within the marine environments.

1.4.2 The socio-cultural dimension of coastal resources
In order to survive, man has developed various strategies of exploitation of the natural resources, instituted rules and institutions to preside over use and mediate conflicts among the users. At the low end of this, one finds the simple organizational structures like the ones exhibited here by the artisanal fishers; that were largely based on elder system and enforced through the respect of the spirits and gods. This latter phenomenon has since been captured by the emerging fields of ethno-ecology and gives hints on how human societies have learnt from nature and struggles to cope with the natural environments. For example current heated debates on establishment of marine protected areas within Kenyan south coast (McClanahan et al, 2005) can be seen as an upfront of this struggle and the realization that actions and development are largely pegged on the natural environment, the advancement of the technologies notwithstanding. Thus social ecology and to a wider extent the socio-cultural dimension study of use of resources attempts a conceptual framework that potentially breaks down obstacles for interdisciplinary collaboration.

1.4.3 The biological dimension of coastal resources
This study further attempt to contribute to sustainable exploitation coastal resources; first by giving abroad understanding of the interaction of the artisanal fishers along the Kenyan coast and lagoon based fisheries as a case study. It also analyses the influence of the cultural orientations in the exploitation of coastal resources and the use of indigenous knowledge especially by examining the major tools with which they extracted those resources. Secondly, by examining the exploitation of fishery resources by crude artisan developed gears that are dominant within the study area, it gives an insight on the stability of the interaction between the resources and the people. Due to the low ability to extract huge amount of the resources due to primitive gears, which though makes the fishers less capitalily endowed and poor while on the other hand enforces almost equilibrium between the human population and the resources. This looked at within the perspective of current commercialized fisheries exploitation paints a picture of perhaps greed from man. This kind of greed not only leads to loss of the resources he is dependent on but also affects his own mode of living.

1.4.4 The indigenous knowledge systems
The indigenous knowledge systems are employed by the artisanal fishers here as in most other parts of the world to enable them survive many years with the least disturbance to the stability of their resources. These knowledge systems existed in forms of collective memories, practices, daily activities, beliefs, artifacts, traditions and customs of these communities and must have been useful in the conservation of the rich biological diversity common within this region. Again, such knowledge also enabled and continues to sustain the livelihoods of these communities. These knowledge systems determined their reaction and adaptation to the
environmental changes. Moreover, this interconnected development of community (natural and social) knowledge in time and space – provides non-individual frameworks for learning and increases the resilience of ecosystems by providing individuals with a sense of connectedness as has been observed by Ronald (2006) to respect and live within the limits of what the resources could provide.

An interesting dimension of the knowledge system and how it relates to social ecology is how the people perceive, feel, intuit information, and form opinions. The knowledge that individuals hold affects how they exploit the resources and how they interact with their natural world. While the western way of knowing is predominantly through formal education, which entails several years of school education and scientific experimentation, the traditional system mostly entailed trained senses. As with other typical indigenous groups, the artisanal fisher groups’ spiritual ways of knowing appeared to have been embraced and integrated into coherent patterns of behavior, daily practice and guided exploitation of the resources. Thus further reinforcing a local worldview and concerned with the perpetuation of the resources for the future of their children and prosperity.

1.5 Artisanal Fisheries

FAO (2002) has defined artisanal fisheries as: “traditional fisheries involving fishing households (as opposed to commercial companies), using relatively small amount of capital and energy, relatively small fishing vessels (if any), making short fishing trips, close to shore, mainly for local consumption”. Artisanal fisheries of Kenya are family-based and employing labor-intensive fishing technology, using canoes, usually <12 meters (m) long, and simple fishing gears that includes spears, set-nets, beach seines, gillnets, hand lines and traps. It supports extensive rural employment in the entire coastal belt and in some communities it is the ‘employer of last resort,’ where people without modern labor skills, land or capital resources undertake fishing. This is because fishing is done from an open access waters and some aspects like gleaning require little skills and capital.

In some cases artisanal fisheries have been considered as form of small-scale fisheries, which is generally limited to near-shore waters and inland water bodies. While small-scale and artisanal fisheries clearly differ from industrial and recreational fisheries, the subtle distinctions between them are hard to differentiate (Christy, 1982; Dahl, 1988). From a technological point of view, they are connected but have somewhat different concepts related, on the one hand, to the size of the fishing unit (the scale) and, on the other hand, to the relative level of technology (or ‘artisanality’) expressed as the capital investment / men-on-board. In terms of technological complexity: small-scale fisheries is seen as a sector in which fishermen fish and collect aquatic organisms from lagoons, beaches, from under ice, either by swimming, diving, or wading, or using small-scale fishing craft. According to FAO (1999) small-scale fishing craft are defined, for developed countries, as boats of less than 10-12m LOA and less than 12-15 MT displacement, powered by engines not exceeding 200-300 hp (150-225 kW). For developing countries, this definition also covers canoes, pirogues and open-deck dhows up to 16 m LOA, powered by engines not exceeding 200 hp (150 kW).
In Kenya we can consider artisanal fisheries as a sub-set of small-scale fisheries as there exists some non-artisanal small-scale fisheries as well. The latter are mostly small trawlers owned by a few rich Kenyans and foreigners. The basic social difference of such kind of industrial small-scale fishing to artisanal fishing per se is the lack of personal attachment of the owner of the fishing vessel to the fisheries and its sustainability.

1.5.1 Categories of fisheries based on boat size and technological investments
The most common criteria used to categorize artisanal fisheries is based on the size of the fishing vessels, mostly boats, and the low technological investments found within the fishery (FAO, 1999). Those small-scale fisheries that use very small mostly un-motorized and crude fishing vessels like dugout canoes and with least technological investments are considered to be artisanal (fig. 1). Boats mostly motorized which fall within an intermediate range of size and low technical complexity are usually called modern artisanal or semi-industrial\(^1\). Beyond this range is the industrial category. The position of the graphical boundaries between the artisanal, the intermediate, and the industrial categories is not easy to discern and varies from region to region. Fig. 1 gives an illustration of the various classes of fisheries based on technology and size of the boats.

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\(^1\) Industrial/semi industrial fisheries

Consists of relatively capital-intensive fishing technologies and comprise business concerns and craft of varying sizes, generally owned by commercial entrepreneurs and operated by salaried crews. Boats range in size from 12 m to 24 m, are usually licensed to operate in offshore waters, but are known to encroach on inshore waters, thereby competing with the artisanal sub-sector. Along Kenyan coastal waters these are mostly owned by Chinese, European and local Kenyan tycoon entrepreneurs.
The most prevalent fishing vessels along the Kenyan south coast are the dugout canoes (mostly from big mango trees) which fall somewhere within the lower left-hand quadrant (figure 1). Here boats are small with a carrying capacity of no more than 5 persons and on many occasions do not take more than two persons while going on a fishing trips. They also have a low technological investment.

1.6 Layout of the thesis

The thesis is organized in ten chapters as described below. The breakdown of the methodology, results and discussion into two chapters each have been necessitated by the need to capture and present the two main components of the study (fisheries biology and socio-cultural aspects) separately before generating common conclusions and outlook.

The introductory chapter presents the study problem, research objectives and questions, significance of the study and also highlights the major conceptual considerations. Further, it gives an introduction of artisanal fisheries as well as the common categories of artisanal fisheries based on boat size and technological investments.

The second chapter on artisanal fisheries of the Kenyan coast describes the social and cultural features of artisanal fisheries, their challenges and advantages. At the end, it gives an
estimation of the total number of artisanal fishers along the Kenyan coast as well as the most common fishing gears employed.

The third chapter gives an overview of the study area: its natural geography, hydrographic features, climatic conditions as well as geology and geomorphology of the Kenyan coast. Besides, it examines the human population of the study area particularly the history and ethnography of the Digo people who constitute the bulk of the artisanal fishers in the study area. Additionally, it shows the emergence of commercial and tourism activities. It ends by a presentation of the major stakeholders of the study area as well as the legal provisions which have been evolved by the Kenyan government to assist in the management of coastal zone and its resources.

The methodology chapters present the methods involved in the study. The first section deals with fisheries biology components and involves a description of the biological study sites, landing sites within the study area as well major human concentration centers within the south coast region of Kenya. The second methodology chapter describes the methods used for socio-economic and cultural studies. It starts by introducing the interactive approach and noting of biases. Finally, it gives the study activities, data gathering processes and statistical analysis.

Chapters 6 and 7 give the results of the study, where the former gives the fisheries biology results and the latter presents the socio-cultural results. Chapters 8 and 9 present the discussions both for the fisheries biology results (chapter 8) and socio-cultural results (chapter 9).

Finally, chapter 10 presents the conclusions and outlook drawn from both the biological component as well as the socio-cultural component. It provides major lessons from the study with insights into the field of artisanal fisheries along the Kenya’s south coat. It also lists various challenges faced by the current traditional fisheries management system within the study area. Finally, it contains proposals that could be incorporated in the management systems to take care of the current emerging scenarios.

All photographs used within the text are by the author, research assistants or those taken within the projects of Eco Ethics Int. – Kenya which were initiated and supervised by the author.
2 ARTISANAL FISHERIES OF COASTAL KENYA

2.0 Social and cultural features of artisanal fisheries along the Kenyan coast

There exists several fishing methods practiced without use of any fishing vessel along the Kenyan coast. This aspect is captured by the FAO graphical presentation of artisanal fisheries classification (check fig. 1) - at the graph’s starting point where the boat size is zero and the level of technology is lowest. These kinds of fishing methods without use of any vessels are common along the Kenyan south coast and are quite popular with fishers who lack adequate capital to acquire their own dugout canoes or the skills to make their own. Some of the most common gears are the ‘spear guns’, the ‘malemas’ ² - the traps and weirs (large and small) used mostly by the older fishermen, the beach seines, gill nets, fishing by hook and line from shore, and manual harvesting of seaweed, bivalves, crabs, etc.

Most of the artisanal fishing is geared towards household consumption – largely conforming to the subsistence nature of artisanal fisheries as is done in most parts of the world (Sequeira, 2002; Lawson & Robinson, 1983). Just about all fishers do in fact take home some fish for their family and by concert also sell (or barter) catch if there is a good market for it and the price is right (Lawson & Robinson, 1983; Cunningham et al., 1985; Sequeira, 2002; Kronen, 2004). Again this condition, whether to sell or take home and by what proportion is more influenced by opportunity than attitude and the balance of what brings the fisher a greater benefit i.e. if the returns from the sale promises more, then that is the option to take and the money is used to meet the family demands. Most artisanal fishers are "commercial" at least part of the time, especially considering that almost all the fish consumed locally are those caught by the artisanal fishers (pers. Comm. 2004). The importance of the coastal fish as a source of animal protein, income and employment in this area cannot be overemphasized.

Artisanal fishing is a source of employment along the Kenyan coast just as it is in many other parts of the world (FAO, 1999; Moses, 2000; Hilborn & Silbert, 1988). There exists high unemployment rate among local people, many with limited occupational skills and majority of them have taken fishing as an occupation and source of livelihood. As most fisheries resources show distinct seasonal cycles of abundance or availability, fishing is profitable only during certain periods of the year. Artisanal fishers here participate in other activities outside these periods, for instance cultivating cassava, making palm wine, running small retail shops commonly known as ‘kiosk’ ³, thus they may be considered "part-time" artisanal fishers. Inversely, there also exists full-time artisanal fishers, who use practically the same gear and methods for the same species and fish during most of the year. Sometimes they modify their methods and gears throughout the year to follow a sequence of different species with different periods of abundance e.g. targeting pelagic species with set nets during one period and shifting

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² Malema is a local name of basket traps of both small and large sizes
³ Kiosk: small retail shops selling fast selling consumer goods
to hand-lining bottom fish or harvesting clams along the shore during inclement weather conditions like the ‘kusi’ 4.

Artisanal fishing is practiced as a livelihood. Here the artisanal fisher’s family (household) livelihood strategy tends to combine various ways of earning a living more so because survival depends on daily incomes. Similar to situations in other parts of the world particularly as pointed out by Reis and D'Incao (2003), Sequeira (2002) and Christy (1986), the most favored and rewarding dynamic livelihood strategies rely on the largest possible range of approaches and available assets, thus reducing risks created by natural or market vagaries. One proven fisheries livelihood strategy also common within the Kenyan coast is the harvesting of various fisheries resources with different gears depending on the season. Yet another strategy is simply doing nothing during the "dead" period particularly when the climate is very harsh. The ‘dead’ period for the Kenyan south coast artisanal fisheries is during the ‘kusi’ when the winds are drifting south easterly driven by the ‘monsoons’ and the waters are rough for the local dugout canoes. It is during this period when most artisanal fishers venture into other strategies of sustaining their families mostly farming and business related activities.

Another successful strategy is to engage in artisanal fisheries during the "peak abundance" or the main season and to undertake another productive activity the rest of the year, such as transplanting rice especially in the area further down past Shimoni. Raising of poultry and livestock or just repairing farm tools for the villages are also common during the dead fishing period. Multiple livelihood sources are known to be useful to help reduce catastrophic natural effects. They are also useful in cases where fisheries management measures have to be imposed during certain periods of the year or on sections of the fishing grounds for management of the fishery.

Artisanal fishers here have also a propensity to take risks something which conforms to Fabio (2004) classification of artisanal fisheries as a risk taking profession. Varying degrees of risk are inherent in almost every decision made by an individual fisherman on when and where to go fishing or run for shelter, what method/gear to use, whether or not to change a fishing spot, which direction to set the gear, when and where to land the catch, etc. These fishers undertake even greater risks during southeast monsoons especially when they have to decide to venture into the waters. Such decisions are taken against the background of changing weather, the condition of the fishing vessel and equipment, and the daring ability of the crew. Besides, there is a pressure and need for food provision to the family. Although the making of these decisions depend on the fisher’s cultural and individual attitude, experience and skill is paramount as the element of hazard is omnipresent. An observation by McGoodwin (1990) that today, artisanal fishers are characterized by hard outdoor work, relatively low incomes, rugged individualism, a high degree of risk taking, the capture of common resources, low public esteem, dispersion captures the situation very well. Thus artisanal fishers along the Kenyan coast cope by muddling

4 ‘Kusi’ a local term used by the local fishers to refer to the period from the months of May to September when the waters are rough, weather is windy, lots of cloud cover and the winds are drifting south easterly. During this period, fishing activities are reduced as the dugout canoes become risky for fishing expeditions.
through, striving to live as they always have, pursuing the only life they know, attempting to adapt, trying to work around factors that threaten their existence and avoiding whatever seems most threatening for the moment.

2.1. Challenges to artisanal fisheries along the Kenyan coast

Along the Kenyan coast artisanal fishers face dire public and government neglect. Reviews from several literature (Christy, 1986; Colloca et al., 2004; Dahl, 1988; Boniface et al, 2002; Emmerson, 1980; Townsley, 1998) shows that in some countries artisanal fisheries are developing rapidly due to expanding markets (e.g. export markets) and adopting new technologies (multifilament nets, echo sounders, satellite positioning systems) this is contrary to the situation along the Kenyan coast. Here many difficulties abound. These authors have also documented that artisanal fisheries are given more attention only in countries where these fisheries contribute substantially to exports, have strong ethnic links with the political leaders or involve most of the population (as in island countries). On the contrary, it is generally not given priority consideration in a country’s modernization and development process. Most of the policy in Kenya guiding artisanal fishery focuses more on fresh water fishery of the inland lakes and which generates highly required hard currency from their exports. This neglect on the marine artisanal fisheries could be attributed in many cases to either lack of data or adequate understanding of their real contribution to the socio-economic or livelihood support mechanisms to those populations involved in artisanal fisheries.

There exists several artisanal fishery management problems and these pose challenges to fishery administrators as well. Most of the problems are difficult to solve due to artisanal fishers physical scattering along the edges of the aquatic systems or marine shores, including sometimes out of reach sites hence unsuitable to the conventional top-down approach that has been employed in fisheries management for decades. This phenomenon has also been captured by Robinson & Lawson (1983), Boniface et al. (2002) when they mention that it is commonly found in several areas of the world where artisanal fisheries is being practiced. In many parts of the world, there has been the challenge to decentralize management of fisheries (Svein & Mikalsen, 2004; Daniela & Lavkulich, 1996) to the stakeholders and to enhance co-management of artisanal fisheries. This has placed the burden on the artisanal fishers to take charge of their resources and to fortify their interests among the competing interests with other stakeholders. In many cases these other stakeholders are better educated and have a greater financial bargain than artisanal fishers.

Artisanal fishers work under some sort of open access regime also as already noted by Dahl (1988) and Boniface et al. (2002). In combination with increasing fish demand and commercialization, this has led to excess fishing capacity, resource depletion, waste of economic and human resources, and poor returns on development efforts. This open-access nature of artisanal fisheries makes aquatic resources an attractive livelihood option for rural people. However, this very advantage also constitutes a threat to sustainability in the absence of access to regulation with particularly negative impacts on people with exclusive dependence on aquatic resources. Artisanal fishers along the Kenyan coast have limited alternative livelihood options and this makes them particularly vulnerable to changes in the condition of
and access to ‘their’ aquatic resources on which they depend. From their point of view, greater control of resource use is advantageous as long as they have access rights.

Lack of recognition and protection of traditional or acquired fishing rights is yet another concern. The extent and nature of these rights (individual or communal, transferable or not) are still hotly debated and there is a danger of exporting industrial-sector solutions aimed at maximizing individual profits (Dahl, 1988; Hilborn & Silber, 1988) to artisanal fisheries. Along the Kenyan coast, fishing rights become non-existent the moment coastal lands become private properties. To develop and maintain the advantages of artisanal fisheries, the system of diversified family livelihoods should be protected and strengthened through rights of access. This option may however require some capital infusion if it is to succeed along the Kenyan coast.

Additional set of constraints and threats is from the high pressures exerted by different and interrelated coastal activities causing water pollution and destruction of fish habitats. Effluent discharge onto the coastal waters affects the regenerative capacity of these ecosystems to produce more fish for artisanal exploitation. Destruction of coastal mangroves negatively affect fisheries resources, especially during the early and most vulnerable life stages of many species. Moreover, the buffering capacity of mangroves is lowered drastically when there is wanton destruction hence survival of coastal communities become vulnerable in the event of storms, tsunamis and other vagaries of nature which are becoming more frequent as climate change effects become more drastic and frequent.

Increasing demand and high prices of coastal land is yet another common problem. Access to fishing sites are increasingly being hindered, as lagoon waters close to the lands purchased by private developers become protected and out of reach to many artisanal fishers.

Lack of infrastructure such as roads and communication facilities has hindered the development of artisanal fisheries. The infrastructure along the Kenyan coastal strip is in many cases not good and some regions are completely inaccessible by road. This in turn results in high costs of accessing markets causing fish spoilage as it takes time to reach buyers. Also, lack of infrastructure like power and electricity increases rate of fish spoilage as it hinders post harvest processing i.e. through cold storage and chilling.

Other challenges are brought about by continued population growth, immigration from the hinterland and development of industrial fishing which constantly add pressure on the artisanal fisheries as there is need to eke more from the same resources.

Artisanal fishers are extremely exposed to natural calamities like floods, inundation, sea erosion and storms and, in many instances; water-related parasitic diseases like bilharzias, river blindness, filariasis or malaria. As a consequence of the diversification and seasonality of their activities, many small-scale fishers show high geographic mobility and do migrate over hundreds of miles in search of new fishing grounds. A case in point along the Kenyan coast are the fishers from Pemba island who move for kilometers down from the Tanzanian island of Pemba to camp at Gazi fish village while doing fishing activities on Kenyan fishing grounds. This mobility encourages spread of infections and constantly exposes fishers to new infections.
Other challenges faced by artisanal fishers along the Kenyan coast are: sporadic incomes, community members and a general public who often hold them in low esteem, and fish dealers who absorb a large share of their earnings. Closely related to the sporadic incomes is the lack of adequate reward from the markets: artisanal fishers drive little from the markets. They have to deal with fish dealers, normally wealthy fish merchants who buy fish landings from fishers at low prices and later sell at the local or far-flung markets at higher prices. These fish dealers in many instances lack competition and hence fix prices arbitrarily; in worst cases they delay buying hours until the fish is almost spoilt to acquire the fish at the landings to throw away prices. Before the emergence of the fish dealers, artisanal fishers used to give apportion of the landings to fish mummies for sale after taking enough for their home consumption. In many cases, these fish mummies were either married to the fishers or were close members of their family. In many cases, they took the fish on credit to pay the fishers once the fish had been sold. This system enabled many members of the fishing community to take part in the exploitation of the fishery resources. However, with the emergence of stronger and wealthier fish dealers or merchants who are able to pay for fish catches upon delivery at the landing sites, fish mummies have been pushed to the periphery. Overtime, the wealthier fish dealers seem to have won and the number of fish mummies has dwindled. This waning of involvement of local women in form of fish mummies in artisanal fisheries exploitation reduces the spread of fisheries benefit to a larger number of the community members.

Artisanal fishers have to contend with many other people whom they regard as meddlesome and at worst as threatening. This group includes, fisheries managers who sometimes implement policies in imperious manner; misguided develop-mentalists, who may involve fishers in ruinous culture change; environmentalists, who are critical of fishers’ practices and who may threaten their economic well-being; tourists who compete for valuable shore space while sometimes offending fishers’ personal values; and sometimes security officials who interrupt their operations in search of illegal drugs, immigrants etc. Some of these challenges are also common to artisanal fishers in other parts of the world (McGoodwin, 1990).

**Possibilities for overcoming the challenges facing artisanal fisheries**

The sustainable development of small-scale fisheries is essential for a balanced social, economic and regional development in coastal and regional areas. To overcome general challenges that are common to most artisanal fisheries it would require, inter alia, increased political and economic support; more favorable fishery development policies and strategies; integration of fisheries into rural development and coastal area management; better identification and allocation of resource rights; stronger protection of reserved fishing areas from intrusion of large scale fisheries (which will require elimination of overcapacity in these fisheries); enhancement of competitiveness in using capital resources; adoption of decentralized, participative management processes; facilitating the development of strong local institutions as a vehicle for empowerment and decentralization; control of fishing capacity and creation of alternative employment; promotion of technological progress, to reduce negative impacts on the environment and improve product quality; better access to credits and inputs, markets and services.
2.2 Advantages of artisanal fisheries along the Kenyan coast

*Low or no running costs and no fuel consumption*: most of the vessels are non-motorized and optimize human power in using more passive gears and practices such as hand-lining, gillnets, fish traps and light attraction. Thus, maintenance costs are relatively low with occasional servicing like boat curing (fig. 2a).

![Curing of a dugout canoe at Mwaepo landing site](image)

*Fig. 2a: Curing of a dugout canoe at Mwaepo landing site*

*Reduced ecological impact*: although artisanal fishers sometimes use destructive methods (such as poison, dynamite, and spears guns), their environmental impact is much lower especially in view of the fact that they mostly employ passive gears. However, increased number of artisanal fishers especially within the lagoon waters could be source of destruction and over-exploitation of near shore stocks. These fishers have low capacity to venture into the offshore waters.

*Source of employment opportunities*: artisanal fisheries are largely labor-intensive and are suited in rural areas where they are more entrenched due to high demographic growth. In turn it offers employment in catching as well as processing and trade of fish and fishery products. Furthermore, the motivation of the fishers is guaranteed and self-sustaining because their undertakings are done out of habit.

*Greater versatility*: involves use of shallow crafts operating from no ports at all and mostly from landing sites relatively close to the fished resource. Due to the small sizes of the boats, artisanal fishers are able to exploit both the open areas along the coast as well as restricted waters that would be difficult, even dangerous to enter, for larger vessels or industrial fisheries. On the other hand this however makes them qualify as one the fishery exploitation strategies that are often a threat to the closed or rather restricted spawning grounds.

*Minimal construction costs*: since small-scale dugout canoes are not intended usually to stay out long, nor go far offshore, they are relatively easy (and inexpensive) to make and fishers either stay ashore or else run for nearby shelter when the weather becomes unfriendly. These
canoes/boats are mainly used during the day or at night, for a period of usually not more than 10 hours.

The making of a canoe involves the use of a large tree (fig. 3); usually a mango tree is preferred along the Kenyan coast. These trees are found in the fishers’ farms or for those who do not own them, they are bought at an approximate cost of Kenya shillings fifteen thousands (approximately 150 Euro). The trunk of the tree is cut to about 6 meters which is then chopped either at the spot where the tree was felt or transported close to the beach for chopping. It takes about a one man/month to dig out the canoe by use of a chisel, axe and a hammer. A ready canoe is then treated by an insecticide or tar for preservation. Some canoes are painted also for preservation.

In some cases fishers enlarge the canoes by adding planks of wood on the sides of the canoe and even attach outriggers (fig. 2b). The latter have a greater carrying capacity and stability. A simple dugout has a market value of about Kenya shillings forty five thousands (approximately 450 Euro). The price for a more advanced boat may go up to Kenya shillings one hundred thousand (approximately 1000 Euro).

![Fig. 2b: A dug-out canoe fitted with outriggers](image)

There are several simple techniques of maintaining the canoes once they are ready and in use. Four ways were readily observed, namely:

- Fire curing: involve the treatment by fire to remove insects see fig. 2a
- Pulling the boat ashore for several months especially during the low fishing seasons. This was effective in driving out certain insects and mollusks commonly found within the coastal marine waters and which eat into the woods making the canoes
- Application of tar, mostly to seal the holes in the wood and also repel insects intent on penetrating into the wood making the canoe
- Sealing cracks by use of metal plates, rubber of used tires or by wooden planks of wood
A well maintained and mended canoe can last for at least five years. Its original value approximates the market value of fish caught by a fisherman within about a half a year.

![Image: Construction of a dug-out canoe in Ukunda](image)

*Fig. 3: Construction of a dug-out canoe in Ukunda*

*Less expensive technology:* Artisanal fisheries require relatively low investment in technology and equipment and thus remain more competitive in most developing regions where labor is cheaper than equipment. In such cases, resources within the technical reach of the small-scale sector are usually most profitably harvested, with greater returns on the less capital invested as may be compared to industrial fishing.

*Relatively larger fishing crafts common towards the Kenya/Tanzania border*

The conformity of the boats is more striking in the study area as only dug-out canoes are used albeit differing in size. Those relatively higher and fitted with outriggers are common towards the south near the Tanzanian border where also large boats are found (fig. 4a & 4b). Consequently, the catches also increase as one moves south of the coast towards the Tanzanian border.
Close to Tanzania border exists boats ranging from 10 -11m in length and with width of about 2m and a depth of 1.5m. Wooden masts could have heights of 8.5m and the rectangular sailcloth measures about 6.5 by 6.0m. They are comparatively seaworthy compared to the dugout canoes and are used to employ encircling nets to even far fishing grounds. These boats can go up to 350m from the shore during calm seasons and when the weather is good.

2.3 Estimated number of artisanal fishers along the Kenyan coast

There exist about 4000 to 4500 artisanal fishers along the Kenya coast (UNEP, 1998), using different types of gear including traps, hook and line, seining, gill netting, spear fishing and gleaning. The fisheries landings at the Kenyan coast are estimated from 6000 to 9000 metric tons per year (UNEP, 1998). Approximately 80% of the marine fish catch is demersal, mainly from shallow coastal waters and reef (ICAM 2002 and Weru, et.al. 2000). The catch mainly includes finfish of the families Lethrinidae, Siganidae (rabbit fish), Scaridae (parrot fish) and Lutjanidae (snappers). Crustaceans, including crabs, lobsters and prawns, and octopi are
commonly collected during low tides in reefs, seagrass beds or mangrove (Kimani et al., 1996). Virtually unkown is the amount of fish taken offshore by foreign vessels and not landed in Kenya.

2.4 Common fishing gears along the Kenyan south coast

Gear type and their deployment can immensely affect not only the efficiency of capture and reward to the fishers but also the productivity and sustainability of the fisheries. Proper documentation, especially by the fishery administrators, and understanding of the choice of the gears, combined with the cultural and social conditions of the fishers is important to enable a complete appraisal of the approaches applied by the fishers. This in turn also assists in the development of feasible management approaches that are not only favorable to the fishers who depend on the resource but also the stock itself. Ruddle (1996b) and Stergiou et al 1996 have further pointed out that this could be useful in management of the artisanal fisheries. Further, national governments’ regulations could be more successful if they focused on regulations that reduced overlap in the selectivity among gears, the size of the fish caught, and the knowledge of the fishing gear traditions as held by the local fishers themselves.

Fishing gears used by Kenya’s artisanal fishers in many cases are suited to ensure that they catch fish by size and species at sizes that do not necessarily undermine sustainability of the fishery resource. Many of these gears are also in tandem with fishery management principles as expounded by Darzell (1996). Gears that do not conform to generally acceptable principles on catch selectivity like the seine nets are normally banned by consensus. For instance, local artisanal fishers in some landing sites had ganged up against the use of the beach seines (Glaesel 2000b and Obura, 2001). Others like gill nets may take a wide variety of species at varying fish lengths. They can also be easily controlled by varying the size of the mesh. This ability to vary mesh sizes of fishing nets is an old tool of fishery exploitation control and management being used almost everywhere along the Kenyan coast to control fish sizes being captured.

2.4.1 Spears

In their crudest forms are made up of sharpened poles measuring about 1.5-2.5m and are used to impale fish. Fishers have since then improved on them to have blunt poles with detachable end section of firm but flexible wire that is projected by a rubber strip (fig.5). Many of the fishers using spears do not have the boats or canoes and thus snorkel within the shallow lagoons hunting for fish and invertebrates during low tides. Are relatively selective as fishers using them mostly go for larger individuals
2.4.2 Hand Line

Hand-line fishing, or hand-lining, is fishing with a single fishing line which is held in the hands. One or more lures or baited hooks are attached the line. A variety of bait is used, including worms, pieces of crabs, squid or octopus. Usually a weight and maybe a float are also attached. Hand lining is one of the oldest forms of fishing and is still common along the Kenyan south coast. Both ground lines and floating lines are common within the study area.

The line can be jigged or moved up and down in a series of short movements, most often close to the seafloor. The motion attracts the fish, which are normally caught while trying to eat the lure but also as they move close to the jigged lure. The line is then hauled in and the fish removed. Hand-lining is most often used to catch ground fish and squid but other species are sometimes caught, including pelagic zone species. Generally, small hooks are used for benthic species in near shore along the Kenyan coast.

Fig. 6: Drawings of hand line (main line refers to the line to which all the hooks are attached)

Hand lines are inexpensive and easy to use. They can be used in any shoreline and the catch is normally live and of high quality. A wide variety of sizes and types of hooks can be used to lure
the fish thus making them very selective. In spite of these advantages it is labor intensive. Again, very limited number of fish can be captured per line and usually some bait is required.

2.4.3 Basket traps

These are one of the most common and traditional fishing methods used in Kenya (fig 7a and 7b). These are devices that fish or shellfish enter in search of shelter or food, or because an obstacle is placed in the fish’s normal path of migration. They are so designed that getting out is harder than getting in. They are mostly used to catch demersal fishes also octopus and cry fish (fig. 7a).

Along the Kenyan coast traps are made of wood and reed strips that are interwoven making hexagon patterns and have one funnel entry. Traps are lowered from a canoe and held on the bottom by large stones. The position is indicated by a float tied to the traps by a string. They are usually left overnight with a mixture of plant and animal bait (algae, crushed sea urchins, brittle stars and mollusks) and checked on daily basis. Trapped fish are removed and the trap is reset in the same place or nearby.

Fig. 7a: Setting up fish traps (Source: Australain Fisheries Management Authority –fishing methods for students. www.afma.gov.au/information/students/methods/b_s_gillnet.htm)

Fig. 7b: A diagram of a basket trap

Fig. 7c: A plan of a basket trap
Basket traps can be tailored to species and size. Since they are made from local materials they are inexpensive and usually require no bait. A big advantage of this fishing method is the high quality of the live catch. However, their construction requires skill and knowledge of the fish movement. They are also bulky and take considerable space on a vessel. Their handling is difficult and hauling arduous. Their biggest limitation is the high loss due to theft, storm damage, degradation of the material and the difficulty to locate once the float is lost.

2.4.4 Gill nets
A gill net is an upright wall of fiber/nylon netting. A fish of a size for which the net is designed, swimming into the net, can only pass part way through a single mesh. As the fish struggles to free itself, the net twine slips in back of the gill. The fish is thus gilled and can go neither forward nor backward. Various mesh sizes are employed, depending on the species and size of the fish to be caught. The great advantage of entangling nets is their selectivity. The way the net is hung and its depth determine the species of the fish captured. The size of the mesh also selects fish species of a specific size. Fish whose girth is smaller than that of the mesh opening are able to swim through, large fish will not enter the mesh but will be scared away. So only fish in a narrow size range will be captured by a gill net of a given mesh size. Along the Kenyan coast gill nets are mostly made of single nylon (monofilament). The nets are approximately 25 m long and 1.5 m high with a diagonal mesh size of 6cm and ~1kg of lead weights fastened on the bottom and ~10 – 15 floats fastened on the top (fig. 8a and fig. 8b). The weights are mostly of composed of coral stones and the floats of old flippers as shown in fig. 8b.

![Diagram of gill net](image)

Fig. 8a: A diagram of gill net

Gill nets are easy to operate as even a lone fisherman can manually deploy a gill net from a small craft or canoe. Floats and sinkers can be made of local materials like coral stones being used as anchors (fig. 8c).
These advantages are balanced by serious liabilities; they cost more than hooks or traps. They require a high degree of maintenance. Picking fish out of the net is labor intensive although this is no problem in the labor abundant Kenyan coast. Since the fish are usually dead when harvested, they might be of low quality. Ghost fishing is yet another problem with the gill nets particularly those made of synthetic fibers. If lost, the nets continue to trap fish, because the fibers are not biodegradable. It is becoming advisable to make the twine holding the netting to the floats to be of a natural fiber, which can rot with time rather quickly.

2.4.5 Set-Net

Set netting involves setting of the gill nets across the current to intercept fish as they swim with the current. The nets are held in a stationary position by an anchor at each end. An anchor can be a stake pounded at the mud or even large coral stones.

These nets can stretch from 20 to 25 meters with a width span of 5 meters with the distance between sinkers being approximately 1.5 meters (fig. 9). Set nets are weighted down at the bottom to anchor it to the seabed.
The set nets can further be categorized into two (Tuda et al., 2008), namely:

a) Bigger set nets – those with large mesh size targeting large fish such as sharks, with mesh size range of 5cm to 12 cm and mostly used offshore.

b) Smaller set nets – those with smaller mesh sizes, ranging from 1.5 to 2.5 cm and normally set in channels along the path of fish.

2.4.6 Cha-cha
This is an improved version of the set nets where the nets are arranged in such a manner that their mesh sizes is gradually reducing (fig. 10). The sinkers and the floaters are also arranged in a manner that the nets can move at varied water levels. Thus, cha-cha is operated in such a way that fish are caught depending on their sizes in the different nets. This net is mostly used to target the sardines and sprats (Tuda et al., 2008).

2.4.7 Beach seines
Beach seines are also called pull seines deriving from the involved pulling whenever they are in use. Are normally jointed pieces of small mesh size nets (usually with a mesh size of about 2.5cm) each being about 25m long and can go up to 4.5m deep. Coral stones (in a few cases lead weights are used) are tied at the bottom of the seine net to act as sinkers.

They are especially used for catching seasonal pelagic species as they feed near shore. They are most often set from the canoes. One end remains on shore, while the rest of the net is set in a curved path and brought back to the beach (fig.10). The net reaches from the bottom to the surface.

![Fig.10a: Setting a beach seine](image)

Once the second drag line is delivered ashore, the hauling begins. The ocean bottom and water surface act as natural barriers for the encircled fish in the net. The contents are dumped into a dugout canoe and the crew moves to another location to repeat the procedure. Seines are frequently deployed from the beach, but are also deployed further offshore using canoes and are even used on the windward side of the reef during calm periods.

Large beach seines are costly. Their use is mostly restricted to large stretches of smooth, shallow bottoms with fairly mild surf. The net is species-indiscriminate and may catch large number of juveniles.
2.4.8 Ring net
Ring nets are typically costly gears used by industrial (large scale) fisheries targeting pelagic fish in surface waters. They were only recorded in one landing site, Gazi, perhaps because of the high cost of the gear. Foreign fishers especially those from Vanga and Tanzania own most of the ring nets used at the Gazi fish landing site. Many of ring nets are seen as from August to May during the fishing season – locally known as the Kazkasi⁵ - period when the ocean is calm.

Fig. 10b: Ring nets loaded onto a boat

Ring nets also called purse nets are long, deep, continuous stretches of nets (fig. 9) that are set from a catcher boat to encircle a surface shoal of fish. A process called pursing can close off the bottom of the net.

Pursing has the effect of trapping any encircled fish on a bowl of netting. The trapped fish are eventually lifted aboard the catcher boat. These nets target a range of species including; kingfish, mackerels, bonitos and tunas, barracudas, silversides, and sardines.

⁵ Kazkasi is a local term referring to the period between August and May when the water is calm with less wind. It is the period of the northeast monsoon winds, usually from October to April. Much of the fishing is done in this season as the dugout canoes can access the calm ocean contrary to the case of Kusi when the winds are dry and strong and the monsoon winds are drifting south east usually from May to October.
3 AREA OF STUDY

3.1 Natural geography of the study area

The coast of Eastern Africa extends for over 7,000km (4,000 miles) (UNEP, 1998; Okemwa and Sted, 1995), from the northern tip of the horn of Africa to Cape Town, and is home to the people of Somalia, Kenya, Tanzania, Mozambique, and South Africa (fig. 11a).

![Map of Eastern Africa showing coastal states](image)

*Fig 11a: Coastal states of Eastern Africa*

The coast north of Kismaayo in Somalia is strongly influenced by an upwelling of colder, nutrient rich water from March – October (Swallow et al. 1991). As a result, there are marked changes in sea surface temperature during the year, varying between 17°C and 30°C. The central and southern region, from Kismaayo all the way down to Cape Town in South Africa (fig.14a) is exposed to consistent, tropical, environmental conditions throughout the year, with seawater temperature usually between 24°C and 31°C. This region extends for approximately 4,500km and includes some of the EEZ of Somalia (approx. 300km), and the entire coastlines of Kenya (500km), Tanzania (900km), and Mozambique (2,800km), and largely the north–eastern portion of South Africa coast of approx. 100km (Schott, 1983; Swallow et al. 1991; Okemwa and Sted, 1995 and UNEP, 1998;).
Within the tropical portion of the eastern Africa coast, the shore and coastal seas harbor a characteristic set of species, habitats, dynamics and environmental conditions. This coastal region, functioning largely as a unit, or ecological region, is called the Eastern African Marine Eco-region-EAME (UNEP 1998, Sherman & Hempel, 2008).

### 3.2 The Kenyan coast

The Kenyan coastline, approximately 500 Km long, stretches from 1° 42’S to 4° 40’S bordering Somalia in the north and Tanzania in the south (fig. 11c). It forms the northern extreme of the tropical East African coast, which stretches another 3500 km south through Tanzania and Mozambique. Northwards, the Somali coastline extends at further 1500km, with a transition from the warm water environments of East Africa coast to the seasonal upwelling system of the Somali current. The Kenyan coast is variously identified as part of the Somali Current Large Marine Ecosystem (Okemwa et al., 1995) which extends south to Dar es Salaam and is based
primarily on ocean current dynamics and the Somali Current dynamics, and the East African Marine Eco-region (UNEP, 2006) which extends from Kismayu in Somalia to southern Mozambique, and is based on coastal marine ecosystem characteristics dominated by the interaction between the Southern Equatorial Current and the African coastline.

![Bathymetric positions of the Kenyan coast](image)

**Fig. 11c: Bathymetric positions of the Kenyan coast**

The width of the continental shelves ranges from 19km in the North to about 120 Km in the central part off Malindi (Central Bureau of Statistics, 2001a; McClanahan and Obura, 1995). Well-developed fringing reef systems are present all along the coastline except where major rivers (Tana and Athi/Sabaki) discharge into the Indian Ocean. Patch reefs occur around Malindi in the north and in Shimoni in the south. Sea grass beds are also dominant and are usually associated with reef systems growing in shallow lagoons, creeks and bays. Mangrove forests are well developed in the Lamu archipelago, where 70% of Kenya’s mangrove occurs (Gang, P.O., and J.L. Agatsiva. 1992; McClanahan and Obura, 1995).

### 3.2.1 Hydrographic features and oceanic currents along the East African coast

Kenyan coastal waters are mainly influenced by four oceanic currents. These are the south Equatorial current, the east African Coastal Current, The Equatorial Counter current and the Somali Current. The westward moving south Equatorial Current divides into two branches once it reaches the African Coast at Cape Delgado. It gives off the Mozambique Current which flows southwards, and the East African Coastal Current which flows north-eastwards, parallel to the coast.
The East African Current flows northwards all the year round as far as Malindi. During the Southeast monsoons it continues beyond Malindi northwards, joins with the Somali Current and continues right to the horn of Africa. During the northeast Monsoons, however, the northward extent off the East Africa Coastal Current is more restricted. At this time it meets and joins the southward flowing Somalia Current (which changes direction under the influence of the monsoon) with the convergence-taking place anywhere between Malindi and north of Lamu, depending on the strength of the monsoon in any particular year. The two streams the turn eastward and flow offshore as the Equatorial countercurrent (Sherman & Hempel, 2008).

The Somalia Current is the only one that reverses it direction of flows under the influence of the monsoon. It flows in the southwesterly direction at about 1.5-2 knots during the Northeast Monsoon. During the southeast monsoon, the Somalia Current reverses its flow and increases its velocity to around 2-2.5 knots. It now appears as the northwards extension of the East African Coastal current, which still arises from the onshore South Equatorial Current. At this time of the year, the Equatorial counter current is not so distinctive from the general Southwest Monsoon Drift at the lower latitude of the Indian Ocean. The net onshore current result in sinking of surface water along most of the coast except near Kiunga where some mild upwelling is thought to occur during the Northeast Monsoon.

Coastal waters are characterized by semi-diurnal tide – approximately two cycles for every 24-hour period. Except for limited periods in the year, however, the level of high and low water of each successive tide differ appreciably from the corresponding tide before and the tide following. The tides can therefore be designated as maxed semi-diurnal tides.

Maximum tides range in Kilindini does not usually exceed 3.8 m. Tidal range for Malindi is 2.0 m for neap tide and 2.9 m for the spring tide (UNEP 1998)

Sea surface temperatures and to a lesser extend salinity are influenced by the Monsoons and tides. During the southeast Monsoon the shifting of Ocean currents brings Pacific Ocean water of high salinity into the south Equatorial current, while during the Northeast Monsoon the south Equatorial current draws water of lower salinity from the Malay Archipelago. Discharges of all the major river systems during the heavy rains of March to May further influence salinity. Surface salinity in coastal waters varies from a minimum of 34.5 ppt. to a maximum of 35.4 ppt. Sea surface temperature reach a high of 28°C - 29°C following the Northeast monsoon in the month of March and April and a minimum of 24°C in the lagoons while falling to 25°C between June –September (UNEP, 1998).

3.3 Climatic condition of the Kenyan coast

The Kenyan coast has a tropical climate influenced by monsoon winds (fig. 12a) of the Indian Ocean. Two distinct monsoon periods occur, the northeastern monsoon (NE) (locally known as ‘Kaskazi’), which blows from September to February and southeastern (SE) monsoon (locally known as Kusi), which blows from March to August (Meinrat et al., 1996; Swallow et al, 1983).
Fig.12a. Movement of monsoon winds along the Kenyan coast

The northeastern monsoon usually brings calm and hot weather. The wave height also drops during this time. The southeastern monsoons are usually windy with cool temperatures and rough seas (fig. 12a). Rainy seasons occur between the monsoons period with the long rains occurring from March to May and the shorter rains from October to December (Swallow et al, 1991; CDA, 2002). Thus, June to September and January to March are mostly dry seasons (fig. 12b).

Along the Kenyan coast exists also a strong semi-diurnal tide (Tuda et al., 2008), with two cycles in a 25 hour period and a strong cycling between neap and spring tides twice during a lunar phase. Jiddawi et al. (2002) points to the fact that the timing of the high tides and low tides over the lunar cycle is stable such that the peak of the morning high tide on the first day of the new moon occurs at about 2 am ± 30 min throughout the year.
Mean annual rainfall ranges from 500 mm in the drier hinterland in the north to over 1 000 mm in the wetter areas south of Malindi (CDA, 2002). Highest average wind speeds are recorded between May and September (9.3 - 9.8 knots). Wind speed shows a daily pattern whereby wind strengths drops during the night and increases during the morning. Sea breezes of cool soothing winds blow during the day from the ocean to the land during the day with land breeze of mild warm wind of cool wind moving from land to the sea at night. Average maximum temperature in Mombasa ranges from 28 - 32°C, with highs between January and March and lows in July and August. Average minimum temperature in Mombasa ranges from 21°C in July and August to 24°C between February and April (UNEP 1998, Sherman & Hempel 2008, Swallow et al, 1991).

3.4 Geology and geomorphology of the Kenyan coast

Three physiographic zones are distinguished in the Kenya coastal zone. The Nyika lies at 600m above sea level and represents the higher ground covered by the Duruma sandstone series and older rocks to the west. The foot plateau occurs between 140 and 600m above sea level and coincides well with the relatively younger Jurassic rocks (Abuodha, 1992). The coastal plain rises
from sea level to 140m and is from a few km wide in the south to cover 40km in the north. The geomorphology of the coastal plain is dominated by a series of raised old sea level terraces. Most of the coastal environment and the modern shore configuration follow the 0-5m and 5-15m sea level terrace complexes (UNEP 1998).

According to Abuodha (1992), the principal rock observed along the coastal margin is of sedimentary origin and range from triassic to recent. The Duruma sandstone series, the oldest formation, is represented by the Mariakani and the Mazeras Sandstones which were deposited under sub-aqueous, deltaic, lacustrine or possibly nitric conditions that prevailed during the opening of the Indian Ocean. Marine limestones and shales with occasional horizons and early limestones represent the upper Mesozoic. Cenozoic to recent rocks comprises mostly of marls and limestones, and is represented by the sandstone, clays, conglomerates and gravels such as the marafa beds. Quaternary representatives include windblown Magarini sands, limestone, cemented sands and coral sands. Recently unconsolidated windblown sands, beach sands and clay overlie the older units.

The coastal region is generally low lying and characterized by the extensive fossil reef, which lies a few meters above present sea level. The coastal plain is backed in the interior by a line of hills that rarely exceed 300m (Abuodha, 1992).

The shoreline in most of the region apart from the Malindi area is receding as a result of coastal erosion (UNEP, 1998). Sand supplies from rivers and coral reefs are not sufficient to keep up with the rise in sea level and the problem is further exacerbated by coastal development.

### 3.5 Human geography of the study area

The population density for Kenya as a whole is 44 persons/km². Along the coast it ranges from 10/km² around Lamu to 280/km² around Mombasa (UNEP, 1998; Central Bureau of Statistics, 1999). In rural areas like the study sites near the Tanzania coast it is even much lower than the 10/km² given for Lamu. The main economy within the coastal urban centers is maritime commerce and tourism. The latter depends heavily on the rich biological diversity including the sandy beaches, beautiful reefs, clear waters and the health of environment. Outside the urban centers, the main economic activities include food production, artisanal fisheries and small retail service enterprises.

#### 3.5.1. Historical and ethnographic backgrounds

The Kenyan coast has played an important cultural role since the 8th century AD, in East Africa, when merchants toiled from Arabia in search of gold, spices, ivory, other goods as well as slaves. Since then, Arabs who had come to trade settled, intermarried, and mingled with coastal Bantu people. During the same period they founded colonies along the coast and came to dominate a large part of the Kenyan coast for many centuries to come. They created a new language called Kiswahili and a culture known as swahili which is still alive today in Mombasa, Lamu and Wasini Islands. This coastal culture, which is a blend of Arabic and Mijikenda
(indigenous), has provided Kiswahili ⁶, which is a national language in Kenya (Spear, 1978; Ngweno 1995). The Arab and Persian traders also brought their religion with them – today the majority of the people in the coast region are Muslims.

In 1498 Portuguese explorer Vasco da Gama’s ship landed in Malindi on his route to India. The European colonial period of Kenya history began. In 1515, Francisco de Almeida’s armada staged a full-scale invasion of several coastal cities. In 1525 the Portuguese returned again to ransack Mombasa. In Mombasa they built Fort Jesus as a stronghold, which still is a main tourist attraction.

However, the Portuguese only gained a partial control over the region and attempts to convert the population to Catholicism generally failed as the Arabs kept several strongholds. In 1698 Mombasa fell to the Arabs from Oman after a 33-month siege and in 1729 the Portuguese left East Africa for good. The Omani Arabs, who heavily increased the slave trade, were seen by the Africans as being hostile just as the Portuguese (Spears, 1978).

Oman came under British influence, and became a British protectorate. The British then became an external force dominating the region. At the 1885 Berlin conference, at the height of European colonialism, the European powers divided Africa and Germany took colony of Tanganyika (Tanzania) while Britain was awarded Kenya and Uganda. The British rule lasted for seven decades until 1963 when Kenya became an independent democratic republic.

3.5.2 The Digo people of the study area

The population along the Kenyan coast like elsewhere in Eastern Africa – can be divided into three (language) groups: the Bantus, Nilotes and Cushites. The Cushitic-speaking peoples moved into Kenya from North African territory around 2000 BC (Ngweno 1995, Spear 1978). They were hunter-gatherers, but also livestock herders and farmers. Today they form only a small part of the population: for example the Somali, Boni, Rendille and Wata herders.

Larger language groups are the Bantu and Nilotic peoples, who moved into Kenya from about 400 AD (Ngweno 1995, Spear 1978). The Bantu peoples came from the Nigeria and Cameroon region (in West-Africa). From them, the Kikuyu, Mijikenda, Dawida, Taveta and Akamba tribes emerged. The Bantus brought new technologies, such as iron working. They were mainly farmers but they supplemented this with herding, fishing, hunting, gathering and trading their iron products with the other tribes who mainly limited themselves to hunting and gathering. The Masai, Luo, Kalenjin and Turkana tribes are Nilotic. Today they form the bulk of the Kenyan people.

The people living in the study area are mainly the Digo, a Bantu speaking sub-tribe of the Mijikenda. They are also the leading tribal group living within the Kenyan coast. The Digo are one of the nine clans who make up the Mijikenda, the name itself meaning “the nine ‘Kaya’”. In the late 1940s, when there was agitation among the coastal communities to form co-operative

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⁶ Kiswahili is a language, which came as a result of the interaction of Arabs and Bantus during the early trade in the Kenyan coast. Kiswahili is today the national language in Kenya.
political organizations, the Mijikenda Union was born, hence giving rise to the name ‘Mijikenda’ (Spear, 1978). For protection against marauding Maasai and Samburu, they preferred to live in fortified forest hilltops called ‘Kaya’s’ mainly along the low plateau running North-South some twelve miles inland of the Kenya coastline (Government of Kenya 1998, Ngweno, 1995).

Since the 15th and 16th centuries, the Digo lived in the plains and hinterland ridges of the Kenyan coast, south of Mombasa where they built the first ‘Kaya’ in Kwale in the hinterland and later ‘Kaya’ Kinondo close to the shoreline (Spear, 1978). Dispersing later to the coastal plains in the 17th century the Digo established other sub-‘Kaya’ along the coast of Ukunda (also known as Diani), Tiwi and Pongwe. In these regions, they conducted a flourishing trade with the Swahili settlements near them and established close connections with the Vumba (Swahili group) at Vanga, which they maintained into colonial period (Spear, 1978).

In the early 19th century, the Vumba-Digo caravans began to pioneer long distance trade into the interior along the regional routes earlier established by the Digo (Spear, 1978; Ngweno, 1995). After mid 19th century, they pushed beyond Chagga to Samburu and Lake Victoria bringing back ivory and slaves. In spite of their previous hold on most of the trade between the coast and the interior by the middle of the 19th century, the Digo lost their hold on trade to the Swahili and Arabs associated with the empire of Zanzibar (Ngweno, 1995). Since then most of them have been very keen in exploitation of the coastal fishery resources.

Although the Digo, compared to other Mijikenda tribes, accept Islam as their religion, they are still deep into traditional practices such as animism (the belief that non-human objects have spirits) and ancestor worship (praying to ancestors for help and guidance). This form of spiritism is exemplified in their use of blood sacrifices to ancestral spirits and consultation of witchdoctors especially during exorcism of evil spirits. This notwithstanding, Islam has influenced their political and religious structure for instance they have adopted foreign attitudes and diets from Muslim Arabs.

3.5.3 Emergence of commercialization and tourism influences

Although the history of the local people before the coming of the Arabs is less documented, it is reasonable to believe that fishing played a major role in their lives particularly through the traditional systems of collection of marine products like crabs and mollusks. The inhabitants of the coastal community within the south coast of Kenya are mainly fishermen, peasant farmers or a combination of both. Besides being well entrenched artisanal fishers, one also finds a strong case of farming. They grow mainly maize which forms the bulk of many a Kenyan community staple food as well as vegetables of various kinds and several fruit trees, the most common being coconut palms and mangoes. In each of the homestead or in their vicinity at least a few coconut palms can be found. While most members of this community had a claim to some small farms or attended those owned by their parents or relatives, many of them also take part in fishing activities. The younger members also look for jobs either as casuals or permanent laborers in the tourist hotels and tourist facilities. A few of the village sons and daughters became married to Europeans who were at one time visiting tourists. During the period of study, several of them were putting up magnificent concrete houses within the community - an indication of external cultural influence.
The older women are mostly found within vicinity of the homesteads, either attending to their grandsons and granddaughters, or assisting with midwifery and traditional medicine. Young women are engaged in trading activities like selling of fish catches, with some selling attires and other tourist related wares along the beaches. In Chale-Kinondo landing site, the younger women prepare the food either at the landing site or prepare it at home and take it to the fishermen at the landing site. Here they sell the food to the fishermen at affordable rates. Their patience in demanding for payments from the fishermen remains admirable. There also exists an appreciable respect between them and the fishermen, majority of who are their relatives.

3.5.4 Major stakeholders and human activities within the study area

It is vital to appreciate the inter-play between the various stakeholders involved at the site of study. An attempt has been made to present the main stakeholders, their composition as well as their main interests. Below is a list of some of the major stakeholders identified:

**Fishers:** Most of the fishermen in the area are the Digo and they constitute the bulk of local coastal inhabitants along the south coast of Kenya (Ngweno, 1995). Personal observation and several discussions within the landing sites showed that there were a few migrant fishermen from Pemba Island in Tanzania. Some of them visit periodically, while others have settled in the area and intermarried with the local populations especially at Gazi landing site. All the fishers are men; women are involved only in fish processing, marketing and to some extent gleaning. During high tourist seasons fishers with better vessels also specialize in taking fishing forays with tourists. When the tourism seasons ends, they turn back to their normal occupation of fishing and part-time farming.

**Hoteliers:** They own and manage hotels, bars, clubs, cottages and restaurants situated along and immediately behind the beaches (Tourism Trust Fund, 2001). They form the largest financial investment block in the area and play an important role in its cultural dynamics. There exists some conflict between them and the fishers. Most of these conflicts derive from access to the beach. Hotels and tourist establishments, desire of limiting access of local persons including fishers to certain sites frequented by tourists - both on land and water. This is to ensure safety of the tourists and their belongings and also to accord the tourists some privacy while enjoying their vacations. Because of their monetary power, they have been able to exert a considerable influence on beach management and policy issues, in some cases to the disadvantage of other stakeholders i.e. their campaign to have the beach traders restricted to certain areas.
Beach Operators: over 2500 beach operators are estimated working in the area, including beach hawkers, curio dealers, tour guides and operators (for safaris and diving), taxi drivers, wood carvers, massage parlor operators, and camel operators (CDA, 2002). These groups have the greatest pressure from the hoteliers who consider them competitors to their businesses. Furthermore, the hoteliers blame beach operators as a potential security problem to tourists’ belongings.

Boat operators: This category includes the large fishing and diving boats. They ferry tourists to points of interest. Personal observations and discussions proved that most of them are owned by Europeans and a few rich local people but no local artisanal fishers. There exists a conflict here as well between the hotels and large boat operators on one hand and the artisanal fishers on the other hand. Some tourists normally show interest in joining local fishers on fishing trips, but they are cautioned against it by the hotels and large boat operators on the pretext of lack of safety and insurance coverage.

Women: they provide a vital support service and hence play a key role in the economic activity of this area. Relatively a few gain livelihoods from the tourism or fishery industry. The main economic activity of the women is production of coconut oil, maize flour milling, merchandising of fish and related products.

Sport fishing: is becoming an increasingly popular activity in the area (Tourism Trust Fund, 2001). Foreign and Kenyan tourists are the main clients (Central Bureau of Statistics, 2001b). Their catches and their value are difficult to quantify since the fish catches are consumed by those involved in sport fishing or sold directly to hotels.

![Image: A marlin taken by sport fishing along the Kenyan south coast](image)

Fig.13. A marlin taken by sport fishing along the Kenyan south coast

Collection of shells: ornamental shells are collected by fishers as a supplementary source of income and sold to licensed dealers or directly to tourists and hotels. Diani sub-location (CDA,
2002) records the highest shell collection compared to other localities, mainly due to proximity to an extensive beach and due to availability of ready market from the neighboring tourist hotels.

Tourism: the south coast of Kenya is famous for its white sandy beaches and coral reefs, which are major tourist attractions, and tourism is a major economic activity in this area (CDA, 2002, Tourism Trust Fund, 2001). These white sand beaches are palm fringed and points where the turquoise waters of the Indian Ocean meet beautiful coral reefs. The protective reefs have created ideal beaches with calm waters. The beaches are bordered by green coastal rainforests with prolific birdlife and variety of wildlife including baboons, rare Columbus monkeys and even leopard. A wide range of World Class resorts, exist around Diani/Ukunda area which allow visitors to relax and enjoy.

The offshore reefs are alive with coral, myriad fish, sea turtles and dolphins. Both outer and inner reef walls offer diving with coral gardens and drop offs. At Kisite-Mpunguti, a Marine Reserve has been established around beautiful Wasini Island, an ideal day trip for divers and snorkelers. Further south, the small fishing village of Shimoni is home to a series of deep mysterious coastal caves that stretch from the sea to deep into the jungles. Historically, these caves were long used as a refuge for Dhow Sailors, Arab slavers and explorers. These and many others are the center of touristic attraction around this area.

Inland, the fertile hinterland of Kwale District consists of small villages inhabited by the Wakamba, Digo and Duruma tribes that churn out cheap labor to support tourism related activities.

Farming activities: Unlike other rural areas of Kenya, farming is not a major economic activity in this area. Main food crops grown are; maize, rice, cassava, cowpeas, peanuts and green grams. There exists also small scale farming of cash crops like coconut (both grown for subsistence as well as for the market), citrus and cashew nut. Farming is an activity mostly done by women in cases where men are more active in fishing and tourism.

Small-scale business mainly at the nearby market centers: these involve mainly retail trade, catering and services. Other business dealings involve the Jua kali7 (artisans working in open areas) dealing in metal fabrication, furniture making, open-air-garages, woodcarving and manufacturing/selling of curios and thatching materials (makuti). Sand harvesting is also visible and limestone rocks are mined for building materials for the hotels and houses. Sale of fish and operation of small distribution outlets like those of coca cola are also common.8

Mangrove harvesting: mangrove trees are mainly harvested by the local people and are used for building, making of handicrafts, charcoal, boats, and fencing poles among others (Dahdouh-Guebas, F. et al, 2000; Aboudha, P.A.W and Kairo, J.G., 2001). Some of the harvested mangroves also find their way to the rapidly expanding building and construction industry in Mombasa and Ukunda (the nearest large towns).

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7 Jua kali: jua kali sector involves the informal working sector that is mainly done in the open areas by artisans.
8 Makuti: are thatching materials made of palm leaves commonly used in traditional houses.
3.6 Legal provisions for the management of the Kenyan coastal resources

Kenya has a fairly advanced and sophisticated legal system. There exist acts and policies to protect, conserve and guide the use of the natural resources sustainably in order to improve the standard of living within the entire Kenyan coastal strip. However, they remain largely in writing and almost all the local people interviewed expressed ignorance on all of them. Those acts and policies are entrusted to different government authorities. This again causes substantial conflicts and overlaps resulting in no action being taken by anyone. The most common acts are summarized below:

The environmental management and coordination Act (1999 - EMCA)
By this act the national environment and management authority (NEMA) was established. According to section 28 of the EMCA all new enterprises and projects must undergo environmental impact assessment (EIA). According to section 53 (13), an EIA must be carried out before the implementation of any project within the natural conservation areas or those closer to higher concentrations of people. This act is however silent on the development of the tourism infrastructure along the coastal areas especially where the local communities interests are in conflict with those of the developers.

The fisheries industry Act
The fisheries Act chapter 378 of 1989 of the laws of Kenya (GOK, 1998) provides for development, exploitation, utilization and conservation of fisheries and for connected purposes. The Act is one of the ‘modern’ comprehensive laws of Kenya guiding the use of natural resources. The Act provides for promoting the development of traditional and industrial fisheries, fish culture and related industries through extension services, research and survey, infrastructure development, restocking, exploring markets opportunities as well as enhancing community participation in fisheries management. The protection of the fish and marine organisms is accomplished through prohibition against their catching, disturbance or possession. The Act also regulates use of fishing through licensing systems for both local and foreign vessels.

The marine zone Act
The Marine Zone Act chapter 371 of 1989 of the laws of Kenya (GOK, 1998) consolidates the laws relating to territorial waters and the EEZ of Kenya, to provide for the establishment and use of the exclusive economic zone of Kenya for the exploration, exploitation, conservation and management of the marine resources. The Act has provisions to put into effect the international agreements that relate to marine environment.
4 METHODOLOGY I

ARTISANAL FISHERIES - BIOLOGICAL COMPONENT

4.1 Biological study investigation sites

This study was conducted in Kwale district of the coast province of the Republic of Kenya. Kwale district is one of the six districts of the coast province of Kenya. Here I had initiated a project within several landing sites that aimed at mobilizing the fishers to form joint groups and enhance their capacity to manage fishery resources. These projects had also intended to give artisanal fishers a stronger voice to influence fisheries policies and laws. Several policy documents were under discussion and there was need then to have a good input from the artisanal fishers. I had registered a non-governmental organization, Eco Ethics Int. Kenya Union (EEIU-Kenya), to assist the artisanal fishers of the Kenya’s south coast realize these goals. Through these projects I had attained some understanding with the artisanal fishers within this area. It was advantageous to have the studies for the present thesis undertaken in this area. Moreover, working already with these artisanal fishers within the projects of EEIU-Kenya trust had been developed. Also, several details like names of artisanal fishers, nature of the fishing vessels and gears, spread of the fishing grounds had became apparent.

There were several landings sites along the Kenyan south coast and most of these had been visited and good understanding achieved. However, for this study, it was necessary to select a number that could be manageable based on several considerations such as:

- The chosen landing sites were to be as representative as possible to the artisanal fisheries exploitation common within the Kenyan south coast
- They were accessible to investigators, withdrawal of permission was not going to be a hindrance to collection of data and artisanal fishers had shown willingness to cooperate during the data gathering process
- The total area sampled was estimated to be able to provide reasonable representation so as to enable a proper description of artisanal fisheries of the Kenya’s south coast.

The study area has various advantages: fishing is almost exclusively by artisanal fishermen using a limited number of relatively simple gears. All catches happening in the study area are landed at a limited number of landing sites where they can easily be recorded.

From the aforementioned considerations, a stretch of coastline chosen as study area containing nine landing sites was selected to constitute the study sites. These sites are situated within four main known locations (fig. 14): Diani area (Mwakamba, Tradewinds); Kinondo area (Mwaepi, Mvuleni, Mwanyaza, Mgwani and Chale); Gazi area with the famous and relatively bigger Gazi landing site and finally the Shimoni area (Mwaembe and Mkunguni landing sites). The study site stretches a few kilometers from the Kenya/Tanzania border to about 50km northwards.
4.1.1 Areas along the Kenyan south coast where the study sites were located

*Diana area with landing sites Mwakamba and Tradewinds*: is located 30 km south of Mombasa. It is a 15km stretch of beautiful white sand on the southern coast of Kenya and rapidly becoming a center for packaged tourism. It takes about an hour drive from Mombasa including a short trip across the Likoni creek on a ferry. The beach is possibly Kenya's finest, extending about 13km from the Mwachema River in the north, where it meets Tiwi beach, to Galu beach in the south. The shoreline is fairly developed with hotels, bar/restaurants and private residencies but remains scenic with a profusion of coconut palms. Local activities include artisanal fishing, deep sea fishing, scuba diving, snorkeling, wind and kite surfing, jet skiing, golf plus an assortment of trips on dhow or glass bottom boats to the local marine attractions. Additionally, about 30 kilometers away is the Shimba Hills national reserve with its population of elephants and the last remaining sanctuary of the Sable antelope. Immediately after the shore line exists a coastal bush like vegetation in areas that have not been cleared for development of tourist activities. Here one finds Bush babies which are unique to Africa and are common nocturnal visitors to gardens, hotels and homesteads. There are also other indigenous species of monkeys living in Diani.
**Kinondo – Chale area with landing sites** Mwaep, Mvileni, Mwanya, Mgwani and Chale: South of the busy Diani area. The level of tourist development falls sharply and the beaches of the Kinondo Peninsular feel blissfully remote by comparison.

![Fig. 15. A section of Chale landing site](image)

In this area, rural settings of the Digo people become more dominant with many areas occupied by the indigenous green lush vegetation of the Kenyan coast.

**Gazi:** is located on Gazi Bay. Compared with further north on this coast, this location is very remote, hidden deep within palm plantations, many kilometres away any major tourist development.

![Fig. 16a: Road leading to the Gazi landing site](image)  ![Fig. 16b: Artisanal fishing boats off the Gazi landing site](image)

**Shimoni with the landing sites** Mwaembe and Mkunguni: is on the extreme southern end of the Kenya coast. It is relatively free of mainstream tourist development primarily because the
waterfront here is mainly mangrove swamp rather than white sand beaches. Offshore from Shimoni coast however is probably the best diving on the Kenya coast and here exist the government protected Wasini and Kisite-Mpunguti National Parks.

The distance between Mwakamba which is the most northern study site to Mkunguni - the most southern site is approximately 50 kilometers. The inhabitants of this area live in village clusters of roughly about 200 to 500 persons with higher densities around local urban centers of Ukunda, Msabweni and Shimoni (fig. 20).

4.2 Study activities

Although I was already familiar with most of the chosen fish landing sites from earlier contacts within EEIU-Kenya projects, I revisited these sites again to reconnect with the artisanal fishers and negotiate with them to be active participants in this study. During these initial visits, I briefed them on the objectives of the study and the roles that I expected them to play. I promised to visit them again in the company of my field data enumerators who would be assisting in the data generation process. Later, I showed them some examples of the data gathering protocols to be used in the study.

Next, I designed the data gathering protocols. These data protocols had the space for recording the name of the landing site, date and month of visit as well as the names of the gears used (traps, gill nets, beach seines, lines, spear, set nets, cha-cha and ring nets). Also within the protocols were fish groups or taxa. Here the catches were grouped into demersals, mixed demersals, pelagics, others – mostly sharks and sardines, crustaceans and miscellaneous as shown on table 1a and 1b.
Table 1a: Fish categories/groups

<table>
<thead>
<tr>
<th>Fish categories</th>
<th>Common name</th>
<th>Scientific name</th>
<th>Local Names (Digo)</th>
<th>Swahili Names</th>
</tr>
</thead>
<tbody>
<tr>
<td>Demersals</td>
<td>Rabbit fish</td>
<td><em>Siganus spp</em></td>
<td>Tsafi</td>
<td>Tafi</td>
</tr>
<tr>
<td></td>
<td>Scavenger</td>
<td><em>Lethrinus spp</em></td>
<td>Tangwi</td>
<td>Changu</td>
</tr>
<tr>
<td></td>
<td>Snapper</td>
<td><em>Lutjanus spp</em></td>
<td>Tembo</td>
<td>Tembo</td>
</tr>
<tr>
<td></td>
<td>Parrot fish</td>
<td><em>Scarus spp</em></td>
<td>Phono</td>
<td>Pono</td>
</tr>
<tr>
<td></td>
<td>Surgeon fish</td>
<td><em>Acanthurus spp</em></td>
<td>Nimaku</td>
<td>Kangaja</td>
</tr>
<tr>
<td></td>
<td>Unicorn fish</td>
<td><em>Naso brachycentron</em></td>
<td>Puji</td>
<td>Puju</td>
</tr>
<tr>
<td></td>
<td>Granter</td>
<td><em>Pomadysis</em></td>
<td>Pamamba</td>
<td>Pamamba</td>
</tr>
<tr>
<td></td>
<td>Pouter</td>
<td><em>Gerres spp</em></td>
<td>Tsaa</td>
<td>Chaa</td>
</tr>
<tr>
<td></td>
<td>Black skin</td>
<td><em>Gasterin sordidum</em></td>
<td>Futa</td>
<td>Fute</td>
</tr>
<tr>
<td></td>
<td>Goat fish</td>
<td><em>Upeneus spp</em></td>
<td>Mkundazi</td>
<td>Mkundaji</td>
</tr>
<tr>
<td></td>
<td>Streaker</td>
<td><em>Aprion virescens</em></td>
<td>Pali</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Rock cod</td>
<td><em>Serranids spp</em></td>
<td>Tsewa</td>
<td>Tewa</td>
</tr>
<tr>
<td></td>
<td>Cat fish</td>
<td><em>Tachysurus spp</em></td>
<td>Fumi</td>
<td>Fume</td>
</tr>
<tr>
<td>Mixed demersal</td>
<td>Pelagic</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Cavalla jacks</td>
<td><em>Carangoids</em></td>
<td>Kolekole</td>
<td>Kolekole</td>
</tr>
<tr>
<td></td>
<td>Mullets</td>
<td><em>Mallets spp</em></td>
<td>Mchizi</td>
<td>Mkizi</td>
</tr>
<tr>
<td></td>
<td>Little mackerel</td>
<td><em>Rastrelliger kanarguta</em></td>
<td>Rongwe</td>
<td>Una</td>
</tr>
<tr>
<td></td>
<td>Baracuda</td>
<td><em>Sphyraena jello</em></td>
<td>Mzia</td>
<td>Tengesi</td>
</tr>
<tr>
<td></td>
<td>Milk fish</td>
<td><em>Chanos chanos</em></td>
<td>Mwatiko</td>
<td></td>
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<tr>
<td></td>
<td>King fish</td>
<td><em>Schomeromorous commersoni</em></td>
<td>Ngulu</td>
<td>Nguru</td>
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<tr>
<td></td>
<td>Queen fish</td>
<td><em>Chlorinemus tol</em></td>
<td>Majusi/ Pandu</td>
<td>Pandu</td>
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<tr>
<td></td>
<td>Sail fish</td>
<td><em>Istiophorus gladius</em></td>
<td>Makanza/ Sulisuli</td>
<td>Sulisuli</td>
</tr>
<tr>
<td></td>
<td>Bonito, skip jacks, tunny</td>
<td><em>Euthynnus pelomis</em></td>
<td>Sehewa/ Chiboma</td>
<td>Kiboma</td>
</tr>
<tr>
<td></td>
<td>Dolphin</td>
<td><em>Coryphaena hippocus</em></td>
<td>Pombo</td>
<td>Pombo</td>
</tr>
</tbody>
</table>
### Table 1b: Fish categories/groups (for the category of crustaceans, others and miscellaneous)

<table>
<thead>
<tr>
<th>Fish category</th>
<th>Scientific name</th>
<th>Local Names (Digo)</th>
<th>Swahili Names</th>
</tr>
</thead>
<tbody>
<tr>
<td>Others</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sharks / rays</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sardines</td>
<td>Sardinella melanura</td>
<td>Usimwi</td>
<td>Dagaa</td>
</tr>
<tr>
<td>Crustaceans</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Lobsters</td>
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<td></td>
<td></td>
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<tr>
<td>Prawns</td>
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<td></td>
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<tr>
<td>Crabs</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Miscellaneous</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oysters</td>
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<td></td>
<td></td>
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<tr>
<td>Bech-de-mer</td>
<td>Holothuria spp</td>
<td>Gongola ra pwani</td>
<td>Jongoo la pwani</td>
</tr>
<tr>
<td>Squids</td>
<td>Loligo duvauseli</td>
<td>Ngisi</td>
<td>Ngisi</td>
</tr>
<tr>
<td>Octopus</td>
<td>Octopus macropus</td>
<td>Pweza</td>
<td>Pweza</td>
</tr>
</tbody>
</table>

Sardines were not considered under the pelagic due to their seasonality and I reasoned that their presence in the pelagic could distort the data since they also happened to be caught in relatively huge quantities for the periods that they occurred.

The data capture protocols also had space for recording the total catches per day, number of fishers per method per day as well as the total boats in this case the dugout canoes per day (Table 2).

### Table 2: Artisanal fisheries data capture protocol

<table>
<thead>
<tr>
<th>Site</th>
<th>Month</th>
<th>Date</th>
<th>Fish groups / taxa</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gears</td>
<td></td>
<td></td>
<td>Trap</td>
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</table>

45
Following the development of the data capture protocols was the identification, recruitment and training of the field assistants. The help of the field assistants became necessary due to the spread of the nine fish landing sites over a long stretch of coastline.

Fig. 17: A map of coastal Kenya, major areas of Kenyan south coast as well as the study sites (the landing sites are red circles – areas for biological data generation and green circles are the villages – mostly used for the generation of socio-economic and cultural data.

In the selection of the field assistants much emphasis was laid on fluency of the local language, being conversant with artisanal fishing techniques and likeable interpersonal skills. It was imperative to get field assistants who could communicate readily with the fishers, be able to join me sometimes and the fishers in fishing trips besides being able to create an atmosphere necessary for digging out salient features of artisanal fisheries. After the recruitment and agreement on terms of engagement, I trained them on the necessary data gathering techniques. This involved showing them the need to be among the first persons on the fish landing sites before fishers took off to fishing exercises. It was during those moments that records were made of the number of canoes going for fishing as well as the number of fishers aboard the canoes. Also some observation was done as regards activities like prayers or rituals undertaken by the fishers before embarking on the canoes. These were later used under the
socio-economic and cultural analyses. Another important aspect was to liaise with the fishers first as they landed their fish when back from the fishing expeditions. The idea here was to ensure that all fish brought at the landings sites were first weighed before being distributed for family consumption or sold to prospective fish dealers. The process of weighing involved grouping the fish into the various categories. This aspect was not difficult to achieve since I had made an agreement with the fishers about this procedure and in any case it was suppose to be done as fast as possible to allow the tired fishers dispose of the catches. At each landing site data of total catch, fish taxa, number of fishers who participated in the fishing, weight of catch per kilogram, composition of catch, types of gears and where possible cost and earnings were recorded.

Scheduling visits to the landing sites was the next important issue. All the nine fish landing sites (fig.17) were visited twice a month. This was made easy by the fact that one of the assistants lived within the Shimoni area and he was in charge of the landing sites in the south of the study area (Mwaembe and Mkunguni), while the one who lived in Diani took care of the landing sites to the north (Chale, Mgwani, Mwanyaza, Mvuleni, Gazi, Mwaep and Tradewinds). I also had a timetable for my visits on a monthly basis. My dates of visits to the landing sites were not made available to the assistants, just to make sure that I my visits also to supervise the effectiveness with which data was being gathered. Not least, on my very first visits I accompanied each of my assistants in their respective stations and we undertook the process together. This also assisted instill the process procedure among the artisanal fishers.

For two subsequent years, the data gathering process went on. On each day of field visit and whenever it was possible field data protocols were brought to a central point. When this did not happen either due to lack of transport means to reach the central point in Mombasa or where fishers went fishing late in the day or night, the protocols were brought to the central point the following day.

4.3 Terminology used in biological data

A few terms need to be understood before delving into the rigor of the data analysis: 

*Catch*: used to mean the biomass caught by a gear (a boat, trap, net, spear guns e. t. c.) and brought onto the canoe.

*Landings*: used to mean part of the catch that is actually brought to the landing site. In any case landings are almost identical to catches, as virtually no by-catch was extracted before landing.

*Yield*: In this study has been used to mean both the numbers of a certain taxa and their total weight in the landings.

*Fishing effort and activity*: in our case this has been used to link the number of canoes with the number of fishermen engaged in the fishing.
5 METHODOLOGY II

METHODS FOR SOCIO-ECONOMIC AND CULTURAL DIMENSIONS OF ARTISANAL FISHERIES

5.0 Introduction

The communities living within the south coast of Kenya were the center of this study. It was planned with them in mind and they were the key agents. Besides the generation of a doctoral thesis, this study was also meant to benefit them either directly or indirectly by providing comprehensive information on the complex system of fisheries along an important part of Kenya’s coast. Furthermore, it is hoped that the recommendations made can be found adoptable by government and developmental agencies active in the area. In a socio-economic study like this it is indispensable first of all to build trust by fully respecting the lifestyle of the people involved in it. To minimize disruptions to the communities’ daily work, interviews and discussions were arranged normally in the evenings and over the weekends. On the other days, attempts were made to get the information at the places of work and commitment was made to assist in whatever the community was doing. Interviews were also kept within the limit of one hour.

Since I am not from the area myself, it was important to recruit my two assistants from the local area. It made it easier to ensure that local customs were respected and followed during the interviews. It also reduced the amount of time required to learn the power structures, habits, traditions and norms of the fishers, and hence increasing acceptance by the community. Besides, a rapport had been established with the community during the numerous contacts through socio-economic development projects under EEIU-Kenya. I was instrumental in the initiation and implementation of those projects. Following the work with the communities within the frameworks of projects, access to accurate information was generally easy to acquire. Again, with my assistants coming from the area, it was possible to judge the accuracy of information given to us. Friends and the social capital we had gained from this community over time together with the genealogical lineage of my assistants made it possible to undertake the study successfully.

Two months were taken to explain the objectives of the study to the community, again after several months of involvement with the community in the projects of Eco-Ethics International-Kenya Chapter, the duration of which the community had already interacted with the team and settled several curiosities about myself and my assistants. In all visits, adequate time was spent to explain objectives of the study and enough chance was given to the community to express any feelings not only about the study but also about myself and my assistants. They also had the chance to recommend how things should be done. These kinds of recommendations were noted and reviewed every evening and where possible incorporated in the subsequent surveys or discussions.
5.1 Involving use of interactive approach

The fact that I had worked with the same people for some time reduced tension and on several occasions made it possible to crack jokes and even ‘stereo types’. That was useful in enhancing interaction with the respondents. It also assisted to explore topics that were unexpected and unplanned for, made it possible to question responses that were unclear and to clearly understand the multi-dimensional, socio-cultural and managerial dimensions that were the central themes in this study.

Further, it assisted in development of positive relations with the community members, scheduling meetings with them at their own social and yet informal settings. This aspect greatly enhanced the phenomenon of talking WITH the community and not TO talk to them especially in regard to their knowledge, opinions and perceptions about the coastal and marine resources on which their livelihoods revolved.

5.2 Noting of biases

Being cognizant of the fact that communities and their members hold different views, perspectives, perceptions, priorities and interests, different members were interviewed in some cases separately. However, this strategy was still not enough to eliminate biases. Interests and responses vary within each member of the community. The elders might give highest priority to religious taboos etc, women to subsistence of the families and young fishers to good earnings. That means biases were widespread, with ‘Kaya’ elders being more biased towards traditional systems while the younger fishermen lacking gears and boats and adequate sea experience appeared more liberal and open to almost any alternative source of livelihood even being beach boys; walking along the beaches with a wishful belief of an opportunity opening up during peak tourist seasons.

To minimize the biases, issues that generated contradictory responses from different informants were filtered and additional follow ups made, e.g. the use of spear guns among the local fishermen. Understanding the different orientation of informants was considered as well as the interests that they might have had in regard to the questions being asked. Additionally, informants were clearly made aware of who we were, why were there, and what interests I had in what my assistants and I were talking about. This was patiently done over and over again.

Women and children preferred to remain silent in presence of men, yet in some cases they gave even better and more objective responses to our questions. Therefore permission was requested to interview women in the course of their activities, which favorably secluded men though we remained cautious that this did not raise strains within the families.

Over and above, notes were taken about the answers and how the answers were given. Records were taken on information about informants’ attitudes and behaviour, subjects that were being avoided, time spent on different subjects and their interactions with each other in the course of the discussions. These were later used to enrich the responses from the questionnaires.
All data gathered were crosschecked to determine the stakeholder groups and parameters, which were being assessed, and to assist determine the accuracy of the information gathered, identify and perhaps eliminate potential biases. The principle of triangulation was mainly used during the preliminary studies and this involved comparing the data from three different sources, involving three different members (my two assistants and I) and from three different data collection methods. Every evening discussion was held with the assistants to compare information and findings and to filter out inconsistencies and contradictions. Those discussions provided opportunities for reflective as well as adaptive learning processes, particularly in the starting phase of the study where those discussions greatly improved the quality of understanding of the community within the study area.

5.3 Methods applied in socio-cultural studies

Four major groups of methods had to be adopted in order to provide a comprehensive picture of the fishery communities including their social structure, economic and cultural attributes. Interviews and surveys, focus group discussions, observations and oral histories were used.

5.3.1 Interviews and surveys

The terms ‘interviews’ and ‘surveys’ were considered as any discussion from which information was collected, ranging from formal and structured to casual interviews. The information obtained was only considered for analysis when there was strong belief that it was reliable. Reliability was checked by comparing informant’s responses with those of other informants and sources (Lofland, J. & Lofland, L.H., 1995). Under this main category of interviews and surveys, the following methods were applied to obtain the social, economic and cultural data on the communities in the villages of the study area:

a). Formal interviews: involved use of a structured question-and-answer format but were not tape recorded, as most informants feared that it could be used for other purposes and even attract the wrath of other community members especially if opinions expressed were in conflict with generally agreed perceptions.

In all cases, additional anecdotes and extemporaneous information were recorded during the process of the interviews. Formal interviews were requested only after at least one initial encounter with the informant (s).

b). Informal interviews: were used to either supplement on the formal interviews during the surveys or to give adequate and at a rather relaxed atmosphere to the informant (normally the artisanal fishers or local community members). In cases where situations did not allow every question to be asked, attempt was made to personally revisit the informant.

This method was a major source of data used in this thesis and involved the use of questionnaires, which were highly structured with close-ended questions. The questionnaire used had specific questions with limited answers (e.g. some were multiple choice, true or false) thus creating a possibility to get the quantitative data that could be analysed statistically.
c). The survey questionnaires: wherever they were used there was no intention to encourage follow-up questions or explanatory answers as was the case for semi-structured interviews and those used for the Focus Group Interviews, in many cases some issues were not clear to the respondents. Those issues were subsequently addressed by key informants or focused group discussions.

d). The pre-testing questionnaire: was mainly used at the reconnaissance of the study and from it follow up questions were developed and used in the complete questionnaires, semi-structured and focus group interviews. A full survey was conducted at the end using the complete questionnaire to get quantitative data on topics felt of greater importance.

Surveys were found useful in determining the distribution of variables (e.g. incomes, ages) within the artisanal fishers and their community. The data generated from this method was extrapolated to give a representation of the whole community besides being used as a quantitative data on desired aspects and issues.

e). Semi-structured interviews: involved the use of a set of open-ended questions or discussion points, which assisted to generate qualitative information. This method offered the flexibility to probe for answers, follow up the original questions and pursue new lines of questioning. Additionally, this method allowed for a two-way interaction and facilitated exchanges of information between the interviewer and interviewee making the atmosphere more relaxed.

Although the semi structured method allowed to direct the discussions, the survey by questionnaire method was used to solicit specific responses especially those demanding limited answers. The use of both was necessary in order to get as much information as possible from the community members and artisanal fishers in particular.

The semi-structured interviews were found useful in generating in-depth and explanatory yet qualitative information on areas of interest besides allowing for an exchange of information between interviewer and interviewee. Additionally, it encouraged the informants to raise relevant issues that were not common knowledge i.e. women were not allowed within the inner precincts of the ‘Kaya’. This method of an open ended discussions allowed informants to discuss sensitive and emotive issues thus assisting to identify local priorities and commonly used terminologies in the given village.

f). Key informant interviews: these interviews were in fact informative discussions with persons, selected for their vast experience and knowledge who could provide extensive insight into bio-socio-cultural aspects of the community. This method was mostly used when there was need to gain a deeper insight into an issue or when there was need to cross-check data or obtain explicit explanations on other information e.g. the specifics of sea ritual or the origins of the ‘Kayas’ and ‘Mzimu’s. One major weakness of those discussions was that it entailed the views of only one individual and in some cases it was difficult to separate these from the views of the larger group.
g). **Household interviews:** involved entire households but in many occasions, it was not possible to have the entire family together. These interviews were used to understand the household living strategies, income, challenges and struggles. They were normally conducted in the evenings when the family gathered for prayer and meals or on Fridays which are taken as free days and people were present in their houses. To assist towards building of household economic profiles, expenditures on most common household items were noted with emphasis on expenditures as opposed to the incomes from the assortment of activities or occupations of the various members of the family.

### 5.3.2 Focus group interviews (FGIs)

This method resembled the key informant interview method save for the fact that whereas key informant interviews were normally open for additional informants who shared a common background or knowledge. Alternatively put; it involved a group of artisanal fishers or community members with an interest or knowledge in a particular topic or issue e.g. diving groups, tourists, fisher groups, ‘Kaya’ elders. By this method we were able to obtain information from several informants at once and the group dynamics involved, motivated the informants to think of other aspects. However, on many occasions it was time consuming and opened the possibility of drifting away from core intentions.

This method was used in the middle and at the end of the data collection exercise and came at a time when there was already an understanding established with the local community and other stakeholders. These made it possible to re-orientate the FGIs to suit particular topics and to assist invite appropriate participants.

This method was useful in generating information on a range of issues, allowing a freer exchange of information among the informants besides offering the opportunity to views of a particular group. It was also useful in accessing a large number of informants in a relatively short time.

### 5.3.3 Observation method

The observation method involved the qualitative descriptions of what was seen and obtained by myself and my assistants about the life in the village and of the informants when they were at work. Observations were either directed or continuous.

- **a). The directed observations:** viewed specific activities like, active fishing, fish landing or fisherman’s meetings.

- **b). Continuous observations:** were employed when seeking a broader understanding of activities throughout the day and night or the entire period of the activity. This approach was mostly employed during the performance of the sea spirit appeasing rituals including the preceding arrangements and actions.

Both types of observations took place throughout the data collection exercise, although they were initially used during the preliminary studies to prepare interview and survey questions.
Procedures of important activities or social functions to be observed were noted before visiting the sites. In many cases, some information about these activities was gathered beforehand. Sessions were started by walking through the area, providing introductions to those persons who had no idea of the purpose of the study or whenever there was a group of respondents who were not conversant with my team. To observe fishing activities, joint fishing expeditions were undertaken with the artisanal fishermen. Sketches were made to describe certain activities or gears while photographs were additionally taken to record observations. The notes and pictures were used for late reviewing. They also helped during the writing of this thesis. Whenever possible observations were conducted in the presence of key informants or other persons involved explaining activities as they were observed. Contacts with those key informants had been made prior to the observation sessions. The most commonly used observation method was the ‘participant observation’ and involved taking an active role during the activity under observation, e.g. setting and hauling of fishing nets, measuring fish after the landing or being a participant.

Major weaknesses with the observation methods were that in many cases they generated data, which were difficult to code and to statistically analyze with confidence. Besides, they were limited by time of the day, and season as not many fishermen went fishing during the southeast monsoons.

5.3.4 Oral histories

These were the verbatim and gestural, accounts of stories, anecdotes or personal biographies told by the artisanal fishers or local community members using their own language, terminology and gesture. The oral histories were used in this study to provide descriptive and qualitative information.

Through these oral histories, informants were also encouraged to tell their versions of the past. Lessons were learnt about the way they delivered these stories, the language they used, the events they chose to talk about and the way they analyzed them. These gave insights into local priorities and further shaped the course of the study.

This method was also useful in generating quotes, which have been extensively used in compilation of this thesis. Further, it was used to identify local terminology, language and priorities that assisted to interpret other information gathered during the study. Moreover, it generated in-depth and explanatory, qualitative information on specific issues especially those touching on historical events and personal memories. In a few cases, it was used to probe informants to raise relevant issues that were not initially thought of.

5.3.5 Visualization techniques

Visualization techniques were invoked to adequately capture data. These included the use of transects, timelines, seasonal calendars, historical transects, decision trees, and ranking. These techniques were used to gather large amounts of complex information in a clear, concise and easily understood format i.e. the use of wealth ranking within the economic study.
They were also used to encourage interaction between the study team and the respondents. On many occasions sketches were made on the ground to make issues easier and more familiar to understand. Summary of these capture tools used for the collection of social data are summarised in table 3.

5.4 Study investigation sites

The study sites for socio-cultural surveys were undertaken in thirteen villages: Mkwakwani, Maweni, Chale, Magutu, Biga, Mwabungo, Kinondo, Mwaroni, Mwakamba, Mvumoni, Diani scheme, Mwamambi and Gazi, all found within Diani (Ukunda) and Kinondo locations of Kwale District. Most of these villages are located around Ukunda which is a major tourist town (fig. 17 green circles and fig. 18).

![Village Location](image)

**Fig. 18: Distribution of study villages and the landing sites**
Here, aspects of my study included living conditions, access to artisanal resources, skills and knowledge about ecology of these resources and their management systems. The study involved use of a schedule/questionnaire. These same sites were also visited during discussion sessions, running village transects, mapping, drawing of seasonal calendars or timelines, decision trees and rankings. These villages also gave verbatim accounts of stories, anecdotes or personal biographies told by respondents in their own language and terminology.

5.4.1 Criterion for selection of study villages

The studies were undertaken in a total of thirteen villages all within the Diani and Kinondo locations of Kwale District (fig. 20). These sites had been visited earlier while working for EEIU-Kenya and a good understanding had been attained between the artisanal fishers as well as members of the villages. It is also in these villages where most of artisanal fishers lived. I reasoned that social and cultural data should be gathered at the villages and not at the landing sites because then the fishers would be more relaxed and the village setting would allow a more conducive atmosphere for discussion. This was in contrast to the landing sites where the fishers were either in a hurry to go fishing or were tired and hungry once they were back from fishing trips. Furthermore, the social data in many cases involved not only the fishers but also other members of the larger community which fishers were part of.

These villages were accessible as they were not far from the road. Further, by virtue of being close to the tourist town of Ukunda, it was possible to study some cultural changes that have taken place over time and the apparent reasons for those changes. In many instances it was possible to see at play the cultural influences brought about by the interactions between the locals and tourists, an aspect that added value and interest in this study.

5.5 Study activities

The socio-cultural and economics component of the study started in 2002. The first three months were spent undertaking preliminary and reconnaissance study while working with artisanal fisher communities in EEIU-Kenya projects. These activities continued into the rest of the year. Findings of the preliminary studies were later used as benchmarks on which the major data gathering processes were based.

It was also during the preliminary phase, that all the fish landing sites for data gathering were identified. These landing sites were visited and familiarization made with the artisanal fishers as well as their families and the local community to which they were part.

Visits were also made to the several households within the selected villages and informal introductions done. Further, some aspects that were later to be involved in the study were also quantified during this phase, i.e. household sizes, hierarchy and communal influence on decision-making processes. Additionally, key informant persons were visited as well as influential persons like the elders, village heads and all kinds of local administrators’ including the District Commissioner of the entire district of Kwale. Contact with government officials in charge of national and regional fisheries administration and management was also done during this phase. Further contacts were to non-governmental agencies working within the study area.
The assessment of the entire study area in terms of household set-up was used to draw up a program of running the socio-cultural questionnaires during the second phase of the study. Pertinent issues like daily activity timelines were drawn during this phase, so as to be aware of the appropriate times for organizing the interviews and to minimize disruption of respondents’ activities.

5.6 Data gathering processes

Main survey – SURVEY 1: This was the main survey and was undertaken in all the 13 villages. It consisted of a total of 250 survey questionnaires were run out of which 189 were used for statistical analysis after being filtered. These questionnaires examined the living conditions of the fishers, their access to the coastal resources, their skills and knowledge about ecology of these resources. Further, the management systems in regard to use and conservation of these resources were also examined as described in detail in Appendix 2. A total of 61 questionnaires had to be filtered out as they consisted of incomplete or double entries or other shortcomings.

SURVEY 2: A second set of questionnaire was tailored for artisanal fishers and fishermen groups selected on the criteria below (details in Appendix 3). This set was meant to give an elaborate insight on the experiences of some of the long time artisanal fishers and those who could be considered ‘ideal’ fisherman. Further it concerned with digging out hidden traditions and cultural attributes particularly in regard to artisanal fisheries exploitation. This survey was undertaken at Mwaepe village and landing site. The target here was to gain an elaborate insight of the experiences of some of the artisanal fishers. Criteria used to determine ideal fishermen along this area mostly revolved around:

a. High amount of time dedicated to fishing activities; those who spent most of their active working hours fishing were favoured.
b. Over half of the family income was coming from artisanal fishing related activities.
c. Whether artisanal fishing was a main or part time activity; full time artisanal fishers were favoured.
d. Possession of local fishing gears was a priority. Those who had more expensive gears were left out, as they were not representative of the local majority of artisanal fishers.
e. High number of years involved in fishing with ten years as the minimum
f. Good knowledge and expertise in the field of artisanal fishing; selection favoured those who had exhibited deeper understanding of the nature and condition of artisanal fisheries exploitation, especially the interaction between the fishery resources and the people dependent on them.

SURVEY 3: was undertaken about the indigenous traditional knowledge (ITK) as shown in Appendix 4 (in Chale, Gazi and mvuleni villages). Here the main interest was to gain a deeper insight into the traditional knowledge held by the artisanal fishers especially in regard to fisheries resources and their ecology i.e. breeding behavior of the different species of fish, spatial distribution of resources, interactions among organisms and influence of fishers on resources. This survey further explored the implications of the use of this knowledge on the
exploitation of the artisanal fisheries. Most of the targeted respondents were the elderly fishermen and those in charge of sea rituals as well as spirit appeasing ceremonies, since they were considered more knowledgeable in these aspects owing to their long experience and involvement in those activities.

**SURVEY 4:** Another set of survey questionnaires was about the economic and household data surveys held at selected representatives of artisanal fisher households’ and their members (at Mvuleni Appendix 5). These questionnaires examined the household structures, incomes, and nature of fish marketing and educational levels of selected artisanal fishers. Here a selection criterion was similar to number 2 above, except for the location, which was at Mvuleni. For this survey the village again was selected again due to my closer and personal relationship with the artisanal fishers’ households within this site. This relationship had been established during the implementation of ‘fishers livelihood enhancement project’ supported by Canadian Fund for Local Initiatives (CFLI) for which I was the coordinator. A total of 20 households were carefully selected. These households had at least someone actively engaged in artisanal fishing, some substantial portion of their subsistence was being provided for by fishery resources and in general they had some attachment to artisanal fishery as being practiced within this area. These households were surveyed for a period of over three months. The first 2 months were spent visiting the families and being with them as they undertook various household decisions touching on their livelihood options. Only one person, normally the head of the household, represented each household. A total of 8 households were headed by women. The male household heads were active and experienced artisanal fishers while the female household heads relied mostly on artisanal fisheries related activities like buying and re-selling fish products from the male fishers. Other female members of the households managed stalls and kiosks mostly patronized by the artisanal fishers in between fishing trips. Besides answering the questionnaires, the other data capture tools like observation (directed, continuous and participant) were involved. Income was mostly approximated from data obtained through active involvement with the families.

Other sources of social data were the several discussions sessions, village transects, maps, seasonal calendars, decision trees, ranking, timelines, verbatim accounts of stories, anecdotes, or personal biographies told by respondents in their own language and terminology as summarised in table 3.
Table 3: Summary of data capturing tools for social studies

<table>
<thead>
<tr>
<th>Type of data capture tool used</th>
<th>Components</th>
</tr>
</thead>
</table>
| Semi-structured interviews    | Key informants’ interviews  
|                               | Group interviews  
|                               | Household interviews |
| Surveys                       | Structure questionnaires |
| Focus groups                  | Almost similar to key informants’ interviews but not regulated. Number of respondents were between 5 and 13 |
| Observations                  | Directed  
|                               | Continuous  
|                               | Participant |
| Oral histories                | Verbatim stories, anecdotes and personal biographies |
| Visualization techniques      | Transects  
|                               | Timelines  
|                               | Decision trees  
|                               | Ranking  
|                               | Seasonal calendars  
|                               | Historical transects |

5.7 Statistical analysis

Most statistical analyses were performed using Microsoft Office Excel 2007 version. In some cases the use of the program SPSS © (Statistical Package for Social Sciences) version 13 has been employed. Most of the data collected was in simple figures mostly detailing the weights of fish catches within the various landing sites, number of fishers as well as that of the fishing gears. Again, most of the analysis performed involved generating simple tables as well as graphs from which trends could be obtained. Initially a detailed statistical analysis was undertaken also with some assistance from the University of Bremen student statistical advisor, Werner Wosnik. After, several reviews with rich yet highly divergent opinions from many academics, most of those tests were ruled out e.g. CANOCO was mostly used to generate the correspondence analysis which was meant to show the graphical spread and concentration of the various gears along the various landing sites. The idea to use CANOCO analysis was borrowed from its use to show the spread and concentration of rodents within study sites. In subsequent steps, some academics reasoned that this would not be necessary as the simple x-excel graphs were adequate and that in any case, fishers were highly mobile and all the gears and vessels could be traced back to specific landing sites.

The use of other statistical tests like the non-parametric Spearman Rank correlation analysis for exploring the relationship between two variables has also been since omitted. This is because the regression analysis has since been discarded, mostly on the basis that gears are entirely different.
In the analysis involving the use of the software SPSS, Pplots were used before transformation to find out whether the data were normally distributed and thus suitable for analysis. Since data showed high level of skewness these data were hence subjected to a log transformation (logarithmic to base 10). After transformation of the data (logarithmic to base 10) a repeat with the same Pplot was undertaken. The high level of skewness was gone, showing log transformation was adequate in making the data homogeneous.
6 RESULTS I

ARTISANAL FISHERIES - BIOLOGICAL COMPONENT

6.0 Testing the data for normality by use of Pplots

Pplots were used before transformation to find out whether the data were normaly distributed and thus suitable for analysis. The graph below (fig. 18a) shows high level of skewness hence the decision to carry out a log transformation.

![Normal P-P Plot of Weight in Kg](image)

*Fig.18a: Normal P-P Plot of weights in Kilograms*

*Expected Normal quantiles calculated using Blom’s proportional estimation formula and assigning the mean to ties, for variable WEIGHT. Normal distribution parameters estimated: location=520.74372 scale=1163.905*

After transformation of the data (logarithmic to base 10) a repeat with the same Pplot was undertaken. The high level of skewness shown above was corrected as in fig. 18b; showing log transformation was adequate in making the data homogeneous. Pplots were used in to test for normality in all data sets.
Fig. 18b: Normal P-P plot of log_weight

Expected Normal quantiles calculated using Blom’s proportional estimation formula and assigning the mean to ties, for variable LOG_WT. Normal distribution parameters estimated: location = 2.4585378 scale = 52857815

A detrended Normal P-P plot of LOG_Weight was generated as shown below after transformation of the data

Fig. 18c: Detrended Normal P-P plot of log_weight
Other descriptive statistics showing mean and standard deviations for the transformed data sets is shown in table 3a.

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Mean</th>
<th>Std. Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>LOG_CATC</td>
<td>1926</td>
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<td>1.3833</td>
<td>.61585</td>
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<tr>
<td>LOG_FISH</td>
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<td>.00</td>
<td>1.98</td>
<td>1.2715</td>
<td>.35681</td>
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<tr>
<td>LOG_BOAT</td>
<td>1688</td>
<td>.00</td>
<td>1.60</td>
<td>.6936</td>
<td>.33777</td>
</tr>
</tbody>
</table>

6.1 The distribution of traditional fishing gears across landing sites

Each artisanal fisher was found to be more or less specialized in one kind of gear, although gear choice was also to a small extent influenced by fishing seasons. Each fisher uses his canoe to operate the given gear. So that a trap fisherman uses his canoe for setting traps and the same to the gill net fisher. Each of the canoes belongs to an individual fisher with a few exceptions where a group of fishers own the canoes. For the traps and lines it is common to find one fisherman operating alone while for the other kind of nets the owner has to take one or two other fishers on board.

All the nine landing sites had a presence of the traditional fishing gears of spears, line, trap, gillnet (fig. 19a) out of the total eight present within the area. The introduced fishing gears of cha-cha and ring-nets were only in use at one landing site, Gazi. The beach-seine was found in the landing sites of Chale and Mgwan.

![Distribution of gears across landing sites](image)

*Fig. 19a. Distribution and composition of gears across landing sites*

(Where R-net refers to ring nets, S-net to setnet and B-seine to beach seine)
Traps were the most abundant with a count of 545 of all the 1928 gears sampled within the 9 landing sites constituting 28% (fig. 19b). The second most common fishing gear was the spear (23%) while both the line and the gill nets were also common with a distribution of 20% each. The least common gears were the set-net (2%) and ring-nets (1%) as shown in fig. 19b. The contribution of these gears in terms of catch contribution to the study area is shown in fig. 23.

The three landing sites of Mvuleni, Mwaembe and Tradewinds had low number of gears while the landing sites of Chale, Mgwani, Mwanyaza, Mwaembe, Gazi and Mkunguni had relatively high number of gears.

![% composition of gears](image)

*Fig. 19b: Distribution (in percentage) of gears across all landing sites*

### 6.2 Distribution of dugout canoes (vessels) across landing sites

According to the distribution across landing sites (table 4), the dugout canoes were most abundant at Mkunguni (320) and followed by Mgwani (288) and Mwaembe (263). Sites close to the urban center of Ukunda (Diani) like Mvuleni (had 95), Mwaepe (96) and Tradewinds (91) had the least number of dugout canoes as shown in table 4.
**Table 4: Distribution of dugout canoes across all sites**

<table>
<thead>
<tr>
<th>LOCATION</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chale</td>
<td>201</td>
</tr>
<tr>
<td>Mgwani</td>
<td>288</td>
</tr>
<tr>
<td>Mwanyaza</td>
<td>165</td>
</tr>
<tr>
<td>Mvuleni</td>
<td>95</td>
</tr>
<tr>
<td>Mwaeppe</td>
<td>96</td>
</tr>
<tr>
<td>Tradewinds</td>
<td>91</td>
</tr>
<tr>
<td>Mwaembe</td>
<td>263</td>
</tr>
<tr>
<td>Mkunguni</td>
<td>320</td>
</tr>
<tr>
<td>Gazi</td>
<td>180</td>
</tr>
<tr>
<td><strong>Total gears</strong></td>
<td><strong>1699</strong></td>
</tr>
</tbody>
</table>

### 6.3 Spread of fishers across landing sites

Artisanal fishers were found to be more concentrated within areas remote from the major urban and tourist center of Ukunda. The highest number of fishers was found in Mgwani, followed by Mkunguni then Chale and Mwaembe consecutively (fig. 20). Artisanal fishers were also many in Gazi with a total count of 230. The fishing sites close to Ukunda (Diani) had the least number of fishers with all the three nearby landing sites each having less than 100 artisanal fishers (fig. 20).

![Number of fishers in various landing sites](image)

*Fig. 20: Number of fishers across landing sites*

### 6.4 Distribution of fishers across gears

Gears like lines, traps, gill nets and spears were more widespread among the fishers, while the beach-seine, set-net, *cha-cha* and ring-net had fewer fishers using them and were only found in a few specific sites (fig. 21). In some cases one fisher owned more than one gear.
Fishers shifted gears depending on seasons e.g. from the use of gill nets to traps during ‘kusì’ periods of strong winds normally from April to September. During such periods of strong winds and rough seas, using simple canoes of low stability become risky and fishing become restricted within the shallow lagoon waters.

Fishers could also be categorized into two groups, namely: main fishers who own the canoes – these are the well established fishers. In some cases they leased out their canoes for fish catch rewards which was about 10% of the total catches. This encouraged ownership of canoes and gears, although costs appeared a major handicap. On the other hand were assistant fishers who lacked canoes and in some cases gears as well. They had to accompany main fishers on fishing trips or lease canoes and gears. The latter were also hired on certain occasions by main fishers especially during good fishing seasons to increase on their amount of fish catches. This encouraged ownership of canoes and gears although their higher acquisition costs appeared a major handicap.

### 6.5 Fish catches by types of gear and across landing site

There was a marked variation on the level of catches across the gears. Spears contributed the highest catch and beach-seines the lowest in the landing site of Chale (fig. 22a). Fish catches also varied across landing sites. In Mgwani gill nets had the highest amount of catches while the sporadically employed beach-seine contributed the lowest amount of fish catches just as in Chale (fig. 22a and 22b).
Fig. 22a – b: Total catches at the sites of Chale and Mgwani respectively for 46 fishing days sampled distributed over 23 months in 2003/2004. Note that different scales have been used for the two landing sites.

In most of the landing sites along the Kenyan south coast, use of beach seines had been banned by general agreement and it is still in use within these two sites of Chale and Mgwani. Through discussions with the fishers, it was clear that the use of it was in many cases viewed with suspicion. It might be arguable that fishers using this gear did not land all the catches from the beach seines at the official landing sites, hence such low amounts. This phenomenon of hiding fish catches from the official landing sites, especially when using outlawed gears was not uncommon.

At Tradewinds, both the gill-nets and the lines had the highest catches with lows from traps and spears (fig. 22c), while in Mwanyaza spears had the highest contribution of catches followed by the traps, set-nets, and with least catches (fig. 22d) obtained from lines and gill-nets respectively.
Catches at Mvuleni were high from gill nets followed by lines with lows from traps and spears, which had almost similar amount of catches (fig. 22e). In Mwaembe, highest catches were from the fishing gear trap, while the line and the spear had almost same quantity of catches with gill nets getting a little more than lines and spears but quite less than the amount from the traps (fig. 22f).
Fig. 22c - h: Total catches across gears at the various landing sites of Tradewinds, Mwanyaza, Mvuleni, Mwaembe, Mkunguni and Gazi over 46 fishing days sampled - distributed over 23 months in 2003/2004. Note that different scales have been used for the various landing sites.
In Mkunguni highest catches came from the traps followed by lines and gill nets respectively with lowest amount of catches coming from spears (fig. 22g). At Gazi, most of the catches were contributed by the ring-nets, while other gears had minimal contribution (fig. 22h). At the landing site Mwaepe, catches were almost evenly spread across the gears (at least compared to the other landing sites), with highest catches coming from gill nets followed by lines, then traps and the least quantity of catches from the spears (fig. 22i).

![Catches against fishing gears at Mwaepe landing site](image)

**Fig. 22i:** Total catches across gears at the landing site of Mwaepe for 46 fishing days sampled - distributed over 23 months in 2003/2004.

In summary the artisanal fish catches decreased in the order of traps, ring nets, lines, gill nets and spears (a controversial gear commonly found along the entire Kenyan coastline) as in fig. 23 below. The greatest amount of catches were from the traps followed by the ring net, then lines, gill nets, spear with a small amount of catches being nabbed by the cha-cha, set net and by the beach seine in that order.
In terms of total catches across landing sites total catch was highest at Gazi contributing 32% of all the total catches followed by Mkunguni with 30%. The smallest catch was from the landing sites of Mwanza and Mvuleni all contributing merely 3% of the total catch as shown in fig. 24.

Even though Gazi had the highest catch among the landing sites, these catches were mostly contributed by ring nets (fig. 24c). In Mkunguni the highest catches were from the traps.
followed by lines. In percentages, ring nets caught 72% of all catches in Gazi (table 9) while traps caught 51% of all catches in Mkunguni.

Table 9: Landing sites, gear types, total effort and percentage catch by gear per landing site  
(Effect is measured in terms of totals of fishers and canoes, catches in Kilograms, data sets sampled twice a month for both 2003 and 2004)

<table>
<thead>
<tr>
<th>Location</th>
<th>Gear</th>
<th>Catches</th>
<th>Total effort</th>
<th>% catches by gear per landing site</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chale</td>
<td>Line</td>
<td>929</td>
<td>653</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>Trap</td>
<td>1241</td>
<td>1894</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>Beach seine</td>
<td>214</td>
<td>34</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Gillnet</td>
<td>1389</td>
<td>566</td>
<td>14</td>
</tr>
<tr>
<td></td>
<td>Spear</td>
<td>6159</td>
<td>5102</td>
<td>62</td>
</tr>
<tr>
<td></td>
<td>Totals</td>
<td>9932</td>
<td>8249</td>
<td>100</td>
</tr>
<tr>
<td>Mgwani</td>
<td>Line</td>
<td>1643</td>
<td>978</td>
<td>16</td>
</tr>
<tr>
<td></td>
<td>Trap</td>
<td>1541</td>
<td>1991</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>Beach seine</td>
<td>40</td>
<td>15</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Gillnet</td>
<td>4391</td>
<td>2588</td>
<td>43</td>
</tr>
<tr>
<td></td>
<td>Spear</td>
<td>2068</td>
<td>1389</td>
<td>20</td>
</tr>
<tr>
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<td>Set-net</td>
<td>523</td>
<td>229</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Totals</td>
<td>10205</td>
<td>7190</td>
<td>100</td>
</tr>
<tr>
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<td>Line</td>
<td>10205</td>
<td>537</td>
<td>68</td>
</tr>
<tr>
<td></td>
<td>Trap</td>
<td>1292</td>
<td>2411</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>Gillnet</td>
<td>279</td>
<td>102</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Spear</td>
<td>2268</td>
<td>2645</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>Set-net</td>
<td>868</td>
<td>362</td>
<td>6</td>
</tr>
<tr>
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<td>Trap</td>
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<td>712</td>
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<td>30</td>
</tr>
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<td>Trap</td>
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<td>648</td>
<td>16</td>
</tr>
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<td>Gillnet</td>
<td>1736</td>
<td>895</td>
<td>39</td>
</tr>
<tr>
<td></td>
<td>Spear</td>
<td>648</td>
<td>423</td>
<td>14</td>
</tr>
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</tr>
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<td>Trap</td>
<td>5735</td>
<td>5813</td>
<td>64</td>
</tr>
<tr>
<td></td>
<td>Gillnet</td>
<td>1400</td>
<td>2388</td>
<td>16</td>
</tr>
<tr>
<td></td>
<td>Spear</td>
<td>810</td>
<td>1083</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>Totals</td>
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</tr>
<tr>
<td>Mkunguni</td>
<td>Line</td>
<td>13932</td>
<td>1692</td>
<td>30</td>
</tr>
<tr>
<td></td>
<td>Trap</td>
<td>23912</td>
<td>3611</td>
<td>51</td>
</tr>
<tr>
<td></td>
<td>Gillnet</td>
<td>7352</td>
<td>5313</td>
<td>16</td>
</tr>
<tr>
<td></td>
<td>Spear</td>
<td>1241</td>
<td>371</td>
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<td>10887</td>
<td>100</td>
</tr>
<tr>
<td>Gazi</td>
<td>Line</td>
<td>5164</td>
<td>520</td>
<td>10</td>
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<td>Trap</td>
<td>58</td>
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<td>0</td>
</tr>
<tr>
<td></td>
<td>Beach seine</td>
<td>2122</td>
<td>1471</td>
<td>4</td>
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<tr>
<td></td>
<td>Gillnet</td>
<td>876</td>
<td>216</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Spear</td>
<td>960</td>
<td>711</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Cha-cha</td>
<td>5152</td>
<td>3327</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>Ring-net</td>
<td>36235</td>
<td>2420</td>
<td>72</td>
</tr>
<tr>
<td></td>
<td>Totals</td>
<td>50567</td>
<td>8723</td>
<td>100</td>
</tr>
</tbody>
</table>
Traps contributed the highest amount of catches at Mwaembe with a value of 64% (table 9). The lowest amount of catches in the same landing site came from spears with barely 9%, while the other two gears of gill nets and lines contributed 16% and 11% respectively.

In tradewinds the highest catches were of gill nets with 39% followed by lines with 30% (table 9). Lowest catches were from the gears of spears with 14% and traps with 16% respectively (table 9). Landing sites of Mvuleni and Mwaepa did not have much disparity among gears in terms of total amount of catches in those landing sites.

In the landing site of Mwanyaza the highest catches were from lines (68%) while gill nets had the lowest catches making up only 2% (table 9) of the total catches within the same landing site.

In Mgwani gill nets contributed 43% of total catches with that of beach seines being negligible (table 10). In Chale highest catches were from the spears with a staggering 62% and beach seines having only 2% (table 9).

6.6 Effort across different gears

This rough and simple measure of effort as a summation of total number of fishers as well as canoes for a given gear was introduced by DeLury (1952) and reflects both the input of fishermen and their boats or canoes in this case. There is no dimension of time as it can be assumed that there is only one fishing trip per day. The duration of the fishing trips as well as the number of fishing days per year are assumed to be rather uniform.

The amount of effort across gears and the returns in terms of catches to the artisanal fishers varied across the landing sites. As can be seen from fig. 25, artisanal fishers seem to invest more effort in traps followed by gill nets, spears (more fishers and fewer boats) and the lines, which were the ‘typical’ traditional gears along this region. The gears with the least effort were the set-net (only found within one landing site – Gazi) followed by beach-seine and finally by the two introduced gears of cha-cha and ring-nets (fig. 25).
Fig. 25: Total effort per gear in percentage of overall effort of artisanal fisheries in the study area

Thus traps had the highest percentage allocation of boats and gears at 29%, followed by the gill nets with 24%, then Spears with 21% and the least being set nets with barely 1% the total allocation of fishers and canoes assigned to this gear throughout the entire period of study.

6.7 Comparison of catch per unit effort across landing sites for the entire period of study

Catches and effort varied across the landing sites as summarized in table 10. Beach seines had the highest catch per unit effort ratios both in Chale and Mgwani. In fact in the two landing sites of Chale and Mgwani, beach seines had a catch per unit effort values of 6.3 and 2.7 respectively. This indicates that even though these gears had their use restricted they offered the best reward to the artisanal fishers per effort of fishing in those two landing sites.
<table>
<thead>
<tr>
<th>Location</th>
<th>Gear</th>
<th>Catches in kgs</th>
<th>Effort (No. of fishers + canoes)</th>
<th>Catch/effort</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chale</td>
<td>Line</td>
<td>929</td>
<td>653</td>
<td>1.4</td>
</tr>
<tr>
<td></td>
<td>Trap</td>
<td>1241</td>
<td>1394</td>
<td>0.7</td>
</tr>
<tr>
<td></td>
<td>Beach seine</td>
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<td>24</td>
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</tr>
<tr>
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<td>Gillnet</td>
<td>1389</td>
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<td>2.5</td>
</tr>
<tr>
<td></td>
<td>Spear</td>
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<td>5102</td>
<td>1.2</td>
</tr>
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<td>978</td>
<td>1.7</td>
</tr>
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<td></td>
<td>Trap</td>
<td>1541</td>
<td>1991</td>
<td>0.8</td>
</tr>
<tr>
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<td>Beach seine</td>
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<td>15</td>
<td>2.7</td>
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<td>Gillnet</td>
<td>4391</td>
<td>2588</td>
<td>1.7</td>
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<td>Spear</td>
<td>2068</td>
<td>1389</td>
<td>1.5</td>
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<td>Set-net</td>
<td>523</td>
<td>229</td>
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<td>465</td>
<td>537</td>
<td>0.9</td>
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<td>Trap</td>
<td>1292</td>
<td>2411</td>
<td>0.5</td>
</tr>
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<td>Gillnet</td>
<td>279</td>
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<td>Spear</td>
<td>2268</td>
<td>2645</td>
<td>0.9</td>
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<td>Set-net</td>
<td>808</td>
<td>362</td>
<td>2.4</td>
</tr>
<tr>
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<td>Line</td>
<td>1705</td>
<td>944</td>
<td>1.8</td>
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<tr>
<td></td>
<td>Trap</td>
<td>950</td>
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<td>Gillnet</td>
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<td>1007</td>
<td>2.1</td>
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<td>Spear</td>
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</tr>
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<td>790</td>
<td>1.7</td>
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<tr>
<td></td>
<td>Trap</td>
<td>729</td>
<td>648</td>
<td>1.1</td>
</tr>
<tr>
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<td>Gillnet</td>
<td>1736</td>
<td>895</td>
<td>1.9</td>
</tr>
<tr>
<td></td>
<td>Spear</td>
<td>648</td>
<td>423</td>
<td>1.5</td>
</tr>
<tr>
<td>Mwaembe</td>
<td>Line</td>
<td>1003</td>
<td>600</td>
<td>1.7</td>
</tr>
<tr>
<td></td>
<td>Trap</td>
<td>5735</td>
<td>5813</td>
<td>1.0</td>
</tr>
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<td></td>
<td>Gillnet</td>
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<td>2388</td>
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<td></td>
<td>Spear</td>
<td>810</td>
<td>1084</td>
<td>0.7</td>
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<td>1.0</td>
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<td>1471</td>
<td>1.4</td>
</tr>
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<td>Gillnet</td>
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<td>4.1</td>
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<tr>
<td></td>
<td>Spear</td>
<td>960</td>
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</tr>
<tr>
<td>Totals</td>
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<td>146 788</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Total catches in Kilograms tabulated for 46 fishing days (since two visits per landing site were made per month) taken by the specific gear. The catch per unit effort is therefore the total amount of fish catches divided by the summation of fishers and canoes for the same period of fishing days sampled – 46 days (De Lury, 1952).
In Gazi a higher catch per unit effort (15.0) came from the ring nets and was the best rewarding gear in that landing site. As mentioned above ring nets were only used by migrating Pemba fishermen while many local fishers in the other landing sites detest its use. They argue that ring nets are largely unselective and in some instances thought that it is responsible for the decreasing catches in the neighboring fishing grounds. No wonder many an artisanal fisher within the larger Kenyan south coast showed some animosity to the Pemba fishers and associated them with many evils linked to fisheries’ operations along the coast. Within the Gazi landing site itself, the few artisanal Digo fishers showed the same apathy towards the use of ring nets although they were too few to throw its users out of the landing site. Further the use of ring nets within this landing site had a long history and of late has received the support of local rich people who had infiltrated its users to eke more fish catches for local market.

In the landings site of Mwaepo, catch per unit effort was higher with the traps. Although catches from this gear was not high (923Kgs) even if compared to that brought by gill nets (2035 Kgs) in the same landing site (table 10), few fishers used it here. In Mgwani traps had a low catch per unit effort (0.8).

The situation at Chale was unique since the amount of catches and effort were relatively higher than the other landing sites of Mwanyaza, Mvuleni, Mwaepo and Tradewinds. Even though there were better catches in Chale than the other neighboring sites, the presence of many fishers and canoes lowered the catch per unit effort except for the beach seines and gill nets (table 10).

The situation where catch per unit effort was less than one was found in four landing sites of Chale, Mgwani, Mwanyaza and Maembe. In the remaining five landing sites of Gazi, Mkunguni, Tradewinds, Mwaepo and Mvuleni the catch to effort ratio was more than one – meaning at least fishers were guaranteed some kilos after a days’ fishing exercise.

6.7.1 Catch per unit effort at Mwaepo

Prior to the start of the study there had been a supply of traps to Mwaepo fish landing site selected members as part of a trial to improve fish catches through improvement of traditional gears specifically traps. Thus each fisher had received a few more effective traps. The results show that catch per unit was above 25Kg, mostly as a result of traps. The other three gears of lines, gill nets and spears had less than 2.0 Kg of catch per unit effort (fig. 27).
6.8 Catch per unit effort across all traditional gears

The catch per unit effort varied among the four common traditional gears. Lines had the highest mean value of 4.0 for the entire study area for the 46 fishing days sampled. Both the traps and gill nets had 2.0 and spears had only 1.0. Thus lines were the most rewarding gear to the artisanal fishers while spears were the least rewarding (fig. 27c).

Although this general assessment favors lines, traps and gill nets in terms of higher cpue, there was marked variation across different landing sites. Beach seines had remarkably higher cpue values in Chale and Mgwani with exceptionally low value in Gazi. The beach seine was employed only in these three landing sites. On the whole, it is possible to say that beach seines
had a high cpue value since it is strongly believed that its catch values were underestimated by the fishers in order to avoid acrimony by the other fishers who were largely against its usage.

Traps had similarly high catch per unit effort values in Mwaepo ostensibly because of improved catchability by the improved traps.

Gill nets gave a relatively more or less constant cpue value across all the landing sites. It had values of 4.1 Kg in Gazi to 1.7 Kg in Mgwani with a low value of 0.6 Kg at Mwaembe.

Comparing the catch per unit effort across the landing sites, it is visible that the landing sites of Gazi and Mkunguni had higher values. While in Gazi this is partly due to more effective improved gears, it could also be as a result of a wider spread of the floor of the lagoon waters in these two landing sites. Both Gazi and Mkunguni exhibit bay like features and in fact they are sometimes referred to as Gazi bay and or Mkunguni bay. These landing sites are composed of water bodies surrounded or otherwise demarcated by land. Like is common to other bays they have calmer waters than the surrounding sea, due to the surrounding land blocking some waves and often reducing winds thus highly favoring the use of traditional gears to catch fish.

6.9 Influence of seasons on catches

The amounts of catches caught by the artisanal fishers were influenced by the two strong seasons of the northeast monsoon (locally called the kaskazi period) and southeast monsoons (kusil). The northeast monsoon, which is normally calm, and normally sets from October to April while the southeast monsoon sets in from April to September. There were correspondingly higher amount of catches from the month of October to beginning of April for both two years (fig.28). The periods from April to September had reduced amount of fish catches for both two years.
Fig. 28: Distribution of total catches across seasons in all landing sites taken together the two years of 2003 and 2004. The Y-axis shows the log transformed values of catches in Kg while the X-axis shows the months.

The influence of seasons on the amount of fish catches varied across the various landing sites (figures 29a – 29i). In the windy season of the kusi (SE monsoons) fishing activity was apparently reduced also the catchability was lower than the other seasons.

Examination of the level of catches across various landing sites revealed that for Mvuleni and Mwaepo the catches were relatively uniform. The amount of fish catches appears to be determined by both the availability of fish and the demand by the local population including the tourist hotels as those landing sites closer to the highly populated Ukunda town had more or less stable level of catches all through the year.

In Gazi high seasonality in catches is caused by the seasonal migration of the fishers from the Tanzanian Island of Pemba to Kenya during the September to April. This is the period of calm winds and good catches.

In Mkunguni catches reflect natural seasonality of fish. This seasonality is also discernible in the landing sites of Mgwani, Mwaembe, and Chale.
Fig. 29a-i: Total amount of catches at the various landing sites across the months showing the seasonality of fishing activities within the study area. These catches were the totals of all the gears at each landing site.

A complete comparison of catches across all the landing sites across the year (fig. 30) shows that Gazi exhibited the greatest seasonality in catches.
Fig. 30: Artisanal total fish catches across different landing sites across months

Mkunguni landing site did not show strict conformity to seasonality like all the other landing sites (fig. 30). Besides, Mkunguni landing site is the second highest productive fish landing site after Gazi for all seasons. This is partly due to its protection by land (it is a bay as already mentioned) giving rise to calm waters favorable for easy harvesting of fish using simple canoes. It is also shielded from strong winds of kusi, thus fishers appear to have raked more fish during the low fishing season perhaps to fill the market gap of July and August when catches were virtually low at all landing sites. The period close to the start of September, catches dropped even at Mkunguni as fishers took time off to prepare fishing wares for the on setting good fishing period.

The catches at the other landings sites were relatively low to those of Gazi and Mkunguni making their seasonality less visible when presented in a single graph with the same scale. However figures 29a-i depicts the seasonality of each of the landing sites under this study. There is a huge disparity in catches of Gazi and Mkunguni sites in comparison to the other remaining seven sites.

6.9.1 Fish categories, catches and variation across months

The composition of the fish catches by taxa was not uniform over the two years but showed clear seasonal differences across categories of demersals, pelagics, crustacea and miscellaneous. To show this variation of taxa with seasons two landing sites of Mwaembe and Mkunguni which best presents this scenario have been used as shown in figures 31a and 31b. They differed however substantially in their catch (note different scales).
In both scenarios, the taxa demersals (table 12) had not only the highest amount of catches. It showed also the highest seasonal variation in both two landing sites.

Pelagics did not exhibit this seasonal variation in catches as strongly as was the case with the demersals. In fact, for both sites, the amount of catches for pelagics had increased during the low fishing period of April to August (fig. 31a - b). At Mkunguni it increased from May to June. It is also apparent that while the amount of demersals showed rapid increment from September in both landing sites, the catches for pelagic went down until November when they started to improve.

The other categories were relatively low (table 11) with just few squids, octopus and rays being recorded for Mwaembe and Mkunguni.
<table>
<thead>
<tr>
<th>Table 11: Fish catches according to categories across time for Mwaembe and Mkunguni landing sites</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Mwaembe landing site</strong></td>
</tr>
<tr>
<td>Demersals</td>
</tr>
<tr>
<td>Scavengers (Lethrinus spp)</td>
</tr>
<tr>
<td>Rabbit fish (Siganus spp)</td>
</tr>
<tr>
<td>Snappers (Lutjanus spp)</td>
</tr>
<tr>
<td>Rockcod (Serranids spp)</td>
</tr>
<tr>
<td>Blackskin (Gasterin spp)</td>
</tr>
<tr>
<td>Parrot fish (Scarus spp)</td>
</tr>
<tr>
<td>Goatfish (Upeneus spp)</td>
</tr>
<tr>
<td>Totals</td>
</tr>
<tr>
<td><strong>Pelagics</strong></td>
</tr>
<tr>
<td>King fish (Scomberomorus spp)</td>
</tr>
<tr>
<td>Barracuda (Sphyraena spp)</td>
</tr>
<tr>
<td>Totals</td>
</tr>
<tr>
<td><strong>Miscellaneous</strong></td>
</tr>
<tr>
<td>Squids (Loligo duvausel)</td>
</tr>
<tr>
<td>Octopus (Octopus macropus)</td>
</tr>
<tr>
<td>Totals</td>
</tr>
<tr>
<td><strong>Others</strong></td>
</tr>
<tr>
<td>Rays</td>
</tr>
<tr>
<td><strong>Crustacea</strong></td>
</tr>
<tr>
<td>Lobster</td>
</tr>
<tr>
<td><strong>Mkunguni landing site</strong></td>
</tr>
<tr>
<td>Demersals</td>
</tr>
<tr>
<td>Rabbit fish (Siganus spp)</td>
</tr>
<tr>
<td>Scavengers (Lethrinus spp)</td>
</tr>
<tr>
<td>Snappers (Lutjanus spp)</td>
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<td>Blackskin (Gasterin spp)</td>
</tr>
<tr>
<td>Rockcod (Serranids spp)</td>
</tr>
<tr>
<td>Parrot fish (Scarus spp)</td>
</tr>
<tr>
<td>Goatfish (Upeneus spp)</td>
</tr>
<tr>
<td>Totals</td>
</tr>
<tr>
<td><strong>Pelagics</strong></td>
</tr>
<tr>
<td>King fish (Scomberomorus spp)</td>
</tr>
<tr>
<td>Barracuda (Sphyraena spp)</td>
</tr>
<tr>
<td>Totals</td>
</tr>
<tr>
<td><strong>Others</strong></td>
</tr>
<tr>
<td>Rays</td>
</tr>
<tr>
<td><strong>Crustacea</strong></td>
</tr>
<tr>
<td>Lobster</td>
</tr>
</tbody>
</table>
Comparing the variation of taxa within the demersal category results (figures 32a and 32b) show that rabbit fish (*Siganus spp.*) was the highest caught in both landing sites. It had exhibited the greatest seasonal variation at Mkunguni. At Mkunguni parrot fish (*Scarus spp.*) showed high seasonality. In both landing sites rock cod and goat fish had the lowest catches.

![Mkunguni demersals: catches according to taxa across months](image)

*Fig. 32a: Demersals catch variation according to fish categories at Mkunguni*

![Mwaembe demersals: Catches across months](image)

*Fig. 32b: Demersals catch variation according to fish categories at Mwaembe*

Whereas there were only a few species that recorded higher catch at Mkunguni, at Mwaembe most of the demersal groups were available although in low amounts of catch. Fishers must have capitalized on the availability of few demersal groups at Mkunguni, since there was incredibly high amount of catches there compared to Mwaembe. This could show lack of
selectivity among fishers and their gears especially in the event of availability of a given taxa. There was also much greater seasonality in Mwaembe compared to Mkunguni.

The pelagics category, was composed of only two species – *Scomberomorus spp* (King fish) and *Sphyraena spp* (Baracuda), there was no marked variation with Sphyraena spp at Mwaembe. In Mkunguni, the pelagic catches dropped (fig. 33a) during the high fishing season of September to April and showed remarkable increase during the low fishing season of May to August. This very trend is visible also in Mwaembe (fig. 33b), where catches started to shoot up not until December and also with higher catches within the low fishing period of April to July. This might indicate that fishers alternated the fishing of demersals with pelagic, so that during the good fishing seasons they put more effort on the demersals and less during the harsh seasons.

![Mkunguni pelagics: catches across months](image)

*Fig. 33a: Pelagic fish catches variation across months at Mkunguni*
Fig. 33b: Pelagic fish catches variation across months at Mwaembe

In general, comparison of all the categories in terms of catches for two landing sites (Mwaembe and Mkunguni) indicated that demersals constituted the highest catches and also showed marked variation across the seasons. In terms of the two fish taxa used to present the pelagic category one (barracuda) was continuously low all year round.

6.9.2 Seasonality in the use of fishing gears

The four common gears of traps, gill nets, spears and lines showed variation in the amount of catches across the seasons (table 12). For the gill nets the highest catch was three times the lowest catch and the same was the case with the spears (fig. 34). All gears had an upsurge in the amount of catches from October to March and lowest catches from April to September.
Gears like cha-cha, set nets and beach seines were not common to all the landing sites and were mostly used during certain seasons of the year. At Gazi, the migrating fishers from Pemba Island used beach seines and ring nets only during the good fishing months of September to April. The use of beach seines and ring nets had been banned through local agreement and additionally enforced by the fishery officers. This made their data not comprehensive enough for seasonal analysis.

6.9.3 Fishing effort and seasonality

Attempt was made to find out whether fishing effort was influenced by the seasonality. The periods of holy month of Ramadan when fishing went down had minimal effect on the amount of catches i.e. the month of Ramadan for 2004 started on the 15th October and ended on 12th November. For the month of October the sites were visited before the start of Ramadan and for November the sites were visited after the end of Ramadan. Still each site was visited twice a month as was the case for non-Ramadan periods.

Fishers stepped up fishing effort in the good fishing months especially in October to March across all the four main gears which were common in all the landing sites (fig. 35). Gill nets appeared to have been used much less in February and October, the months preceding the good fishing seasons – probably to allow for their repair and maintenance in readiness to bumper harvests. During strong winds in the months of March to August the use of the four common gears appeared more or less stable (fig. 35). A similar trend was visible with almost all
the gears – an indication that fishers reduce fishing effort prior to the onset of the good fishing seasons.

![Seasonal variation of fishing effort across months](image)

**Fig.35: Seasonal variation of fishing effort across months**

Spears and lines appeared even to do better during the low fishing seasons. At some point prior to the onset of the good fishing period, spears appear to have been mostly deployed. The use of lines also increased during the low seasons an indication that fishers could have been forced by the rough seas to limit fishing to the very shallow near shore waters better exploited by both the crude lines and spears when poor canoes were unable to venture into the offshore waters.

### 6.9.4 Catch per unit effort and seasonality

As expected seasons influenced catch per unit effort with higher values being obtained during the good fishing seasons of September to April (table 12). As already indicated traps were the most rewarding gears across all the landing sites sampled. Spears had drastic increment in catch per unit effort during the good fishing seasons. This could be attributed to clear waters and reduced numbers of canoes available to them since most of the canoes are then used to access far flung waters offshore. Catch per unit effort for the lines were rather stable with only small increment during the good fishing seasons (table 12).

Traps had the highest catch per unit effort values while lines had the least catch per unit effort values across all the months. Since catch per unit effort was calculated as the rate of total catches divided by the total number of fishers and canoes the fact that traps could be used without canoes or a single canoe could be used to set several traps probably made them have higher cpue values.
Table 12: Comparison of catches and effort across gears

<table>
<thead>
<tr>
<th>Months</th>
<th>Jan</th>
<th>Feb</th>
<th>Mar</th>
<th>Apr</th>
<th>May</th>
<th>Jun</th>
<th>Jul</th>
<th>Aug</th>
<th>Sep</th>
<th>Oct</th>
<th>Nov</th>
<th>Dec</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lines-catches</td>
<td>2554</td>
<td>1492</td>
<td>2210</td>
<td>1293</td>
<td>1913</td>
<td>1887</td>
<td>1742</td>
<td>1735</td>
<td>1852</td>
<td>1634</td>
<td>1844</td>
<td>1950</td>
</tr>
<tr>
<td>Lines-effort</td>
<td>470</td>
<td>363</td>
<td>402</td>
<td>465</td>
<td>450</td>
<td>468</td>
<td>472</td>
<td>430</td>
<td>477</td>
<td>454</td>
<td>405</td>
<td>422</td>
</tr>
<tr>
<td>Catch/effort lines</td>
<td>5</td>
<td>4</td>
<td>5</td>
<td>3</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Traps-catches</td>
<td>7483</td>
<td>4541</td>
<td>5927</td>
<td>4341</td>
<td>5161</td>
<td>5450</td>
<td>4786</td>
<td>5181</td>
<td>5245</td>
<td>4851</td>
<td>6291</td>
<td>5677</td>
</tr>
<tr>
<td>Traps-efforts</td>
<td>553</td>
<td>426</td>
<td>541</td>
<td>540</td>
<td>525</td>
<td>520</td>
<td>461</td>
<td>528</td>
<td>534</td>
<td>510</td>
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<td>595</td>
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<td>Catch/effort traps</td>
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<td>11</td>
<td>11</td>
<td>8</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>12</td>
<td>10</td>
</tr>
<tr>
<td>Gill nets catches</td>
<td>3340</td>
<td>3177</td>
<td>4442</td>
<td>3361</td>
<td>3009</td>
<td>3357</td>
<td>3420</td>
<td>4084</td>
<td>3153</td>
<td>1250</td>
<td>4415</td>
<td>4230</td>
</tr>
<tr>
<td>Gill nets efforts</td>
<td>507</td>
<td>448</td>
<td>563</td>
<td>537</td>
<td>540</td>
<td>515</td>
<td>524</td>
<td>535</td>
<td>540</td>
<td>435</td>
<td>581</td>
<td>576</td>
</tr>
<tr>
<td>Catch/effort gill nets</td>
<td>7</td>
<td>7</td>
<td>8</td>
<td>6</td>
<td>6</td>
<td>7</td>
<td>7</td>
<td>8</td>
<td>6</td>
<td>3</td>
<td>8</td>
<td>7</td>
</tr>
<tr>
<td>Spears- catches</td>
<td>3507</td>
<td>3086</td>
<td>3211</td>
<td>2507</td>
<td>3016</td>
<td>1222</td>
<td>1829</td>
<td>2844</td>
<td>1293</td>
<td>3230</td>
<td>4288</td>
<td>1615</td>
</tr>
<tr>
<td>Spears-efforts</td>
<td>511</td>
<td>386</td>
<td>427</td>
<td>453</td>
<td>459</td>
<td>360</td>
<td>403</td>
<td>465</td>
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<tr>
<td>Catch/effort spears</td>
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<td>8</td>
<td>8</td>
<td>6</td>
<td>7</td>
<td>3</td>
<td>5</td>
<td>6</td>
<td>3</td>
<td>8</td>
<td>10</td>
<td>4</td>
</tr>
</tbody>
</table>

For gill nets despite increase of effort during the low fishing, season catches remained low. However, the months succeeding September showed increased amount of catches despite the same amount of effort (fig. 36) while the traps, the amount of catches and effort resonated (table 12).

The introduced gears of cha-cha, beach seines, ring nets and even set nets which were only used at one landing site presented a rather unique case, i.e. the use of *cha-cha* (basically a form of set-net), gave a big disparity between the amount of effort and catches. Efforts were much higher for lower catches except from September when of catches drastically shot up (fig. 36).

The beach seine though restricted for use within most of the local landing sites through local group consensus as well as traditional control, presented a classic case of economic endeavor; where increase in effort resonated with increase in the amount of catches, almost throughout the year (table 12).

The set-net like their close associate of *cha-cha*, also showed similar trends with catches responding to increase in amount of effort throughout the year (fig. 35).

For the ring net only used in Gazi and only during the good fishing months of October to May – there was high catch per unit values. Ring nets can be considered to be the most rewarding to fishers with a catch per unit value of up to 52 Kgs. The fact that this gear is only restricted to Gazi and operated by the migrating fishers from Tanzania and during only the good fishing seasons – shows how efficient these migrating fishers are compared to their local counterparts.

Further insight into about the relationship between the catches and effort of the gears cha-cha, beach seines and set net which were used only within a few landing sites is further shown in the figures 37a to 37c.
Comparison of catch per unit effort for all the gears including those that were only restricted to certain landing sites is as in figure 42. It is clear that the highest ratio of catch per unit effort was obtained from the set nets which again were only used in two landing sites of Mgwani and Mwanyaza. The second highest value of catch per unit effort (fig. 38) was attained with cha-cha, a form of set net again only found in one landing site of Gazi. Ring net was the third in terms of higher CPUE values.

Fig. 37a.  
**Fig. 37a**: Catches and effort of cha-cha at Gazi  
**Fig. 37b**: Catches and effort of beach-seine at Gazi  
**Fig. 37c**: Catches and effort of set-net at Mgwani
It is clear from fig. 38, that the three gears of set net, cha-cha, and ring nets which are not considered common gears along the Digo fishermen of the Kenyan south coast had the higher CPUE values (fig. 38), so to speak the best rewarding gears to the fishers. Indeed, two of these gears, the ring nets and cha-cha, were only deployed during the good fishing seasons. Moreover, even the set net which though was deployed during the non-fishing seasons, showed remarkably reduced catches during that period compared to the good fishing period when it netted high amounts of fish catch.

The continued use of the gears that give very low values of catch per unit effort within the area confirms my assessment that there has been little gear improvement within this region. Comparison of the rich catches by the cha-cha and ring nets to the catches from the other gears (traditional gears) indicates that the traditional gears remained with very low catchabilities. While these locally assembled gears are environmentally friendly and mostly selective they are less rewarding and keep the fisheries in the rather unproductive phase.

7.0 Estimation of a catch per area (t/km²)

An annual catch per kilometer of coastline is used as a rough measure of fishery productivity in tropical artisanal fisheries (literature) which fish rather close to the shore. The calculation outlined in table 14 resulted in an estimate of about 14tonnes of fish per kilometer coastline. This figure compares favorably with the UNEP (1998) estimation of fisheries productivity along the Kenyan coast which gives a figure of 6000 to 9000 metric tons (UNEP, 1998) – this means about 12 – 18 tones per Kilometer coastline.
From the data sets available it is possible to come up with an overall estimate of the total amount of fish catches in the study area during the years 2003 and 2004. This is based on a number of assumptions:

1. No fish is landed outside the 9 landing sites
2. There are very few fish caught outside the near shore waters of the study area, and all these catches are still taken by the artisanal fishers to the 9 landing sites.

**Table 14: Steps of estimation of annual catches in tones per Kilometer within the study area**

There are about 20 fishing days per month for every artisanal fisher  
Duration of study in months = 23 months  
Total number of fishing days = 440 days (leaving out 2 months to cater for Ramadan months for each year)  
Each month each landing site was visited only twice for a total of 23 months = 46 days  
Therefore total fish catches represents 46 days  
Ratio of catch for the whole duration is 440:46 = 9.8  
Total catch for the total sampled days = 146 788.7 Kg  
Total catch for one day = 146 788.7 ÷ 46 = 3191 Kg  
Total catch for 1 year (220 days) = (220 × 3191) Kg = 702 020 Kg  
This is the total catch in an area spreading 50Km  
Catch in terms of tones per km per annum = 702 ÷ 50 = 14t/km per year.
7 RESULTS II

SOCIO-ECONOMIC AND CULTURAL DIMENSIONS OF ARTISANAL FISHERIES

I. Socio-economic surveys

7.1. Household composition, marital status, number of dependants, level of education and age components

The survey showed that 45% of the households were headed by fishers above the age of 45 years, 25% headed by those between the ages of 31-44 (table 15). And 30% of all the artisanal fisher households’ surveyed were of those below 30 years (table 15). It is important to note that the average lifespan in Kenya is about 50 years. This makes the age above 45 years be considered old age. Young men and women also marry at relatively young age – usually as from 18 for boys and even as from 15 for girls. Thus, it is no surprise that 30% of the families surveyed were below 30 years.

Many of the artisanal fishers still cherished strong family unions, with 80% being married and only 5% being single (table 15). Households were characterized by high dependencies that mean children and relatives living in the household. Those having over 6 dependants were leading with 30%, followed by those with 5-6 constituting 25%. Households of single fishermen or couples constituted only 5%. Generally the fishers exhibited close knit families and even though men were the heads and bread winners of those families, there appeared to be a close consultation between the husband and wife in making many decisions. Several observations showed that women had more time with the children especially when they were young. Men even though spent many hours fishing; they were mostly available at home for those days that they did not go fishing, perhaps to compensate for the time they spent in the waters.

The level of education is low in the fishing community with barely 25% having some basic literacy skills and 10% some vocational educational skills - having got some live survival trainings in carpentry, masonry or tailoring, while the rest (65%) were illiterate (table 15). There are a few primary schools within the study area. There exists really no motivation for higher education as there are few well read and studied persons in the area to motivate the young. Worse, parents find the extra effort from their young ones useful in livelihood activities like fishing, farming and selling. No wonder, the sight of young boys and girls merchandising items on the beach or by the roadsides was a common sight.
Table 15: Household composition statistics: number and percentage of selected artisanal households each represented by one respondent

<table>
<thead>
<tr>
<th>Aspect of inquiry</th>
<th>Cluster (s)</th>
<th>Counts (n)</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age component</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0 – 30</td>
<td>6</td>
<td>6</td>
<td>30</td>
</tr>
<tr>
<td>31 – 44</td>
<td>5</td>
<td>5</td>
<td>25</td>
</tr>
<tr>
<td>Over 45</td>
<td>9</td>
<td>9</td>
<td>45</td>
</tr>
<tr>
<td>Marital status</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Married</td>
<td>16</td>
<td>16</td>
<td>80</td>
</tr>
<tr>
<td>Single</td>
<td>1</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>Widowed</td>
<td>2</td>
<td>2</td>
<td>10</td>
</tr>
<tr>
<td>Divorced</td>
<td>1</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>Number of dependants</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>None</td>
<td>1</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>1 – 2</td>
<td>5</td>
<td>5</td>
<td>25</td>
</tr>
<tr>
<td>3 – 4</td>
<td>3</td>
<td>3</td>
<td>15</td>
</tr>
<tr>
<td>5 – 6</td>
<td>5</td>
<td>5</td>
<td>25</td>
</tr>
<tr>
<td>More than 6</td>
<td>6</td>
<td>6</td>
<td>30</td>
</tr>
<tr>
<td>Level of education</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>None</td>
<td>13</td>
<td>13</td>
<td>65</td>
</tr>
<tr>
<td>Primary</td>
<td>5</td>
<td>5</td>
<td>25</td>
</tr>
<tr>
<td>Secondary</td>
<td>2</td>
<td>2</td>
<td>10</td>
</tr>
<tr>
<td>Tertiary</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

7.2 Household incomes

Most of the families within the study area could be considered as fishing families: they depended on fisheries in one way or the other, at least one member of the family was involved in active fishing or selling of fish products, some percentage of family income is generated from fishing or related activities and there is some traditional attachment to fisheries like respect or belief in the sea spirits. In those families an average of 32% of the total income came from fishing activities (table 16).

Other sources of income in the fishing communities included operating small businesses locally known as kiosks, which mostly involved merchandising various household items, they constituted about 13% of the total household incomes. Farming, an activity undertaken by majority of the artisanal fishers constituted about 21%, while the buying and re-selling of fish catches mostly done by the women constituted 16% of the total household incomes (table 16). The direct selling of fish catches by the artisanal fishers was considered separate from that act of buying and re-selling. There were also other sources of income like sale of plots, inheritances or dowry to those who had sons and daughters. In total, these other myriad sources of household incomes added up to 18% of the household incomes as shown in table 16.

Fishing was mostly for household sustenance (subsistence) though with some intention to sell to obtain some cash money other household requirements. Reasons for fisheries exploitation were heavily in favor of this premise with 34% of the respondents saying it was done out of the need to meet both their subsistence as well as commercial. There was no subtle difference between subsistence and commercial with percentages of 32 and 34 respectively.
It is important to note that while fishing constituted about one third of the meager monetary income of the fishing families, it provided more important portion of the family protein rich food and it is the major valuable food for the subsistence of the community.

**Table 16: Household incomes and expenditure: number and percentage of selected artisanal households each represented by one respondent**

<table>
<thead>
<tr>
<th>Aspect of inquiry</th>
<th>Cluster (s)</th>
<th>Counts (n)</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Employment</td>
<td>Government employed</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Private company employee</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Self-employed e.g. fisherman</td>
<td>20</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td>Unemployed</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Sources of income</td>
<td>Fishing</td>
<td>12</td>
<td>32</td>
</tr>
<tr>
<td></td>
<td>Kiosk and merchandising</td>
<td>5</td>
<td>13</td>
</tr>
<tr>
<td></td>
<td>Farming</td>
<td>8</td>
<td>21</td>
</tr>
<tr>
<td></td>
<td>Merchandising of fish products</td>
<td>6</td>
<td>16</td>
</tr>
<tr>
<td></td>
<td>Other</td>
<td>7</td>
<td>18</td>
</tr>
<tr>
<td>Earnings from fish related activities per week in Kenya shillings (Kshs.)</td>
<td>0 – 100</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>101 – 500</td>
<td>17</td>
<td>85</td>
</tr>
<tr>
<td></td>
<td>501 – 1000</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Over 1000</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Not available</td>
<td>3</td>
<td>15</td>
</tr>
<tr>
<td>Income from other activities</td>
<td>0 – 500</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>101 – 500</td>
<td>19</td>
<td>95</td>
</tr>
<tr>
<td></td>
<td>501 – 1000</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Over 1000</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

The low level of education within the fisher villages (table 15) might explain why there are no government employed persons within these communities.

The level of monetization within these communities remained very low, with earnings from fish related activities ranging mostly from Kenya shillings 101 to 500 and those from other activities also being largely on the same range, totaling to roughly US$ 2.6 per week (table 16). This was considerably low especially given that the income from fishing related activities alone already made up a third of all the household incomes (table 16). However not has to be taken that these are subsistence communities where most basic commodities are acquired possibly without using money. In some households, they survived for weeks without any money, so we learnt during the interviews.

It is also important to note that the income obtained from fisheries and related activities did not take into account the proportion used at home. In some cases, fishers only had enough catch for home consumption. Thus one might say that fisheries and related activities actually contributed more than we were able to quantify and more than the fishers imagined.
Most of the household incomes were spent on the basic requirements of food (79%), medication (10%), school related expenditures (10%) and water (1%) as shown in table 17. Since the area is close to the sea level most of the water is salty and hence the need to buy clean un-salty water for drinking purposes.

Table 17: Percentages of common household expenditures

<table>
<thead>
<tr>
<th>Nature of expense</th>
<th>Amount of money in Kenya shillings</th>
<th>% of total expenses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Food</td>
<td>6,605</td>
<td>79</td>
</tr>
<tr>
<td>Medicine</td>
<td>876</td>
<td>10</td>
</tr>
<tr>
<td>School</td>
<td>818</td>
<td>10</td>
</tr>
<tr>
<td>Water</td>
<td>59</td>
<td>1</td>
</tr>
</tbody>
</table>

7.3 Leadership

The villages are under the leadership of the village elders. A few villages depending on the number of people constitute a sub-location. At the sub location level one finds a government officer mostly in charge of instituting government policy and interpretation. This official also oversees security concerns within this area and settles together with a college of elders those disputes that have been referred to him by the village elders. Over and above, the council of elders is the most immediate form of leadership. They interpret traditions, taboos and norms besides acting as deterrent to those who would wish to disobey them. Although they can prescribe punishment, enforcement of the taboos and most other generally consented to rules is done through group cohesion and the love for peaceful co-existence. The fear of the wrath of the spirits or curses from the elders also assist enforce rules and order. In many other occasions the elders presided over vital village occasions like marriages, burial of the dead or blessing the beginning of fishing season.

In an effort to examine the effectiveness of leadership and whether intervention strategies could be hinged on the same leadership structures, the view of how they held their leaders was examined (table 18). A total of 45% of artisanal fishers rated their group/village leadership to be more on the average, with 45% saying leadership was good and 55% hinting it was just satisfactory.
Table 18: Perception of leadership effectiveness: number and percentage of selected artisanal households each represented by one respondent

<table>
<thead>
<tr>
<th>Aspect of inquiry</th>
<th>Cluster (s)</th>
<th>Counts</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leadership of the fishers’ group</td>
<td>Excellent</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Good</td>
<td>9</td>
<td>45</td>
</tr>
<tr>
<td></td>
<td>Average</td>
<td>11</td>
<td>55</td>
</tr>
<tr>
<td></td>
<td>Poor</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Other times and out of the ear shot of fellow villagers, fishers complained of declining authority of the elders. On some issues they thought the elders are not doing enough to talk to the government to offer them assistance like loans to buy better gears or good schools for their children. On the extreme they even blamed their poverty on the elders, especially the young ones who felt the elders are too old and uninformed about the new developments like marriage without payment of dowry. This study on the perception of current leadership was felt important to assist understand how a new fishing development or technology could be implemented or even recommended.

7.4 Occupation

Many of the local people interviewed viewed themselves as being affiliated to subsistence farming (47% - table 19). Small holder farm agriculture remained a common practice among all the adult persons within this community even to those who were actively engaged in fishing as were employed labor like teachers.

Table 19: Occupation: number and percentage of selected artisanal households each represented by one respondent

<table>
<thead>
<tr>
<th>Aspect of inquiry</th>
<th>Clusters</th>
<th>Counts</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Occupation</td>
<td>Farming</td>
<td>91</td>
<td>47</td>
</tr>
<tr>
<td></td>
<td>Fishing</td>
<td>25</td>
<td>14</td>
</tr>
<tr>
<td></td>
<td>Others</td>
<td>14</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>Wage laborers</td>
<td>61</td>
<td>33</td>
</tr>
</tbody>
</table>

It was not easy to get a clear picture of the distribution of occupations. In many cases activities like fishing or farming were never taken as jobs or occupation by the community. They were considered means of living or rather a way of life. In any case, there were strictly no single individual who was restricted to any one occupation. Fishers dangled between fishing and other activities during the low fishing seasons. Young fishers sometimes abandoned fishing when it rewarded them for more lucrative openings within the nearby tourist facilities. It is not clear why many of them identified with the other occupations more than fishing, but it could be that fishing as an occupation is more spoken of at the landing sites or while doing actual fishing and not under a discussion somewhere at or near home. Because of this aspect of juggling between
several occupations between seasons and even hours of the day, it was not easy to estimate
the amount of hours the family spent on fishing. In any case, only one member was involved in
fishing activities at any given time; women fish dealers married to the fishermen stayed at
home while the men went fishing and only processed and merchandised the fish once the men
were back home.

7.5 Traditional resource controls

Traditional fishery resource controls involved use of generally acceptable principles to guard
the exploitation of fishery resources. These principles although not written were presented in
form of taboos, norms and general code of conduct while fishing. Failure to adhere to these
taboos and norms met some sanctions and reprimand from the elders who were involved in
ensuring not only the smooth co-existence between the people themselves but also with their
environmental resources.

Awareness of resource exploitation and use controls was fairly high with 52% being aware of
these common controls and restrictions and 48% expressing ignorance (table 20). Further, I
analyzed the level of awareness about fishing period restrictions. Many more fishers agreed to
being aware of fishing period restrictions with a total of 62% being aware of the controls, and
30% not and 8% feigning ignorance (table 20).

Going into details of fishery resources exploitation controls, the respondents were asked about
being aware of restrictions on fishing gears or not, to which 63% were aware, barely 9% were
not and 28 % had no idea about fishing gear restrictions. Further investigations on the fishery
exploitation controls, a total of 68% were aware that catching of certain fish species and
cohorts were prohibited by traditional agreement and consensus, barely 2% were not aware of
the controls and 30% had no idea about these controls (table 20).

To determine sustainability or continuity of these traditional controls, questions were asked
about pillars of the belief systems. These belief systems acted like the driving force behind
these rules – having learnt this from the reconnaissance studies and several informal
discussions. One of the major components of the fishing belief system here were the sacred
sites referred to us the ‘Kayas’ and ‘Mzimus’. These terms have been explained in the later
parts of this thesis. It was important to find out whether ‘Kayas’ were being preserved and
whether new ones were being enacted to replace those that had been cleared for human
settlement or development. Results showed that sacred sites like the Kayas were no longer
being formed even in cases where the old ones had been pulled down by tourism
infrastructural developments or other uses. A sweeping 96% of the respondents said no more
sacred sites, kayas and mzimus, were being formed (table 20) and that even the old ones were
never being adequately cared for as was the case before.
Table 20: Resource controls and regulations: number and percentage of selected artisanal households each represented by one respondent

<table>
<thead>
<tr>
<th>Aspect of inquiry</th>
<th>Cluster (n)</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Awareness of rules governing resource exploitation</td>
<td>Yes</td>
<td>52</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>48</td>
</tr>
<tr>
<td>Awareness about fishing period restrictions</td>
<td>No</td>
<td>30</td>
</tr>
<tr>
<td></td>
<td>Yes</td>
<td>62</td>
</tr>
<tr>
<td></td>
<td>No idea</td>
<td>8</td>
</tr>
<tr>
<td>Those in-charge of restrictions</td>
<td>Kaya elders</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Village fishermen</td>
<td>11</td>
</tr>
<tr>
<td></td>
<td>Others</td>
<td>25</td>
</tr>
<tr>
<td></td>
<td>Elderly fishermen</td>
<td>62</td>
</tr>
<tr>
<td>Are new pillars of beliefs like Kayas and mzimus being formed?</td>
<td>No</td>
<td>96</td>
</tr>
<tr>
<td></td>
<td>Yes</td>
<td>0.5</td>
</tr>
<tr>
<td></td>
<td>No idea</td>
<td>3.5</td>
</tr>
<tr>
<td>Are there repercussions for failure to observe rules?</td>
<td>Yes</td>
<td>97</td>
</tr>
<tr>
<td></td>
<td>No idea</td>
<td>3</td>
</tr>
<tr>
<td>Are there restricted types of fishing gears?</td>
<td>Yes</td>
<td>63</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>No idea</td>
<td>28</td>
</tr>
<tr>
<td>Are there species or age cohorts that were restricted for fishing?</td>
<td>Yes</td>
<td>68</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>No idea</td>
<td>30</td>
</tr>
</tbody>
</table>

It is important to note that the figures given above are just the backbone of the outcomes of the interviews which provided far much more non quantitative information.

Results also showed that majority of the fishers knew of restrictions regarding certain fish species or fish cohorts (table 20). Discussions with fishers gave insights about fish spawning periods when fishing was not allowed within certain fishing grounds. Catches of larvae fish during certain phases of the moon were prohibited. Fishers who went against these restrictions could be slapped with some sanctions or fines.

Certain spots associated with unfamiliar phenomena like springs and very rocky surfaces on the ocean bed, were appreciated and isolated from use by the artisanal fishers. These sites were further controlled by general communal consensus and fishers were not allowed to enter those areas as shown in table 21.
Table 21: Traditional consensus on demarcation of special spots within fishing grounds

<table>
<thead>
<tr>
<th>Aspect of Inquiry</th>
<th>Responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Which were the special spots in the waters in regard to fishing?</td>
<td>Mzimus (places which were believed to host the sea spirits and gods). Vyambani (extremely rocky areas under the waters) Mavovo, fish spawning and rearing grounds, especially within abundant younger cohorts and eggs</td>
</tr>
<tr>
<td>Uses of the special places</td>
<td>For offering prayers for increased catches, good health of fishers, peace and general communal fortunes</td>
</tr>
<tr>
<td>How were special sites protected?</td>
<td>Accesses to those sites were restricted and only minimal fishing activities allowed with special permissions. Fishing could be allowed into those sites only with authority from the elders or to get catches for special village occasions like ritual ceremonies.</td>
</tr>
</tbody>
</table>

7.6 Survey on indigenous traditional knowledge with elderly fishers

Much effort was made to dig out the indigenous knowledge system of the artisanal fishers and its implications on the fish resources. It was largely meant to test the hypothesis that artisanal fisheries exploitation was undertaken within the framework of traditional knowledge systems that have been accumulated across generations through experiences, informal learning processes and testing.

It was found out that there are several names given to the gods and spirits by the fishers. An indication that they worshipped or paid reverence to the existence of these gods or spirits. Some of the names used to refer to the gods or spirits were: shetani, jinni, suhani.

Fishers also revealed that there were joint meetings and discussions before at the beginning of the fishing trips. Each of these meetings were convened by a respected elder, who together with the fishing trip members decided on the fishing grounds to be visited and assigned tasks to various fishers. This lead elder also checked on the status of body and mind health of the fishers to allow involvement in fishing activities. The leader also inspected the water worthiness of the fishing vessels mostly the dugout canoes and they ability to ensure safety of the fishers in the sea.

After the meetings and discussions, fishers moved to the canoes and thereafter the waters for fishing. It was generally expected that they follow the instructions given during the elderly briefings.
7.6.1 Assemblage of gears and their maintenance

Assemblage of fishing gears and their maintenance were one aspect where the indigenous knowledge systems were largely used by the artisanal fishers. Here the knowledge about some plants that could stand salty water conditions were identified and used for making the fishing gears. The maintenance of the gears assembled was also part of this knowledge system as shown in table 22.

Table 22: Indigenous knowledge on assemblage and construction of fishing gears and their maintenance

<table>
<thead>
<tr>
<th>Aspect of Inquiry</th>
<th>Responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>b). Dug-out canoes</td>
<td>Mostly made from a variety of mango trees. The mango tree was dug and fell complete with all the roots. Special rituals were performed before felling the tree. The branches were then cut and the desired length of the trunk cut off. Chopping and filing succeeded the earlier steps until the required shape was attained.</td>
</tr>
<tr>
<td>a). Malema (traps)</td>
<td>Material for making traps are from special trees, which were cut, split, dried, dampened for a few days and then weaved. Some fishers took up specializations in these tasks and exchanged their skills for making gears for some favors like daily fish catch rations.</td>
</tr>
<tr>
<td>c). Uzio (fish fences)</td>
<td>These were large trap kind of gears that were positioned within the waters to trap fish. Slender trees from the bushes were assembled and tied with a minyaa (a rope like vegetation). These assemblages were combined into a large roll which was then taken to the waters to form a kind of homestead (boma), leaving an inlet for the fish to move in but which did not allow the fish to move out.</td>
</tr>
<tr>
<td>d). Spear guns (Mkonzo)</td>
<td>Most common and were readily made by local blacksmiths from scrap metals. Used a similar technology like the sport fishing guns.</td>
</tr>
</tbody>
</table>

Maintenance of above gears

| Dug-out canoe | A piece of cotton wool would be placed in any emerging cracks. The boat was roasted after every two weeks with fire flames to guard against fungal infestation. |
| Malema (traps) | No major repairs were made. Once worn out, they were thrown away and new ones made |
| Uzio (fish fence) | Repairs mostly entailed, replacement of the worn out minyaa which were used to tie together the slender trees or shrubs |
| Mkonzo (Spears) | Maintenance involved replacement of the wooden part and regular sharpening of the metallic component. |

Available also to the fishers were indigenous knowledge about special plants and vegetation which could be used in the process of fishing activities to make fish dizzy and thus easy for
capture. One of the most common plants cited by the fishers was locally known as ‘Utupa’. This plant was pounded and sprinkled on the water. Its effects on the fish were usually very effective but were rather unselective even on the fish eggs and larvae. Due to its unselective nature, the use of it was seldom allowed by the elders.

7.6.2. Indigenous knowledge about oceanic conditions in relation to phases of the moon

The ocean tides, currents and wave movements have a close relation to the position of the moon relative to the earth and the sun. This in-turn influences the seasonality of various marine animals and even plants. The artisanal fishers exhibited great awareness about these changes especially as they influenced the abundance of fish species on which their lives depended. The fishers knew that during the full moons there were less fish and undertook little fishing. Fish abundance improved during half moon. It was known among the fishers that highest abundance was attained during the crescent phase of the moon. The fishers also varied gears and their art of fishing according to the phase of the moon.

7.6.3 Indigenous knowledge on fish species and their life histories

The artisanal fishers exhibited a wide range of knowledge about various fish species. This knowledge consisted of the life cycle of the common fish species, their migration patterns, occurrence, and feeding behavior (table 23). Although less vigorous, it was practical and useful within the needs of the fishers. Some of the most common fish species cited by fishers within the study site were: Tafi (Rabbit fish), Changu (Scavengers), Pono (Parrot fish), Msuza (Baracuda)

Table 23: Artisanal fishers knowledge on fish species and their life histories

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>a).</strong> Pono (Parrot fish) Scarus spp.</td>
<td>Life cycle: lays eggs in the miwani (within mangroves-mud). The eggs then hatch and young ones migrate to deeper waters. Occurrence: Normally occur as shoals, bigger individuals can however be found alone. Feeding: Mostly feed on sea grasses</td>
</tr>
<tr>
<td><strong>b). Tafi (Rabbit fish) Siganus spp.</strong></td>
<td>Life cycle: lays eggs in rock crevices and inlet rivers and larvae and juveniles swim into deeper waters after hatching Occurrence: found in shoals and common within deeper waters Migration: Do migrate and are rarely available during certain seasons Feeding: mostly on planktons</td>
</tr>
<tr>
<td><strong>c). Changu (Scavenger) Lethrinus spp.</strong></td>
<td>Life cycle: lays eggs on rock crevices or corals, stays around until after hatching. Occurrence: found in shoals</td>
</tr>
</tbody>
</table>
7.7 Coexistence amongst local fishers, government agencies and tourist infrastructure developers

The relationship was frosty between the artisanal fishers and the government agencies as well as with the tourist infrastructure developers and entrepreneurs like hoteliers. This became obvious from personal observations as well as in conversations with various fishers and their group representatives. In this survey, only 26% thought their relationship was good and cordial. In an attempt by the Kenyan government to institute a marine protected area within those some parts of the study area opinion from fishers varied. A total of 30% were brave enough to out rightly say it was a bad idea and 44% politely said it was fair (table 24). Further on, many of them (76%) said they had a frosty relation with the government because of its attempt to alienate their fishing grounds for the establishment of a marine protected area, while 10% thought it was also due to other reasons and 14% avoided the discussion by feigning ignorance (table 24). This change in response might have been brought about by the way the question was asked. In fact the 44% of the ones who had earlier said it was a good idea now agreed it was a big bone of contention between them the fishers and the government (table 24).

Table 24: Stakeholder relations: number and percentage of selected artisanal households each represented by one respondent

<table>
<thead>
<tr>
<th>Aspect of inquiry</th>
<th>Cluster (n)</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Relationship between fishers and marine protected areas (MPAs)</td>
<td>Good and cordial</td>
<td>26</td>
</tr>
<tr>
<td></td>
<td>Bad</td>
<td>30</td>
</tr>
<tr>
<td></td>
<td>Fair</td>
<td>44</td>
</tr>
<tr>
<td>Expression to alienate certain areas as MPAs</td>
<td>Yes</td>
<td>76</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>No idea</td>
<td>14</td>
</tr>
<tr>
<td>Has tourism development led to displacement or dislocation of fishing grounds?</td>
<td>Yes</td>
<td>59</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>34</td>
</tr>
<tr>
<td></td>
<td>No idea</td>
<td>7</td>
</tr>
<tr>
<td>Has there been disagreement with government/tourist agencies?</td>
<td>Yes</td>
<td>48</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>38</td>
</tr>
<tr>
<td></td>
<td>No idea</td>
<td>14</td>
</tr>
</tbody>
</table>

On presentation of the scenario ‘Has tourist infrastructural development led to removal from your fishing grounds creating a major bone of contention between you and these developers?’ A total of 59% agreed with only 34% being on the negative and 7% expressing ignorance (table 24). About a half of all the fishers felt that in general the government and its agencies in charge of fisheries administration and conservation of coastal resources have not helped the situation.
7.8 Management challenges

The area of study had many management challenges which were able to come out during the study. One such challenge identified by the respondents was the invasion of the fishing grounds (table 25). This problem has been compounded with reduced communal rights on ownership which have since shifted away from the traditional elder systems more to the government. Presenting fishers with question “Are your fishing grounds visited by foreign fishers?” tested this. Of the total respondents surveyed, 75% agreed that this was the case, 5% said no and 20% feigned ignorance.

The study area borders Tanzania waters on the south. While Kenyan fishers do not fish in Tanzanian waters, fishers from Tanzania tend to migrate seasonally into the Kenyan waters within the study area. The potential effects of such transgression were addressed in the interviews by asking whether the foreign fishers had knowledge about their traditional management systems. A third of the total respondents alluded that these foreign fishers were ignorant or just did not care of the local management rules and controls, while 28% had no idea and 38% said the foreigners observed the rules (table 25). This was a tricky aspect since some of the fishers interviewed in Gazi were themselves migrating fishers who had been struggling with acceptance by the local fishers for several years. Still some of them had married with the local women and anything contrary to the expectations of the local fishers would be an opposition they were not willing to be drawn into. Perhaps due to this fear of being seen against migratory and foreign fishers many of the respondents (70%) said that there were similarities between those rules being practiced within the study sites and those of their neighbors.

Table 25: Management challenges:
Number and percentage of selected artisanal households each represented by one respondent

<table>
<thead>
<tr>
<th>Aspect of inquiry</th>
<th>Cluster (n)</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Are your fishing grounds visited by foreign fishers?</td>
<td>Yes</td>
<td>75</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>No idea</td>
<td>20</td>
</tr>
<tr>
<td>Do the foreign fishers comply with your rules?</td>
<td>Yes</td>
<td>38</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>34</td>
</tr>
<tr>
<td></td>
<td>No idea</td>
<td>28</td>
</tr>
<tr>
<td>Are impositions and sanctions successful?</td>
<td>Yes</td>
<td>59</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>No idea</td>
<td>32</td>
</tr>
<tr>
<td>Are there similarities in resource regulations with neighboring fishers?</td>
<td>Yes</td>
<td>70</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>No idea</td>
<td>23</td>
</tr>
<tr>
<td>Are there negative or bad border effects?</td>
<td>Yes</td>
<td>18</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>29</td>
</tr>
<tr>
<td></td>
<td>No idea</td>
<td>53</td>
</tr>
</tbody>
</table>


8 DISCUSSION I

ARTISANAL FISHERIES – BIOLOGICAL COMPONENT

8.1 Distribution of traditional fishing gears across landing sites

The area of study was dominated by traditional fishing gears with four of the gears being common to all the landing sites sampled: lines, traps, gill nets and spear guns (fig.19a). These gears have been used for many decades within these artisanal communities (personal communication with elderly fishermen, 2003). Overtime, a few new gears have been introduced like the cha-cha, which though is a form of set net, has had its ability to capture fish greatly increased. This fishing gear, cha-cha, was only found within one fish landing site, Gazi (fig. 19a). Visiting artisanal fishers from the Tanzanian Island of Pemba have recently introduced it to the landing site of Gazi (personal communication with elderly fishers at Gazi, 2003).

The other more recently introduced gear is the beach seine (McClanahan, T.R & Mangi, S., 2001). In most of the landing sites, its use was found to have been banned through general agreement and consensus by the local fishers (Tuda et al., 2008). It was found in only three landing sites of Chale, Mgwani and Gazi (table 19a), also considered landing sites highly infiltrated by the artisanal fishers from Pemba. The beach seine fishing was mirrored in a lot of controversy within the region. It is thought to have been first introduced by the Pemba fishers from Tanzania (Glaesel, 2000b) and was initially tolerated since they fished far from the shallow lagoon waters frequented by the local artisanal fishers and since the resources were abundant. Tensions and resistance to beach seine could be traced to 1964 after the overthrow of the Zanzibar-Pemba government when many of the inhabitants of those islands started moving to Kenya. Thus large seining crews, who hitherto visited the Kenyan waters only for a short duration of time, became stationed in some sites. Because of the sweeping (unselective) nature of the beach-seines, local artisanal fishers started in around 1970s to blame the beach seiners for reducing catches and making the sea barren (McClanahan et al, 1997a). The local artisanal fishers within some landing sites like Chale, Mvuleni, Mwaepe, and Tradewinds banned beach seining by consensus. To further cement hold onto this action, catch improved where this practice was banned as reported in a study by McClanahan and others (1997b). This could perhaps explain why this gear was not common within the various landing sites. However, random spot checks along the landing sites, for instance in Chale and Gazi, confirmed that in a few cases beach seining was still being practised among the fishers even though they would not wish to be associated with it and would not disclose the amount of catches from the use of those gears, mainly to avoid stigmatization from the group majority and especially the old fishers.

The other traditional gears of line, traps, gill nets and spears were common to all the nine landing sites sampled. These gears had evolved with the fishers, for instance, the traditional spear traditionally made up of a sharp harpoon has since incorporated the use of a rubber band and a sharp metal rod as its components. Fishers using the spears were thus able to impale fish even at some distance more effectively.
In terms of selectivity, the beach seine was not far different from the traps and gill nets; but because of their smaller net sizes they capture young individuals before other gears could capture them. Many older fishers also claimed that dragging nets like beach seines could have damaging effects on the fish eggs and corals. The latter acted as refuges for spawning fish. Additionally, the sea spirits and gods to whom many of the artisanal fishers still believed did not approve of such environmental effects on the resources especially where traditional fishery resource exploitation strategies were involved.

Unlike the beach seines, which were also used to capture migrating sardines, the gill nets were largely used to target the capture of reef lagoon fish species as well as small pelagic species like little mackerel and kingfish.

Artisanal fishers were able to alter selectivity of the traps by using those of greater mesh size during seasons when fish were abundant. Fishers also hinted that the nature of the bait used inside the traps could moderate the selectivity of the traps.

The other gear whose distribution was widespread was the spear. For various reasons these gears are thought to have achieved wide preference from the fishers: they are relatively easy to assemble and handle even by less skilled people. Thomas-Slayter and Rocheleau (1995) and Glaesel (2000b) speculate that the use of spear guns could have started in 1950s and 1960s when tourism along the Kenyan coast started to bloom and many young people who had migrated from the interior to the coast in search of jobs observed tourists using spears for recreational fishing. On the other hand we should keep in mind that spear fishing is one of the most primitive and early fishing techniques developed by man. Fish spears had been in use for centuries in the Kenyan river-lake communities like the Luos and the communities at the lower river Tana as recorded by Darrock (1944) long before the coming of the Europeans. It is however, plausible to argue that the traditional spear guns could have been improved upon borrowing from the higher technology of the sport spear fishing mostly by tourists along the Kenyan coast. The spear guns are mostly associated with the younger fishers because of their simplicity of their assemblage, low repair and maintenance costs. Their use also allow for the possibility to engage in other occupations like being a beach boy or beach tour guide. The use of spears for fishing besides requiring fewer skills as Obura (2001) records also appeals to their male ego. Subsequently, the technology of making the spear guns has since improved from being made of wood with rubber-tire strips to the use of metal tubes to increase the strength and power.

On many occasions and from several discussions about gears, spear gun users stood accused by the elderly fishers of not going by the rules of fishing, like not observing the days of the rituals for the sea spirits and gods, some going fishing even on Fridays (considered a day of worship since most of the fishers are Muslims). Many of them were also not active or registered by the fishers’ organisations at the landing sites. Worse a few of them were perceived to be stealing catches from the laid traps in the course of their fish hunting missions. Some of these claims were difficult to verify since not all fishers were members of the fisher groups at the landing sites. Still others went fishing even on Fridays especially when in dire need of money or food for visiting guests at home. Besides, there was to proof that only the spear gun users could have been responsible for pilferage from the trap catches. It is worth to note that in some cases

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especially during rough storms traps were displaced or destroyed, making the spear gun users another easy target for vindication.

The least common gears were found to be the set-nets in Mgwanzi and Mwanyaza and ring-nets at Gazi. The ring nets are relatively capital intensive since they are assembled mostly from nylons in contrast to widely used traps made mostly from vegetative materials abundant along the coastal land strip.

Thus fishing gears distribution among these artisanal fishers depended mostly on the traditional acceptance, affordability, maintenance as well as skill of use. Those gears whose use had highly infiltrated among the fishers like traps, gill nets, and lines and those that did not require more learnt skills or experience like the spears were most widely distributed.

8.2 Distribution of boats (dug-out canoes)

The most common kind of fishing vessel along this region was the dugout canoe, mostly crafted from big mango trees (fig. 3). Towards the Kenya/Tanzanian border one finds in addition to the canoe more developed and better fishing boats (fig. 4a). Besides, some skills were involved in the making of these boats in addition to capital to buy the mango trees in cases where they were not within the reach of the fishers. Thus the dugout canoe remained a treasured asset to an artisanal fisher besides being a source of inspiration and even a symbol of status among peers. Not many fishers owned the larger boats. Canoes were owned by individual fishermen or in some cases by a group of fishers. Still in other cases, they were leased out by the owners for a fee to those who could not afford to have their own. Most of boats were employed for operating the traditional types of gear, particularly traps.

Spear guns, though used also with canoes, in many cases were being used by younger artisanal fishers mostly because they did not require the canoes (better said, they could not afford to own them) and did not require high fishing experience. This aspect was not well taken care of by the statistical presentation since many of the fishers using canoes to set traps also did spear fishing after setting traps.

The distribution of the dugout canoes corresponded to that of gears and fishers, with those landing sites having more traps, nets as well as lines also having a higher number of dugout canoes (fig. 19a-b). Again the distribution of both the fishing gears as well as the canoes was higher in those landing sites with a higher number of artisanal fishers.

There was no discernible difference in the number of dugout canoes and gears between sites close to urban centres where the amount of catches seemed constant almost throughout the year (figures 29a -b and table 10) and those in remote areas. Sites further away from the urban area of Ukunda showed more seasonality in catches – higher catches during good seasons. This could an indication that the almost constant amount of catches across sites close to the urban centres could have been sustained by ready market and higher returns per kilo than better gears.
It is visible from fig. 19 that the number of boats and gears were at par at Mwaembe, Mkunguni, Tradewinds, and Mwaep and almost at par at Mvuleni. There were however higher number of gears compared to boats at Chale, Mgwani, Mwanyaza and Gazi. This difference could be due to various reasons: in Mwaembe, just as the name suggests Mwaembe means mango in Kiswahili. It is one of the most remote of the fishing sites sampled. Here chances of one finding a bigger mango tree that could be chopped into a simple dugout canoe were high and the same applies to Mkunguni. Within the other sites, most of the larger mango trees had been cut down and a fisher had to buy one from the neighbouring villages to chop out a canoe. The landing sites close the urban centre of Ukunda (Mvuleni, Mwaep and Tradewinds) also had equal number of dugout canoes to the gears, this could be attributed to the affordability to buy a dugout canoe from savings made from other income sources. Fishers close to these landing sites had a high opportunity to engage in other income generating activities like paid manual labour from the hotels or merchandising. Thus, the level of monetization within these sites was better than those found farther away from the urban centres. They also had better monetary returns for their catches due to the available ready market than those fishers far from the urban centres. For the landing sites where the dug-out canoes were less than the fishing gears like, Chale, Mgwani, Mwanyaza and Gazi (fig. 19), they conformed to the normal expectation, since some dugout canoes, especially bigger ones, were owned by a group of artisanal fishers, still others operated more than one gear.

8.3 Spread of fishers across landing sites

The concentration of artisanal fishers seemed to decrease towards those landing sites close to the urban centers (fig. 20) and so was the number of gears. The three landing centers close to a major urban centre, Ukunda, which is a leading tourist concentration center along the Kenya south coast, had barely 100 artisanal fishers each (table 4 & table 10). In a later study by Tuda et al (2008), they estimate the total number of artisanal fishers around this area (7 landing sites within the Diani – Chale region) to about 570 - perhaps due to shrinkage of fishing grounds as most of the shallow lagoon waters are claimed by the hotels for their guests. Other reasons for this decline in the number of fishers could be more tendencies to get involved in the tourist related income generating incomes and employment which seemed more economically rewarding considering the low incomes from artisanal fisheries exploitation. This is in contrast to those sites away from the tourist concentration of tourist developments where alternative income sources are limited. It could also indicate that attachment to artisanal fisheries exploitation though a long time entrenched habit is possibly waning due to onslaught by more rewarding livelihood alternatives like paid labor from the tourist hotels and small-scale businesses.

From the management point of view, this could open a possibility for reducing over-concentration of local people in fishing activities by opening other livelihood options. This could result in reduced pressure on the lagoon fisheries and even the possibility to persuade local fishers away from certain areas to create space for the establishment of marine protected areas as has been the wish of the local tourist and conservation interests (Glaesel, 2000b).
8.4 Time fishing spent across gears

Fishers using lines spent more hours in the sea followed by those using gillnets while those using spears spent the least time. In the same study by Tuda et al (2008), they estimate that fishers spend about 85, 551 fisher days per year in Diani – Gazi area. This estimate again could be due to the declining number of fishers. Data for the otherwise considered destructive gears (Beach-seines, set-nets, cha-cha and ring-net) were not adequate for analysis, since fishers feared giving the exact details to conceal reprimand from local fisheries’ officers and fellow fishers opposed to the use of those gears.

It was worth noting that spear fishers spent normally the least time in the waters, since most of them had no boats and had only the opportunity to undertake fishing activities during the low tides. This could be another reason for the continued use of these gears despite the raging opposition against their use by other artisanal fishers (Obura, 2001). Spear fishing was very much a part time occupation leaving time for other activities like paid manual labour at the local hotels or merchandising basic products within the villages.

8.5 Artisanal fish catches

8.5.1 Catches across landing sites
The difference in size of catch was more as consequence of basic differences in the construction and operation of the various gears. Artisanal fish catches were highest at Gazi, followed by Mkunguni, Chale, Mgwani and Mwaembe. Even though in the succeeding publications of Tuda et al (2008), McClanahan et al (2005) and Mangi et al (2007) there is no categorisation of the landing sites according to amount of catches, their categorisation according to the number of fishers supports the idea that Gazi was more productive and had a higher number of fishers. The amount of catches across those sites close to the urban centre of Ukunda (Mvuleni, Mwaep and Tradewinds) was almost similar (fig. 22a-i). It is worthy to note that even though Gazi landing site was 5th after Mgwani, Mkunguni, Mwaembe and Chale in terms of concentration of gears (fig. 20), it had the highest amount of fish catches mostly as a consequence of the use of ring nets (fig. 24).

Comparing catches across the various gears (fig. 23), it is visible that introduced gears especially the ring nets had a higher chance on drastically increasing the catches and more returns for fishers (fig. 24). A comparison of percent values of quantity of gears used across all the landing sites and the respective amount of fish catches across all the landing sites, further support that the two introduced gears of ring nets and cha-cha though less in number contributed a higher percentage of catches than the other gears (table 10).

8.5.2 Relationship between catches and effort
The amount of catches did not necessarily increase with an increase in effort. In some incidences fishers even increased effort when the amount of catches went down like in Gazi. One possible reason for this could be due to the fact that most of the artisanal fishery exploitation practised within the area of study was not only an economic but also a social activity. It was not only driven by demand for money or economic returns but also by habit and attitude. It could also indicate absence of viable livelihood alternatives available to the artisanal
fishers within those landing sites. Thus in absence of well rewarding alternatives, limited educational qualifications to secure other jobs within the up-coming tourist investments and coupled with low or lack of capital to invest in other income generating activities, it remained perhaps the most feasible source of income and livelihood to many local dwellers. Thus they would go fishing even in absence of any justifiable economic motivation and worse even when markets for their catches were sometimes lacking.

8.5.3 Gear reward capacity and preference
Gear reward capacity is this study can be defined as denote the ability of the gears to bring a higher benefit (fish catches) to the fisher. It is more about the efficiency of the gears i.e. those with higher catch per unit effort were taken to be more efficient than those with a lower catch per unit effort. The catch per unit effort was different for all the fish landing sites as well as for the gears (table 10). For the landing site Chale, the highest catch per unit effort was achieved through the use of beach seines (6.294), followed by gill nets and the least were from traps. The same trend was presented for Mgwani though the values were lower. Thus further supports the notion that beach seines have a higher catch per unit effort. This was further supported by the fact that even though beach seines had lower catch per unit effort at Gazi where other introduced gears like cha-cha, and ring nets were used, their catch per unit effort value were still higher than that of traps (1.0) and spear (1.350) which were some of the most common gears in use within the study area in general. The other traditional gears like traps, lines and gill nets had different catch per unit effort across the various landing sites and seemed to present no systematic pattern (figures 26a to 26i). This could be possibly attributed to employment of different gears at different seasons to maximise catches regardless of the fishing season.

Comparing overall catches and effort across gears; ring nets had the highest catches per unit effort (table 10) followed by the line, traps, and gill nets (fig. 27c), though this kind of analysis would not be reflective of the actual situation along the landing sites where certain gears were not present.

From the foregoing, it is clear that the amount of catches was not the major determinant of gears used by artisanal fishers otherwise introduced gears like cha-cha, set nets, beach seines which were relatively affordable and had higher amount of catches per unit effort could have been widespread.

Catches from almost all the gears used were within a limited range (table 12). Reasons for this lack of marked difference in catches in relation to effort from different gears as illustrated by figures 39a to 39d from the landing site Chale could be as a result of individual fishers’ tendency to survive from the catches obtained irrespective of gears used. Strategies involved assisted to maximize on the catches by staying for longer hours in the waters, especially when using the lines, employing several traps for those who used traps, mobility for the younger fishers who used the spears, and overlapping of nets for gill net users especially in periods of limited catches.

Again, the advantage of using better fishing boats which afforded the chance to explore uncommon grounds and which in many cases yielded better catches was watered down by the
costs involved in maintaining such boats or payment to the boat owners\(^9\), which had to take precedence over individual fishers’ share.

Taking Gazi landing site as an illustration to show the kilo per fisher it is visible from table 14 that Kilo per fisher remained relatively low at 1.0 – 4.6 Kg with no marked difference for fishers using cha-cha and beach seines for the year 2003. This is within the global mean of 3.8 kg/fisher/day (Obura, 2002). Returns per fisher were however higher for those using ring nets with highs of 36 kilos per fisher for 2003. Thus, it is possible to say that artisanal fishers using traditional gears of lines, traps, gill nets and spears had almost equal amount of fish.

### 8.5.4 Comparison of catch per unit effort across sites

Sites that were further away from the urban centre of Ukunda had higher catch per unit effort (fig.39) with Mkunguni at the extreme south having the highest values of CPUE for almost all gears.

![Graph of Catch per unit effort across landing sites](image)

*Fig. 39: Comparison of catch per unit effort of gears across landing sites*

It is possible to conclude that sites close to the urban center of Ukunda like Mgwani, Mwanyaza, Mvuleni, Mwaep, and Tradewinds had lower CPUE values due to constant fishing pressure applied all year round. As already hinted, due to constant demand for fresh fish supply, fishers in these sites went fishing even during the rough kusi periods, thus denying fish stocks time to breed and spawn. It could also be that sites further south are rich in fish stocks as shown by higher CPUE values for Mwaembe, Mkunguni and Gazi. In subsequent publication

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\(^9\) Fishers who do not have their own boats can hire boats from wealthy fishers but pay a commission which is normally in terms of a given percentage of the total fish catches.
by Tuda et al (2008) the lagoon is deeper in Gazi than around Diani-Chale region. This could imply that fishers have the potential for more fishing hours in Gazi especially during neap tides.

8.5.5. Factors that influenced choice of a gear
Other than catch per unit effort several factors below influenced a choice of a gear by an artisanal fisher at the study sites:

*Place of origin:* most of the introduced gears like *cha-cha*, beach seines, set nets and ring nets were more or less linked to the presence of foreign or visiting fishers. Emigrant fishers from the Tanzanian islands of Pemba favoured those gears that guaranteed higher amount of catches. The emigrant fishers appeared to be motivated by their urgent desire to satisfy their needs and thus seemed to pay less attention to the consequences of their actions on the resource base, a contrast to those living close to those resources. This made more sense since being within new territories and entirely dependent on the amount of fish catches, they could not depend on other sources of livelihood as was possible for the local Kenyan artisanal fishers. Thus they seemed to favour the use of beach-seines, *cha-cha* a modified yet more effective form of set net and lately the use of ring nets, which they used almost along the entire East African coast as they searched for higher fish yielding sites. The local Kenyan artisanal fishers occupying most of the other fishing grounds were more sedentary and concerned with the ecosystem productivity of their shallow waters. The local fishers appear to have favoured the use of selective gear and avoided the use of beach-seines as already described. Thus management principles that would require use of selective gears and concern for the fishery sustainability could possibly work more easily within those fishing grounds which have been least penetrated by the emigrant fishers.

*Acquisition and maintenance costs:* young fishers, new to the trade and lacking in capital yet determined to survive by fishing were the primary users of spear guns, which could easily be assembled from easily accessible materials. Established fishers had dugout canoes and nets and preferred using nets or traps and had no problem with gears that would demand constant repair, as that was their work. Young fishers who doubled as tour guides and who got engaged with tourists either as pimps, selling souvenirs during high tourist seasons of July to September and between November to April (ICAM secretariat, 2002) favoured gears that could not demand most of their time for maintenance like spears. They also favoured gears that could be left unattended to during certain times of the year and yet could not lose their usefulness of functionality like the spears.

*Age of fishers:* in many cases, the younger fishers would use the spear guns because it appealed to the male ego and required energy and stamina. From discussions both with the young and the old fishers, it was apparent that those who could no longer manage long forays into the waters, chose to use mostly the traps that could be laid within the shallow lagoon waters and in some cases accessed even without the assistance of the canoes during low tides.

*Traditions and local acceptance:* the most common gears along the entire study site were the lines, traps, gillnets and spears (figures 27a – 27i and table 10). Since artisanal fishing was an occupation learnt through doing, experience and passed from one generation to another, the
use of those gears must have been passed from the older generation of fishers to the new ones with only slight modifications. As the adage goes ‘old beliefs die hard’ artisanal fishers had a negative perception to the introduction of new gears e.g. the spear guns. The negative notion against the use of the spear guns which had recently been modified was not in many cases justifiable as they tend to be selective of the fish sizes caught.

**Number of fishers per gear:** gears like the beach seines involved many fishers. In situations where poverty reigned and skills for assembling gears were poor, coming together to buy a gear was perhaps more feasible. This may be coupled with the communal nature of the artisanal fisheries within this area and perhaps facilitated joint acquisition of gears especially those that could be used jointly like gillnets, beach seines.

### 8.6 Influence of seasons on catches

A clear delineation of the fishing peaks usually from October to April when the monsoon winds blow northeasterly and when there was less wind and the sea was calm is visible from the results (fig. 28 and fig. 30). The reverse is true when the direction of the monsoons changed to southeast. The winds became turbulent, the waters rough and impenetrable by most of the poor canoes used by the artisanal fishers. This has lately been confirmed by Tuda et al (2008), where they found that the number of fishers during the North east monsoons is higher than those during the south east monsoons. This marked variation in seasons was reflected in the amount of catches by the artisanal fishers as shown in fig. 30. It is clear that the catches were low from the months of April to September and higher from October to March. Running the same analysis for the two years of 2003 and 2004 showed no marked difference in influence of seasons on catches (fig. 28).

In later studies within the study sites, Tuda et al (2008) also found out that tidal calendars influenced fishing activity, with low tides during the full moon spring phase in the northeast monsoon being the preferred time for fishing and half moon neap phase in the southeast monsoon being the least preferred.

#### 8.6.1 Catches across landing sites and months

Comparing the catches across months and sites, there emerged the effect of seasons across certain landing sites (fig. 29a – i). This was also reflected on the amount of catches. In certain landing sites this seasonality was hard to discern. Those sites where the catches varied with the seasons were; Mwanyaza (fig. 29c), Mgwiki (fig. 29e), Mwaembe (fig. 29f), Chale (fig. 29g), Gazi (fig. 29h) and Mkunguni (fig. 29i), whereas in landing sites of Tradewinds (fig. 29c), Mvule (fig. 29a) and partly Mwaepe (fig. 29b) there was no marked difference in the amount of catches across seasons. There were several reasons that could be given for the lack of seasonal variation on the level of catches across those three landing sites. Those sites were closer to the urban and tourist centre of Ukunda (Diani). Tourist seasons are normally between the months of July to October and also from the months of November to April (fig. 12b). During the high tourist seasons there is increased demand for fresh fish supply to the hotels and also within the local inhabitants due to high level of monetization brought by the increased tourist related activities. Thus, those sites were also characterised by relative availability of other sources of
income from tourist related incomes, which favoured improvement, and acquisition of better gears besides erosion of traditional and social controls which hindered fishing on certain occasions. Consequently, fishers along the nearby landing sites became motivated by the higher returns to capture more fish and improve on their economic well being.

On a general presentation of the fish catch trends within the entire study area; it is noticeable that catches in Gazi and Chale were more seasonal than other parts of the study area. This was mostly due to the seasonal migration of the Pemba fishers.

8.6.2 Fish catches according to categories of taxa and their variation with seasons

In an attempt to find out if the seasonal variation of catches was uniform across the fish categories sampled and in order to generate a holistic view of the fishery situation especially as concerned the economic dimensions, the fishery was divided into categories of demersals, pelagics, sharks, rays and sardines, crustaceans and miscellaneous. The latter involved those that were not easily identifiable to above categories. This was done for the last two landing sites of Mwaembe and Mkunguni.

Crustaceans recorded the least amount of catches despite fetching higher returns in price per kilo (ICAM, 2002). This was due to a few numbers of fishers involved in their exploitation. Further, the exploitation of crustacean was limited to the shoreline caves of shallow lagoons and gleaned mostly during the low tide. Also, crustaceans were mostly meant for sale and not for home consumption while artisanal fishers were in dire need of food and subsistence provision to their families and thus perhaps gave little preference to crustacean fishing. Since those sites were farther away from the tourist hotels found close in Ukunda, very few artisanal fishers engaged in crustacean exploitation (table 12). It can be reasonable to conclude that some components of the fishery within the study site are yet to be economically exploited especially due to lack of market.

For the pelagics category (figures 33a and 33b), the major two fish species caught Scomberomorour ssp (Kingfish) and Sphyraena spp (Baracuda). Their catches increased during the lean months of May to July. This could imply that as the waters became rough during those periods, fishers might have tended to shift more effort to netting pelagic species than demersal ones.

A comparison of all the fish categories and their respective catches within the two landing sites of Mwaembe and Mkunguni are shown in figures 31a and 31b. Again, it is visible that the catches from demersal fish species were most affected by the seasons than those of pelagic. The catches of those other fish categories, which were grouped as miscellaneous remained less affected by the seasons since the two main species included in this cluster were the squids (Loligo spp) and Octopus (Octopus spp) which were fished mostly within the shallow coral reef lagoons mostly using traps and spears and therefore were less susceptible to influence by rough water conditions. The cluster ‘others’ (mostly rays – Cacharinus spp), appeared to be mostly captured during the lean months of April to July (figures 31a and 31b) and almost resembling the situation of the pelagic species. Thus, it is reasonable to conclude that during the rough weather periods catches from demersal species reduced as those of pelagics and other clusters
soared or remained the same. Thus, the aspect of partial exploitation of different categories for certain seasons remained feasible.

**Similarity of artisanal fisheries of Kenya’s south coast to other tropical fisheries in Africa**

The situation of the artisanal fisheries in Southern Kenya is more or less similar for other coasts in Tropical Africa. As documented by a study by World Bank (2002) a significant proportion of local communities are highly dependent on marine and coastal resources for their livelihoods, through both artisanal and commercial reef related fisheries. Saint Paul and Ekau (2009) have compared the number of persons involved in artisanal fisheries exploitation within the Ghanaian and German coast. While the total fisheries output from the entire Ghanaian coast is only 400 000 tons it employs over 510 000 persons this is contrast to only 38 000 persons engaged within the entire German coast with a total fisheries output of over 260 000 tons. In a study to estimate the total fishing effort over tidal to annual periods in the Diani-Chale-Gazi reef fishery, Tuda et al. (2008) projects that for a total of about 570 fishers operating in 7 landing sites, a total catch of 376,423 kg of fish is generated from the lagoon waters. This indicates that fishery as an economic activity is more paying within the German coast, followed by the Ghanaian coast and least within the Kenyan coast. This is particularly true if understood within the technological advancements found within the German waters and the artisanality of the Kenyan coast fishers. However there exists a similarity in both fisheries; the artisanal fisheries as practiced within the Ghanaian coast is conservative and restricted within the family cycles, involves usage of primitive gears which require little skill (Ulrich Saint-Paul and Ekau, 2009). Most of the artisanal fisheries within the West African coast, just like within the area of study, is also mostly within the lagoons.

**Level of fisheries exploitation of the study area**

As concerns the fisheries being in balance with the productivity of the resources, the data gathered by this study is inadequate to generate a scientific position. However, a study done by McClanahan and Kaunda-Arama (1996) to compare fishery recovery in a coral-reef marine park and its effect on adjacent fishery in Mombasa about 100 miles away from the study area showed that there was not major increase in the amount of catches a few years after the fishing was restricted within the parks. This could mean that the fishing pressure is not way above the productivity of the fishery resources in Mombasa. There are no comprehensive long term studies at hand on the status of the various fish stocks in the complex reef system of Kenya’s South coast. However, the results from the region around Diani-Chale, in studies undertaken by McClanahan et al (1997) and Obura et al (2002) indicates that the area is heavily exploited and are fished at or above sustainable levels.

**Effect of beach seines on the fishery**

It is further argued by McClanahan (2005) and Tuda et al. (2008) that this heavy exploitation of fisheries within a section of the study site (Diani – Chale) could be due to the effects of beach seines on fish populations. This is demonstrated by their high juvenile catch rates. The use of beach seines has also damaging effect on the corals and sea grass beds mostly as a result of trampling by the operators to snagging and breakage when the nets are dragged. The corals
and sea grass beds constitute important fish spawning grounds which are crucial for replenishment of the fish stocks especially within the lagoons.

The introduction of the beach seines was followed by a rapid decline in fish stocks in the shallow lagoons. Initially the introduction of beach seines was welcomed by the local fishers due to their large overall catches and employment of the youths to pull the nets (Tuda et al, 2008). Later, the beach seines were made responsible to a large extent in the depletion of fish populations (McClanahan, 2004). In a study undertaken by Maina et al (2008) four years later beach seine catches per fisher declined to just about 5% of the total catches. However, this reduction in the amount of catches appears not to deter the number of fishers using it. This could be as a result of some fishers already being dependent on it – by way of being engaged in the use of beach seines and thus having no investment in gears of their own. Unlike the traditional gears of traps, lines, nets, and spears, acquisition of beach seines is huge in terms of costs of nets, boats, ropes and maintenance. Although, beach seines guaranteed high catches, these were divided between the high numbers of crews required to pull the nets (Maingi et al., 2007). The process of sharing the catches were also in many occasions mirrored in controversy, since owners and those with experience in their use were favored. Beach seines also remained attractive to young fishers who had no gears of their own.

The use of beach seines was banned through local consensus in many local landing sites and fishing grounds. This was mostly as a result of being unselective especially in catching juveniles not preferred for sale or consumption, prohibitive costs to local artisanal fishers and the common chaos that characterized sharing of catches. The damaging effects of the beach seines on fish populations is demonstrated by their high juvenile and by catch rates as reported in a study by McClanahan (2005). In Mombasa Marine National Park, McClanahan and Mangi (2001) assessed fish catches at different distances from the park edge. They found evidence of higher spillover from boundaries with better fisheries management than in those areas far away from the park and which was open to all gears including the destructive beach seine. This could further indicate that use of beach seines reduced the fish stocks and consequently the fisheries productivity.

Also from several discussions with fishers, it is apparent that the beach seines had originally been introduced from Pemba. In some incidences in Gazi, captains of beach seines were exclusively outsiders mostly from Pemba. Tuda et al (2008) further supports that in some cases ownership of beach seines is by captains from outside the local fishers’ fraternity.

McClanahan and Mangi (2001) further argue that catch per unit effort for most species here for the periods between 1995 -1999 was declining. Work by Mangi (2006) further supports the notion of overexploitation of the region’s coral reef fisheries. He notes that the frequency distributions of lengths for catches from all gear types indicated that large fish are rare. However, this still might not be a sure way of measuring overfishing (Mahon and Hunte, 2001). The question is more of how much of the population do catches of immature fish represent, and are sufficient fish reaching maturity to replenish stocks? Caddy and Manhon (1995) suggest the use of spawning stock biomass per recruit as a guide – which involves setting a minimum spawning stock of say 30% of the un-fished spawning stock. However, in earlier discussions with artisanal fishers around these areas, they dismissed overfishing statistics as attempts by hired
scholars/scientists to support the government and tourists interests to set up marine national parks in these fishing grounds. In any case, the fish catches data for this study for the two years showed no major trend in the amount of catches.

**High catches at the landing site of Gazi**

In all the aforementioned studies (McClanahan et al. 2001 and Mangi, 2006), Gazi still had a high CPUE than most of the landing sites found within the Diani-Chale region. This finding further confirms the results of this study. This could be due to fish schools seeking refuge at the deeper lagoon waters of Gazi from the extensive fishing activity and disturbance around the Diani – Chale region. It could also be as a result of the deeper lagoon around Gazi compared to that around the Diani-Chale region (Tuda et al., 2008).

**The use of ring nets**

It is interesting that in the succeeding publications of Ochiewo (2004), Alidina (2005), Mangi and Roberts (2006), Mangi et al. (2007), Tuda et al. (2008) there is little mention or quantification of the use of ring nets. This could largely be as a result of the controversy of its use and the inability to get quantifiable data from it. As already explained in this thesis, users of ring nets in many cases were hesitant to disclose their catches. In some cases they landed their catches in areas that were not designated as official landing sites in order to avoid retribution from local artisanal fishers. Like the use of beach seines which has been adequately captured by the succeeding publications, they are accused by artisanal fishers of being responsible for overfishing. This accusation needs corroboration since unlike those using beach seines, ring nets are mostly used offshore. The use of this gear again was only limited to the landing site of Gazi where they are largely owned and used by the Pemba immigrant fishers.

The coming of the ring nets introduced a new era of fishing within the South coast of Kenya. From several discussions with artisanal fishers especially those in Gazi, the use of ring nets has been on and off within the entire south coast of Kenya where they are used by financially endowed local fishers as well as those from Pemba. On one hand are periods when their use is banned by the local government fishery officials due to pressure from local artisanal fishers who are against their use, while on the other are seasons when their use is allowed ostensibly due to lobbying by their users (Maangi and Roberts, 2006). There is no study so far about their ecological effects on the abundance and composition on the fish fauna within the study area, an important aspect that needs to be taken care of. A study by Jallow (1995) commissioned by FAO indicates that the use of ring nets is becoming common with African fisheries. He cites common use of ring nets in Senegal, The Gambia, and Siere Leone. In Siere Leone, for instance, fishers are able to net up to 1tonne per day per trip through the use of ring nets (Jallow, 1995).
9 DISCUSSION II

SOCIO-ECONOMIC CULTURAL DIMENSIONS OF ARTISANAL FISHERS

9.0 Social and economic dimensions

The *artisanal* fishery situation along the Kenyan coast was found to be quite complicated. Cultural, social, economic, ecological factors and to some extent foreign tourist influences affected its exploitation. The *artisanal* fishers had crude fishing gears which have not been not been modified for decades also supported by findings of Spears (1978) and McClanahan and Maingi (2004). Other factors that affect it are:

- unfavorable weather conditions – fishing was found to be seasonal
- fishing norms and taboos – controlled mostly by elders
- opportunity costs from other sources of income i.e. wage labor from tourist hotels
- family pressure or call it ‘the burden of the household’

The analysis of all these factors fits into what Edwards and Steins (1999) have termed as the dynamic forces which arraign within the user groups social, cultural, economic, political, technological and institutional environment when exploiting resources especially those that are ‘communally’ or ‘commonly’ owned like the open sea resources.

Some of these factors were clearly endogenous, that is, those which were locally inbuilt and had an immediate impact like family sizes and up-bringing as a fisher. On the other hand were factors which are exogenous or remote. These included fishing seasons and their subsequent influence on alternative occupations and sources of income, control of fishing regimes and gears by the government agencies. Other exogenous factors included incoming fishers from other regions especially Tanzania and inland migrations into the coastal fishing communities. There also existed a combination of both the endogenous and exogenous factors thus leading to what others (Agrawal; 2001b, Edwards and Steins; 1999, McCoy and Acheson; 1987, and social psychologist O’Riordan; 1976 and Ajwen and Fishbein; 1977 and even Hill; 1981) have called ‘a contextual factors continuum’. In the socio-economic and cultural discussion of the results of this study, it is important to appreciate the array of conditions under which *artisanal* fishers along the Kenya coast operated. Even if most of the *artisanal* fishers might have not been ‘actively’ alive to some of these forces, these dynamics of both the local and remote worlds could have consciously or unconsciously controlled their actions, rate of resource exploitation and the emergent control or management systems. And Agrawal (2001a) concurs that ‘what is local is often created in conjunction with external and non-local factors’.

It should further be understood that decisions made by individual *artisanal* fisher may not necessarily be rational but could be influenced by prevalent situations. This kind of decision making theory has been proposed by McCoy and Acheson (1987). It shifts from the old rational choice model where individuals are expected to make rational choices to a scenario where decisions are made based on the context or situation. Thus the situation or context becomes the determinant of the rationality of that choice.
9.1.1 Household composition and its subsequent pressure

A good and capable fisher was expected by the society to have a family with children. His social status was also judged by the capacity to raise and support a family. Thus, the family acted as a salient cultural pressure influencing decisions, activities and even the amount of effort that an artisanal fisher would expend in fishing. From the study, it was realized that 80% of the fishers were married, and only 5% were single as shown in table 15 in the results. These families were also relatively large with over half having above 5 children. Since fishing was the source of most needed nutritional requirement, it remained an important undertaking and fishers valued it as such.

9.1.2 Educational and awareness level of fishers

Two thirds of the fishers were illiterate. The low level of formal education hampered development of the fishery as adaptation of new technologies remained low (table 15). This low education lowered the capacity of fishers to exploit local markets including those of the local hotels as they could not manage formal business transactions. This made them easy targets of exploitation by fish dealers. Perhaps, due to this inability to access markets and reap money rewards, there was no high motivation to harvest more fish and hence the low level of catches.

9.2 Economic analysis: Incomes

Artisanal fisheries provided livelihoods in the form of utilization of fishery resources for food; creation of job opportunities and source of income being derived from sales of fish to the local markets either directly or through fish dealers (table 16). It contributed up to 32% of artisanal fishers’ household incomes (table 16). This figure compares favorably with the literature documentation (MRAG, 2002; UNEP, 1998; Kimani et al., 1996) that artisanal fishing is a primary livelihood earner for the coastal communities of Kenya. It remained a vital engine for the livelihoods of the artisanal fishers’ families.

The study found out that weekly incomes from fishing activities averaged no more than Kenya shillings 500 a week (approximately US$ 1.3 a day). This little amount totaled a third of all fisher household incomes (table 16). Although this figure might be small, it should be understood that calculations of incomes from fisheries was always less the amount that was taken in as food for the family. Other than the income generated from fishing, other sources of income were from kiosk\textsuperscript{10} and merchandising (13%), farming (21%), merchandising of fish products (16%) and others (18%) as depicted in table 16. Still others who had siblings working would normally get some money from them. Some income came from sales of farm produce, yet others got their incomes from gifts and presents. This diversity could not be adequately captured and was grouped together as other income sources. Most of this low income was spent on basics like food (constituting 79% of all expenditures), medication (10%) and school fees (10%). In a few cases, all income generated was geared to meeting only the demands of food (table 17).

\textsuperscript{10} Kiosks – these are the small shops selling local household products.
With rare opportunities for other sources of income, low levels of vocational training, few job openings and general lack of capital to venture into other livelihood alternatives (table 19), fishing remained the most feasible, not necessarily as a chosen vacation but sometimes as a mere means of survival. In other words, it confirmed the suggestion of McGoodwin (1990), Farmer (1981) and Klee (1980), that *artisanal* fisheries is more of a social and cultural enterprise – simply said a way of life. And that might explain why these fishers persisted in this profession even when it no longer provided them with any reasonable economic return amidst the mounting household pressures.

9.2.1 Investments per fisher
Fishers had minimal investment in their trade and profession, fishing. Their economic capital were in many cases limited to a dugout canoe, a few fishing gears like nets, traps lines etc. In some cases, the gears and vessels were owned by a group hence they had to share the harvests. This reduced the economic returns per head given their low catches thus worsening their economic status.

9.2.2 Diversification of sources of income and livelihoods
As is typical with most rural households with unstable incomes, diversification of income sources remained the most employed strategy by the *artisanal* fishers within the study area. *Artisanal* fishers engaged in different occupations with majority of them doing some subsistence farming: the crops were mostly maize, cassava, and fruits like mangoes, which were very common within the area (table 19). The wives of the fishers also played a useful role. While women were not engaged in active fishing, they were involved in buying and selling of the fish catches or gleaning within the shallow mangrove waters (fig.40). The women also were active in fish processing like sun drying, smoking and cleaning. Still others were involved in running small retail shops that dealt in buying and selling of basic items like paraffin, sugar, salt among others.

This variation in activities undertaken resulted in generation of income from different sources. It proved as an economic strategy geared not only to provision of some relieve from fishing uncertainties but also assisted in scaling up the amount of income\(^\text{11}\) required to maintain the household needs.

Fishers also remained very dynamic and relied on the largest possible range of approaches and assets, normally with the intention to minimize risks and maximize on returns. One of the outstanding strategies was to harvest almost unselectively any fishery resource. Majority of the fishers interviewed accepted that they took inshore any fish netted and that their families unlike those of the inland water lakes who had selective tastes only for certain species, were non selective and fed on a variety of fish.

\(^\text{11}\) Arthur McEvoy (1986) describes the tenacity of artisanal fishers to hold in the trade even with extremely low incomes. He asserts ‘fishing requires special skills as well as a tolerance for hard and dangerous work at low pay. It also has the power to hold the loyalty of its workers and their children, who will to the consternation of modern economists stay in the business long after it ceases to produce incomes comparable to those in other trades’. 

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As already pointed out, fishers engaged in different occupations especially at times when fishing was difficult during rough seas. During those periods they concentrated more in farming, mangroves timber harvesting for sale and charcoal burning.

The choice of livelihood alternatives in many cases appeared to depend on the financial endowment of the fisher. Those with greater resources, for example those owning boats, nets, and even those with connections to the local tourist hotels had higher chances of alternating livelihood strategies. From the study it was realized that members of the fisher community who had paid jobs or wage earners especially within the local hotels had more income and ability to undertake other alternative livelihood options. For the fishers, those other occupations were mostly taken during the non-fishing periods and they returned to fishing when season became favorable.

9.2.3 Occupations and separation of roles

The study revealed role separation between the men and women within the area of study. As already explained women were not involved in active fishing but performed relatively noble tasks related to fishing. In an attempt to explain the male dominance of the artisanal fishing, McGoodwin (1990), asserts that this stems from the disproportionate share of child-rearing responsibilities that women assumed in almost all communities. Further and a bit humorous to me; was that fishing vessels had acute space limitations, and there was rarely enough room especially not babies and undisciplined young children. Furthermore, I think that being a risky undertaking; it would not be wise to expose the entire family to this constant risk. However, women had crucial roles in fishing and though the distance of fishing ashore could be a difference, their closer vicinity to the household, as men fished in the high seas was equally an important one.

The roles again varied according to age and considerations of individual success. There was a clear distinction for the roles played by elders, which again was sub-divided into general village elder, village committee member. Normally members of a specified sub-committee could be tasked with, for
example, settling disputes or exorcising evil spirits among others. The ‘Kaya’ elders were considered more powerful and had the capacity to mediate between the fishers’ community as well as the spirits. These ‘Kaya’ elders were also the ones in charge of sea rituals and ceremonies and had authority over traditions and norms of the community. The position of a ‘Kaya’ elder was mostly hereditary but could also be accepted in cases of special happenings associated with special actions of the spirits. To make it more complicated and heavy with authority, intricate and elaborate rituals were performed before one was crowned and vested with these powers. Before these rituals, there was a seclusion time when elders already entrenched into the world of the spirits would initiate and ‘mentor’ the recruit into this ‘Kaya’ eldership’. I think that, those actions while meant to increase the secrecy of this class. This subsequent authority through unquestionable submission and allegiance to their counsel enabled them to educate, instill communal values, and minister an oath. Over and above it made the incumbent not to lead the community astray, lest he gets the wrath of the gods and the spirits.

Roles were also determined by age and the perceived success of an individual. People, who had shown fishing prowess, or accumulated wealth, and in some cases those who had exhibited heroism or some unique skill e.g. art of making better gears or spears had a better chance of being elevated to ‘eldership’ even if well below the acceptable age. Further, older people were known to be more stable and more knowledgeable. This made more sense considering that most of this knowledge was accumulated through experience and learning from one generation to another.

This clear separation of roles based on gender, age and success within these communities made it possible to:

- exploit different fishery resources - like gleaning along the shores by women
- perform different tasks at the same time – men went fishing as women took care of the children
- settle disputes and conflicts – reverence to elders made it possible fishers to respect their resolutions
- Promotion of hard work and success – since this could guarantee elevation to ‘eldership’.

9.3 Ethnological analysis: Taboos, beliefs and traditional fishing controls

The evident risks and uncertainties associated with marine fishing could have prompted among fishers of all types – to develop a rich variety of superstitions, magico-religious mythologies, taboos, rituals, and other beliefs (Anson, 1965; Dorson 1964; Creighton 1950; Orbach, 1977)

Even among modern, industrialized fishers, the observance of various taboos and acting out of certain magical beliefs are quite commonplace in all parts of the world as described in vast literature (Creighton 1950; Anson, 1965; Dorson 1964; Orbach, 1977; Warner, 1983). Orbach (1977) suggests that such beliefs are bandied about partly as a means of coping with boredom, but more important, he joins many others who feel that the main reason such beliefs develop is that they help fishers cope with the various anxieties arising from fishing activity (Homans, 1941; Johada 1969; Kluckhohn 1942; Malinowski 1954; Poggie and Pollnac 1988).
9.3.1 Common taboos and traditions among artisanal fishers along Kenyan south coast
The *artisanal* fisheries along the Kenyan south coast had for a long time been influenced by the elders (Glæsel, 2000a; Mutoro, 1994; Parkin, 1972), who relied mostly on the prowess of the spirits to determine the fishing grounds, period of fishing, conduct and controls at the sea. In several discussions with the fishers it was revealed that it was a general belief that elders first labeled places at the sea and on land as sacred based on visions experienced while dreaming. Through those dreams and visions, they were able to determine days to fish and appropriate fishing methods. They also organized how to approach the gods and spirits and how to intercede between the people and the spirits. This elevated the elders to positions of unquestionable authorities and going against their counsel could bring misfortune to the individual or the community as a whole. This belief system has, to my opinion, been enhanced by the introduction of Islam and Christianity whose foundation rely also on the belief systems. Thus while, Islam and Christianity favored belief in one deity and abhorred beliefs in spirits and ‘traditional gods’ and even sacred sites, the overriding basis of believing in metaphysical forces had been elevated and permeated so strongly along the entire Kenyan coast. One is bound to hear of *majini, mashetani* on any close attention to local discussions. Virtually all *artisanal* fishers still to date believe on the influence of the spirits at the sea and that it influences their general success in fishing.

9.3.2 The role of spiritual beliefs
Through mediation with the spirit world regulations were set by fishing community leaders to maintain social control and access to resources (table 20).

Conservation tendencies also appeared to have roots in the beliefs that those plants, animals and even ecosystems could be refuges for the spirits and gods, more evident in the reverence to the plants and animals found within the sacred sites of the ‘*Kaya*’s and ‘*Mzimu*’s.

The need not to offend the ancestors and the need to keep off shrines and sacred places also played part in conservation of certain areas. These areas, especially those in the sea were to later act as the breeding or refuge grounds and acted as reserves for conservation and preservation (table 21).

Fear and despondency occasioned by bad omens or happenings and ascribed to the spirit world was somewhat an effective tool of legal implementation. While modern management has perfected the rule of law and its consequences, the traditional management structures along this region relied more on the unwritten law of respect to the spirits and the gods. This being vague and vast was even more effective as it could be interpreted differently depending on the situation at hand.

Several attempts made by harmonizing taboos so as to better relations with spirits were used to redistribute resources in space and time among individuals.

Lack of attention by the younger generation especially reduced the number of sacrifices and rituals offered to the spirits – perhaps responsible for their disappearance of the spirits. No wonder, elderly fishers have faulted tourism to rise in noise levels, huge drinking, prostitution and drug use as possible chances of reducing positive influence of the spirits. The spirits were
for high morality, humility, fairness and genuine love, thus anything to the contrary would have displeased them.

Environmental degradation by destructive fishing methods was believed to have annoyed the spirits and caused them to herd the fish away from the shore.

Failure to abide by the taboos was feared to have the potential to transform human beings into non-human forms like seaside rocks, cause mysterious deaths, or cause entire community damages as in flooding, cyclone or tsunamis.

The perceived power of the sea spirits was believed to be more active once a year (Glaesel, 2000a), and a day was set when the entire fisher folk complete with their families partake in a ‘sadaka’, a ceremony of appeasing the ‘active’ sea spirits so that they could have ‘mercy’ on the fishing community\textsuperscript{12}. From the works of Anson (1965) and Zerner (1994), such ceremonies were timed to coincide with the passing by of schools of pelagic fish like sardines or tuna.

Other common taboos and cultural norms that have been observed and documented with the \textit{artisanal} fishers along the Kenyan coast include:

\textit{Formerly no fishing in the night}: with crude gears and no adequate lighting system, it could be more dangerous to go fishing in the night. The elderly fishers argued that the spirits were more active in the night and therefore should not be disturbed.

\textit{No fishing on Fridays}: this has been heavily borrowed from Islam. Fishers do not go to sea on Fridays. A few fishers hinted that, in decades gone, there has been always days in a week when fishing was banned, mainly for repairing of the gears. This also allowed fishers to be with their families. Thus, this acceptance of Fridays as a non fishing day was a mere synchronization between the Islam and the local fishery traditions.

\textit{No fishing in sacred sites}: sacred sites included springs, special and unique coral formations, fish weirs, sites of unique patterns of water movement, places near promontories, cliffs and caves. This assisted in safeguarding fish spawning grounds.

\textit{No use of poisons or capture of juveniles}: along the Kenyan coast, use of fish poison is restricted mainly through taboos, unlike in the fresh water lakes, where use of fish poisons is common.

\textit{Decontamination from immoral filth}: on the day prior to fishing expedition especially one that would take several days, fishers were encouraged to avoid having sex in order to improve concentration and physical strength.

\textit{No unnecessary noise, whistling, hand clapping or shouting at sea}: it is believed by the \textit{artisanal} fishers along the Kenyan coast that spirits are disturbed by noises. In practical sense, these disturbances could easily cause a school of fish to flee or to detect an unfavorable situation.

\textsuperscript{12} \textit{Sadaka} is a Kiswahili word which is locally used to refer to the sacrifice offered to spirits during the appeasing ceremonies
Anson (1965) and Mulk (1994) have explained the common tendency of fishers to prohibit whistling in the sea as it resembles the voices of the wind at sea.

*Neither drinking alcohol, nor going fishing when drunk or under influence of drugs*: it is believed that the sea spirits do not approve of smell of alcohol or ‘marijuana’. By the nature of the job, a drunken fisher would be endangered himself and be a danger to his colleagues in case of emergency.

*Women were not allowed to go fishing*: partly because encouraging women to go fishing could have dangerous effects on the family in the absence of both parents to the children. A woman, who was on her menstrual cycle, was not supposed to touch the fishing gears. This belief is again widely accepted in Kenya. Fishers simply said that at that period women are considered unclean.

*Green vegetative materials were not allowed for carrying fish*: mostly meant to guard against contamination by saps from the plants and attached organisms on them.

Taboos and beliefs also controlled harvesting of younger cohorts of fish and safe guarded breeding places from exploitation. Two thirds of fishers (67%) interviewed agreed that these beliefs were dominant and have assisted to control fish cohorts caught, in terms of age and even species and indirectly through limitations of fishing to some sites.
The ‘Kayas’ and ‘Mzimus’ as pillars of beliefs among the fishers along the Kenyan coast (according to discussions with Kaya elders in 2003). There is scant literature documenting the kayas and mzimus.

a. The ‘Kayas’

The word ‘Kaya’ means a homestead in several Bantu languages. The present ‘Kaya’ forest patches historically sheltered small-fortified village ‘Ma’Kaya’ were set up by the Mijikenda people fleeing from enemy groups in the North. In the last century as safety prevailed in the region, these villages spread out from the forest havens.

The Mijikenda people who had largely been conservative continued to cherish ‘Ma’Kaya’ through traditions and customs. The ‘Kayas’ are viewed as sacred areas inhabited by the spirits of the long dead forefathers of the Digo people. The ‘Kaya’ is a community asset and administered by a council of elders from the lineage clan of the community.

‘Kaya’s’, can also be a sub-set of a forest entrusted to renowned fortune-tellers of the community. Here they set up ‘‘Mzimu’s’’ which is a Swahili word referring to a traditional worshipping place or area. To the Digo it is ‘mzuka’. The mzuka can be under a big tree, a big stone or even a ‘vikura’ (an ancestral grave yard), normally located in revered places like within the ‘‘Kaya’s’’. ‘‘Mzimu’s’’ can also be located in the fishing waters by fishermen. These places are believed to host or hold spirits that control and manipulate the life and activities of the community. It is in this place that an individual prays for health, wealth, and happiness in the family, powers to execute other activities and against other personal afflictions. The fortune-tellers do offer sacrifices and rituals to the spirits in these areas not only for themselves but also to their clients who constitute other community members. Fortune tellers are believed to have powers to communicate with the gods and the spirits.

The Digo people have had a strong belief in the efficacy of the ‘mzuka’ and it is believed that prayers and requests made here are answered or positively granted as fast as possible as long as the offerings and sacrifices are performed accordingly. However, failure to honour the spirits rightly or to ignore advice from the traditional wise men could cause adversely affect the family or community.
The ‘Mzimus’

The ‘Mzimu’ is a sacred place among the ‘Digo’. This place is excluded of any form of pollution (faecal material and urine). ‘Vitsimbakazi’ is the word used to refer to the spirits in Digo. To enhance the presence of the spirits in these areas, there is almost a daily burning of the ‘ubani’ (a special gum like substance) and ‘udi’ a form of wood also referred locally as ‘Kufukiza’. These have the potential to make the spirits stay in this place permanently and makes the ‘Mzimu’ considered ‘live’.

There exist mainly two types of ‘Mzimu’s’, namely

- Family ‘Mzimu’s’
- Community ‘Mzimu’s’

Family ‘Mzimu’ is a worshiping place for a particular family only. However, a person from outside the family can seek permission to worship and offer sacrifices at this ‘Mzimu’. Without consent from the concerned family a wrath of the spirits may befall the third party.

Community ‘Mzimu’ is a revered place of worship, ritual and sacrifice offerings for all the community members, and anybody can pray there without the consent of the elders. Community ‘Mzimu’s’ are closely linked to the ‘Kaya’s’.

Currently no ‘Mzimu’s’ are being constituted, but ‘Pangas’ continue to be constituted. Pangas are like ‘Mzimu’s’, but mainly for the purpose of inflicting suffering to others, i.e. for killing others through the use of demons, to create grudges among community members. These are normally the property of the witches and a section of the traditional medicine men for the purpose of harming those viewed as their enemies or against their interests. On request to the ‘Panga’ owners they can also be used for neutralizing the effects of harm that could have been caused to others.

9.4 Traditional resource controls

9.4.1 Self-regulation and control at the sea

Periods of restricted fishing coincided with the oceanographic conditions of ‘kusi’ rough waters, days for worship and other days for the celebrating special occasions. Certain occasions were not easily apparent to the current generation of fishers interviewed. In some cases those days were declared non-fishing days by elders ‘speaking’ for the spirits. Fishers were emphatic that fishing days were in many situations controlled by cultural calendars and conditions. Many fishermen confessed that some days could be closed for fishing merely by the word of ‘fortune tellers’ especially in the belief that some evil forces were busy in the sea or the sea spirits needed some rest from the rather noisy actions of pulling nets, rowing boats and heavily sweating men.

They all agreed that it was mostly for the security of men at sea that fishing was restricted during the rough waters of the southeast monsoons, commonly called the ‘kusi’ season.
Possibilities of greater risk faced at the sea with those smaller dugout canoes was always eminent even in cases where the canoes were stabilized by the masts (fig. 41).

![Fishers dilemma in the waters, with poor boats amid storms](image)

Fishing periods were determined by elderly fishermen (table 35). Restrictions were generally agreed upon by majority of the fishers in order to have a greater acceptance. Only during special situations like during the sea spirits appeasing ceremonies, spiritual leaders had the final word and would communicate with the elderly fishers on where to fish and areas to be avoided and sometimes even the species to be avoided or be thrown back to the waters when caught.

9.4.2 Effectiveness of the controls
A total of 59% (table 18) of all the *artisanal* fishers interviewed agreed that control by council of elders had assisted towards successful impositions of fines or sanctions. However, they pointed out that recently reverence to the traditional norms and cultural practices have waned. They complained that the younger generation who were more educated in Islamic and western concepts appear to be at variance with the belief systems. Still, it appeared from the responses that the younger fishers did not dare question the system of leadership by the elders. This was more evident from their responses to the question ‘Have the sanctions or impositions have been successful?’. Where majority politely said they had no idea. This was perhaps to avoid being seen as disrespectful to the elders, who are mostly responsible for administration of those sanctions and rules.

The situation of weakened traditional controls could not however be wished away as several fishers confided in us. Weakness had been wrought by: increase in the number of *artisanal* fishers due to the increase of population along the coastline, diminishing fishery resources within the readily accessible shallow waters and the emergence of government control agencies.
In the periods past, when communal hold was strong, fishers were related, had stronger kinship systems, less competition and there existed little external pressure from migrating fishers and governmental control. Those days the ‘elder based’ system of fisheries control was less effective and inadequate. Now, fishers think that the government need to weed out those who do not go by their fishing standards or use gears that they consider destructive. Also, they think the government should lock out foreign fishers.

9.5 Challenges to traditional forms of artisanal fisheries control

Most of the traditional and cultural fishing system practiced by the artisanal fishers within the study area hinged on the belief of three main aspects; the spirits, the ancestors and the gods. The strong belief in these three deities was perhaps well established through the sacrifices, rituals, ceremonies and prayers offered to them at the “‘Kay’a’s’ or ‘Mzimu’s’” which were regarded as special sites. It is at these sites where their ancestors were buried and their spirits still abound. It was at these sites, where the ‘Kay’a elders on behalf of the fisher community interceded with the spirits to seek for favorable harvests in the sea, protection against enemies, safe seafaring, bountiful land harvests, stronger families and good health. These sites were central to influence of the belief system found among the fisher folk within this study area. Besides the reasons given above for the decline in the beliefs, some other major factors which challenged the traditional artisanal fisheries were:

- Cultural erosion
- Diminished influence of the ‘Kay’a’s’/ ‘Mzimu’s’
- Reduced effectiveness of old sanctions and communal controls
- Different cultures and fishing practices

9.5.1 Cultural erosion (acculturation)

While the belief in taboos and the magic of ‘Mzimus’ and ‘Kayas’ to influence catches was widespread no new kayas or mizimus were being formed even as the old ones perished under the responsibility of the younger artisanal fishers (table 20). This might indicate that this tradition was non-progressive and remained largely because of the good will from the elderly fishers.

9.5.2 Diminished influence of the ‘Kayas’/ ‘Mzimus’

Of the total artisanal fishers interviewed 88% agreed that the days of looking forward for good news and protection from the ‘Kayas’ and ‘Mzimus’ were long gone. However, 12% of them still believed that these sacred sites are a harbinger of good fortune and success in the seas and still owe their allegiance to them. I contend that the dying of these beliefs, which not only acted as pressure valves against so many odds and a panacea for some hope to the artisanal fishers, has lowered their morale, dumped their ego and perhaps increased their psychological stress.

9.5.3 Reduced effectiveness of traditional sanctions and communal controls

Majority of the fishers (59% - table 23) still agreed that implementation of sanctions and communal controls were successful, 9% of them gave negative response while 32% feigned ignorance (table 25).
9.5.4 Different cultures and fishing practices
According to local artisanal fishers especially in Gazi, a landing site most frequented by migrating fishers from Tanzania, there existed cultural differences between local fishers and visiting artisanal fishers. To the local fishers the foreigners had no permanent stake within these coastal waters. The new fishers were accused of violating local fishing traditions and taboos used to control exploitation of these fisheries. While this view could be exaggerated due to the salient rivalry between these groups, it made some sense given that the visiting fishers have no long-term interests to protect the fish stocks within the coastal fishing waters to the same extent as the local fishers.

The conflict between local and migrating fishers at Gazi
These are nomadic fishermen looking for rich fishing grounds from the Tanzanian Island of Pemba. Artisanal fishers interviewed associate them to roaming the entire coast in search of more productive fishing sites. Some of them have eventually managed to settle among the coastal people.

The Pemba people are associated with the small mesh size beach seine nets (Juya), which is considered responsible for the over-exploitation of the fishing grounds in Pemba islands and its environs. The beach seine nets are highly destructive to fish larvae, juvenile fish and corals (personal observation and communication with established local artisanal fishers). The Pemba fishermen are also blamed by the local fishers of throwing away several basketfuls of immature fish. They sometimes bury this ‘unsuitable fish’ within the shore further worsening the environmental degradation.

The Pemba fishermen have however a positive side to the local artisanal fishers. They are good fishers and have better facilities than their hosts. They facilitate transfer of fishing technology to the local fishermen. They also create job opportunities to the local youth without any fishing facilities by allowing them to join their fishing trips. The Pemba fishermen are friendlier to local women, whom they allow to buy fish from their catches, normally at fairly cheap prices. To appease the local fishermen, they sometimes donate fish for free to local fishermen particularly on special occasions.

9.6 Traditional knowledge (on gears, oceanic conditions, species and life histories)
Majority of the artisanal fishers within the study area were found to be endowed with a vast depository of traditionally acquired knowledge, tested over time through constant use of the resources, moderated by ecological and environmental changes and ‘regurgitated’ almost constantly by the closer socio-cultural interactions between the various members of the community.

There was an accumulation of a wide knowledge database among the artisanal fishers as shown by their ability to select materials for construction of fishing gears (table 22), use of vegetative materials for fishing, knowledge about movement and availability of fish during various phases of the moon, knowledge on ecology of fish species (table 23), organizational skills desirable for fishing expeditions. This had been maintained by reverence to the culture transferred from one generation to the next. Having depended on the marine resources for such a long time for the provision of a variety of resources, they developed a baffling stake in the exploitation and conservation of those resources. They had long accepted the fact that the balanced and
checked extraction of the resources was a crucial factor in generating the ecological services and natural resources on which their lives depended. To this realization were such crude research methods like manipulation of the environment and observing the subsequent changes with the passage of seasons. Those simple norms and practices that enhanced their survival as well as those of the resources were converted into taboos and cultures, heaped as community folklore, tales and rules of thumb, and continued to be passed onto new generations.

Further, the experience and observation of fish behavior by successive generations of fishermen have been found to result in a wealth of empirically-based and behavior – oriented knowledge of fish and other marine resources (Glaser & Grasso, 1998; Diegues, 2001). Following the logic that the success of a fisher is dependent on his/her knowledge of the causes and characteristics of fish and even their movement, such ‘user knowledge’ has important in catching more fish with reduced effort. The importance derived economically, especially to support the households is huge. These ‘sets’ of knowledge, in form of traditions, taboos, norms, culture and codes of conduct in the sea, attachment to the gods and spirits, are also in many cases were inter-linked and easy to employ together. Their usefulness is even heightened by the fact that, these practices and uses were a matter of intuition and were normally dictated by the prevalent situation and influenced by the group actions.

Discussions with the artisanal fishers showed that they were genuinely aware and concerned about methods used for fishing. Moreover, they were conscious of the other human activities along the shore in order not to hurt the ability of the coastal waters to produce food and shelter for the fish and in turn to ensure good harvests. This ecological understanding was perhaps one of the greatest instruments that assisted in effective enforcement of the fishing rules and resource exploitation along the Kenyan coast.

These sets of traditionally acquired user knowledge were found vital in making decisions about the timing and location of favorable fishing spots in a space and temporal scale. Some of the outstanding use of traditional knowledge and its influence on the decision of the artisanal fishers were mainly:

Local knowledge about the kinds of fishes and their behavior (table 29): Fishers were able to comment about the life cycle of certain species, e.g. Pono or parrotfish (Scarus spp), Tafi or Rabbit fish (Siganus spp), Changu or Scavengers (Lethrinus spp), Msuza or Baracuda (Sphyraena spp) – see table 23. Since these people have fished for hundreds of years, this knowledge has accumulated and was easier to pass on to new fishers more easily.

Migrations of the species: fishers’ knowledge about fish movements and aggregation was well adequate for understanding the ecology and behavior of fishes (table 23). Routes followed by fish were possibly ‘modeled’ by the fishermen and timing was done in a manner to highly capitalize on precision and to minimize missing the targets. Once an aggregation of fish was spotted, it was almost apparent to many fishers, the next course of direction that the fish were likely to take. Fishers therefore never wasted time to trap them.
Fish spawning grounds: Artisanal fishers were quite knowledgeable about spawning strategies of the various fish species (table 23). They also preserved spawning grounds through taboos and belief in spirits and god.

The preservation of a fish spawning site at Chale-Kinondo area through belief in the spirits

An ocean spring was specially marked as a refuge for the sea spirits and in the times past this place was so revered that no fisher could go through it without clearance from the elders. It was also the spot for offering gifts and rituals to the spirits. During one of the visits to this site, in a specially organized spirit appeasing ceremonies, I made observations of several young fingerlings going round the spring area. Since no fishing was allowed within this site, at least by traditional laws and taboos, it acted as perfect breeding grounds due to least interference from the fishers. Fishers also avoided places that were cave-like, normally because the spirits liked such places, an aspect that additionally reduced pressure on the spawning grounds. Spawning aggregations were also deliberately avoided, though observations proved otherwise especially during the low fishing seasons of the southeast monsoons, the ‘kusii’. During a procession to a sea spirit appeasing ceremony supported by this study (fig. 42), a goat was slaughtered at the spring and its blood let flow to the sea spirits, the fishers however brought back most of it for their own feasting within the shores.

![Fig. 42: A procession to the sea spirits appeasing ceremony at Chale-Kinondo – the goat was bought by the funds for this study](image)

The fishers also had a thorough grasp of the physical conditions of the sea like the influence on the tides and waves by the various phases of the moon and their subsequent influences on the fish behavior and productivity. They had mastered the depths of their fishing grounds, to assist during the placement of traps during low spring tides. This was in conformity by a study undertaken by Glaser and Grasso (1998) in Braganca area in Brazil, where they documented that fishers had knowledge that the mangrove crab, Ucides cordatus, and fish catch also
depended on the phases of the moon. A scientific study undertaken between the periods of 1996 to 1998 confirmed that during new moon fewer crabs were collected due to smaller land area exposed during low tide and due to stronger currents. In both situations fishers reported higher fish catches during full and new moon spring tides within the coastal areas.

9.7 The socio-cultural responses to emerging challenges and conflicts

The area of study has been visited by various conflicts and artisanal fishers have reacted to them differently and in accordance to their socio-cultural orientations. Some of the major challenges have been:

- Alienation of fishing grounds as marine protected areas
- Tourism infrastructure development
- Increased suspicion between artisanal fishers, conservationists and government agencies
- Altered traditional management structures

9.7.1 Attempt to alienate fishing grounds as marine protected areas

In 1990 the government of Kenya through the state owned Kenya Wildlife Service a statutory body entrusted for establishment and management of all land and marine protected areas proposed the establishment of a park in the Diani region (fig. 43) within the larger study area. This idea was largely supported by the local tourist hotels, Kenyan elites and research scientists. Fish rich areas were selected to be alienated as park (= to extractive use) and some areas especially those to the north were meant to be reserves (= gear restrictions). The protected areas were expected to be limited to non-consumptive uses like snorkeling, diving and aesthetic scenery view mainly by the tourists.

Two years later when the legal process for the establishment of the park was almost complete the trouble broke out. The local people especially the artisanal fishers were up in arms against the establishment of the park. This was as a result of fear of losing much larger to park status and the park service (Kenya Wildlife Service) seemed unable to guarantee that the park would not be expanded. The artisanal fishers also realized that the reserve status might not help get rid of the loathed migrating fishers from Pemba. The realization by the local government that this marine protected area cannot compete with Masai Mara in terms of revenue generation was another reason to resist the alienation of rich fishing areas as marine protected areas. To date the local artisanal fishers are vehemently opposed to the idea of establishment of marine protected areas within this area. And this continues to be a bone contention between forces for non-consumptive use and those for consumptive use like the local communities.
Fig. 43: A map showing the proposed Diani Marine Reserve (circled)
These areas were contested highly between the local artisanal fishers on one hand and on the other hand, by the government and conservation based agencies, at the end the idea remained shelved pending consensus between stakeholders. In other areas, resistance was not as great and the reserves or parks enacted. Map courtesy of Heide Glaesel, 2000a. The superimposed map shows the entire Kenya coastline with the proposed marine reserve being on the southern side of Mombasa town.

9.7.1 Challenges posed by alienation of marine protected areas from traditional management
This attempt to establish a marine protected area while useful in protecting the coastal biodiversity and acting as a better way of secluding certain areas to act as spawning grounds meant a big blow to the hitherto existing traditional management systems. The traditional structure of management was not critically assessed.

As already expounded, among the artisanal fishers, old age was associated with wisdom and often the ability to communicate with the powerful spirit worlds. The belief system was held in esteem and such great decisions should have been made after consultations with elders in the community who in turn could have consulted the spirit world. The situation had changed and decisions were being made by scientists and implemented by outside practitioners. There was little regard to the existing traditional structures. Worse the traditional systems were unable to
adequately voice their concerns and lacked power to influence decisions or stage a ‘detectable’ protest. This greatly eroded the institutional powers and pillars upon which the traditional resource management in this area was hinged. This erosion of the traditional systems of control and management was to the detriment of the resources, made the costs of implementation soar and affected other stakeholders.

It further weakened the roles of the elders within the fishing community, heavily questioning their authority amidst the mounting government onslaught and lack of recognition. Their inability to convince the government otherwise or to be consulted by the government bodies, was not only an awkward onslaught on their power, but denied them the motivation to continue discharging the vital roles they had the decades past. On the other hand, the government and protagonists of these parks and hotels lost a crucial partner in institutionalization of new management strategies. Also by openly ignoring their presence unnecessary conflicts were opened up as was the case of attempted establishment of marine protected area in Diani.

9.7.3 Development of tourism facilities
There has been rapid development of tourism infrastructure along the Kenyan south coast (Pringle Publishers, 2004). The result of this phenomenal increase in tourism activities has elicited a varied response from the various stakeholders. To the Kenyan government, this was viewed as a positive development since it has created several jobs, attracted several foreign investments, and portrayed the country hub of tourism. Further, it shows the country as stable country worth working with. The Kenyan government in its sessional paper No. 10 (1996) pays tribute to this development. In response some areas have been declared no go zones especially to the artisanal fishers and are mainly allocated for non-consumptive uses like snorkeling, diving and aesthetic scenery view mainly by the tourists. This has created a wedge between tourism and the local artisanal fishers. To the locals, there is more emphasis and concern for the tourists than their own survival. And the gains and benefits accruing from tourism are lost in this debacle of lack of information, involvement and recognition of the traditional forms of management. Thus of all the artisanal fishers interviewed about their perception of the tourist developments, only 15% gave a positive rating for the establishment of the tourist facilities (table 30).

9.7.4 Altered traditional management structures
With the weakened positions of the elders meant the subsequent watering down of the traditional management structures. Younger fishers looked forward to the government officers who in many cases had little knowledge about the local conditions than the elderly fishermen. In my view, these government officers who are posted to work in these sites for limited periods of time may have no permanent stakes to protect. In some cases they have used the initial months of their posting to gain goodwill and establish social networks necessary for these kinds of jobs by allowing or over-looking malpractices.

As already pointed out by workers like McGoodwin (1990), Berkes (1999), coastal areas were not entirely open access under the traditional systems of management as fishers guarded ‘their’ fishing grounds against intruders. Along the Kenyan coast, there were even fines meted against those who had infringed on others’ fishing or landing sites. These payments were
decided by the council of elderly fishers and called sadaka (McLanahan et al., 1996). Sidelining the elders and traditional structures of management meant the opening up the entire coastal waters, especially for those that were not included under the marine parks and reserves, as ‘more’ open to access. The consequences of this was more illustrated under the ‘tragedy of the commons’ as was proposed by Hardin in 1968 and have since received a lot of attention from workers like, McCay and Acheson (1987), Ostrom et al. (1994) and McGrath (2000). In such scenario resources are opened for access with weakened policing from the local traditional authorities.
10 CONCLUSIONS AND OUTLOOK

In this last portion of the thesis, major lessons from the study are provided. These lessons are in no way revolutionary, but they present insight into the special field of artisanal fisheries along Kenya’s south coast as realized from this study. This section also shows how the objectives set at the beginning of the study have been met. Although some of the aspects have been illuminated by other authors, this study intended to give a holistic view of how social and biological factors interact within conditions of:

- high poverty,
- intrusion by foreign fishers in a local fishery,
- cultural erosion and foreign influences as brought about by tourism
- shift from traditional beliefs in gods and spirits to belief in one deity as is propagated by Islam and Christianity,
- outside control – by government agencies
- breakdown of traditional forms of management based on beliefs,

The first study objective was the examination of the fisheries. We showed that there were a total of eight gears used within the study site. Four of them (lines, gill nets, traps, and spears) were common to all the sites. This is further supported by recent literature (Tuda et al., 2008). The other four (beach seine, set nets, cha-cha and ring nets) had been recently introduced to certain landing sites. Recent publications (Tuda et al., 2008; Mangi et al., 2007; Ochiewo, 2004 and McClanahan et al., 2005) have further verified the existence of these gears within the study sites although they have fallen short of showing the impact of the ring nets which are evidently in use particularly within Gazi. The fishers showed a degree of specialization in use of a certain gear. Of all the gears sampled, traps were the most common. This is in contrast to the recent study by Tuda et al. (2008) that depicts spears as being the most common. It ought to be understood that as fishing culture decays, the art of making and owning gears is rapidly waning, thus the young fishers show a tendency towards easy to assemble gears like spear guns.

According to our findings, spears and spear guns were the second abundant gear, while the expensive ring net was the least with its use being restricted to only one landing site of Gazi. Even here, only the migrating Pemba fishers used it. Those people act nowadays as a means of fishing technology transfer by introducing ring nets and beach seines.

The numbers of artisanal fishers were higher in sites far away from the urban centers. There many fishers might have converted to other better paying jobs. This observation has further been reinforced by studies by Maina et al. (2008) that show the number of artisanal fishers around the Diani area to be either constant or declining within the various landing sites. Fish catches were influenced by the seasons, with least catches coming from the periods of rough seas commonly known as the ‘kusi’ during the SW-monsoon. In a recent publication by Tuda et al. (2008), it has been shown that even within the seasons of SEM and NEM, catches are further influenced by the tidal calendars with peak fishing periods being full moon spring phase in the NEM and the lowest during the half moon neap phase in the SEM. Fishers shifted gears depending on season’s as well i.e. they predominantly used traps during rough water seasons and gill nets during calm water seasons. In terms of catches, introduced gears did better.
many decades the fishery was mainly for subsistence and modes of exploitation have remained very simple. There was phenomenal increase of catches by use of ring-nets at Gazi. In terms of local management, fishers had banned the use of what was perceived to be destructive gears by local agreement and consensus e.g. the use of beach seines was prohibited in most of the landing sites and their users rebuked. Comparison of CPUE for different gears for different landing sites showed that those sites to the south were more productive than the sites close to the urban centers of Ukunda – this could among others be attributed to the deep lagoon waters of the region extending south of Gazi (Maina et al., 2008 and Tuda et al., 2008). Fishing around the urban area of Ukunda was undertaken throughout the seasons perhaps due to constant demand for fresh fish and good prices. Such continuous fishing might result in overexploitation as indicated in the lower CPUE (McClanahan et al., 2005; Tuda et al., 2008, Maina et al., 2008). Gear selection was not necessarily out of the reward capacity of the gear; since there was no pattern for preference of well rewarding gears – an indication that artisanal fishery was a social undertaking more controlled by habit and attitude. The estimation of the catch per unit area of the study area gave a figure of 14t/km per year. This estimation is agreement with that given by UNEP (1998) which put the fish productivity of the entire Kenyan coast between 12 – 18 tones per Kilometer per year. In a subsequent study undertaken by Tuda et al. (2008), the average daily fishing effort was estimated at 27.3 ± 8.9 to 42.3 ± 6.6 fishers at each landing site in the SEM and NEM. In a full year, this exerts a pressure of 85,551 fisher-days in Diani-Gazi. The authors estimated the total fisher population at 570 fishers, and the total annual catch, based on gear-specific catch rates at 403 tones. This lower estimate compared to ours is most likely due to catch data from the ring nets being left out. It should be noted that the ring nets brought much higher amount of catches per any fishing session particularly in Gazi.

The second and third objectives of the study were mostly primed on the understanding of the culture, norms, traditional knowledge systems, social organization of the fishers, and how these have influenced, both in the past and present, the extraction and sustainability of the fishery resources. The study found out that the Digo artisanal fishers had evolved strong and elaborate taboos, traditions and customs in regard to fisheries exploitation. These were meant to guide the fisheries exploitation, maintain the productivity and enhance sustainability of the resources. Largely, the evolution of these sets of traditional rules and norms were governed by two main approaches:

1. Traditional knowledge on the biology and ecology of the fisheries; over time the fishers developed a huge biological knowledge of the fisheries within their waters. This knowledge was converted into taboos and cultures, heaped as community folklore, tales and rules of thumb, and continued to be passed onto new generations.
2. Traditional resource use systems; several resource use strategies emerged that restricted access to the fisheries during certain periods and prohibited exploitation of certain species and cohorts of fish. Moreover, inter-personal relation of the fishers was checked by systems that bestowed more power on the elders, ancestors, spirits and gods in that order. This hierarchy of power ensured that there was a continuum of solving disputes amongst the fishers i.e. issues that could not be resolved by the authority of the elders were referred to the spirits. Over and above, this system ensured adherence to the rules through allegiance and fear of wrath of the spirits and gods.
This study found out that although this system had worked well, it is now facing various challenges, namely:

1. **Intrusion by foreign fishers** – fishers from Pemba come to the landing site of Gazi. Here they fish using fairly effective gears of ring nets and beach seines – which the local fishers find unselective and therefore against their traditions. They blamed these foreign fishers also of not abstaining from the sacred ‘mzimu’ sites within the fishing grounds.

2. **Presence of government authorities** together with the intent to control fisheries. This introduced a new concept of management, where traditional system became less visible as much power was given to the government authorities. Although the elder system is still there, the powers of the elders have been watered down and they are becoming more and more disenchanted especially as their advice is not honored by the authorities.

3. **Cultural change – tourism** is rapidly growing around the tourist urban town of Ukunda. Traditional beliefs, ways of life, and fishery management systems are becoming relegated as many young people ape the modern western lifestyles. Elders complain of the noise from tourism, its associated ills like drugs and prostitution as elements that have displeased the sea spirits and hence the dwindling level of fish catches.

4. **Population growth**: many people and even communities are moving from inland to the coast where they try to enter into coastal fishing. These immigrants include also fishermen of inland fresh waters. With population growth, demand for fishing products is increasing and rich local Kenyans are beginning to invest in fishery exploitations. These new entrants are driven by profits and are less interested in the sustainability of the fish stocks. Worse, they do not honor the beliefs and taboos associated with the traditional artisanal fisheries exploitation. Even more worrying, is their lack of understanding of the biological aspects of a fishery and their tendency to bribe the government officials to attain their goal – more fish for more money.

On the social organization of the fishers, the study found out that 80% of households were married with only 5% being single, an indication of strong family bond. Households had high number of dependants, mostly from close relatives and children, those with over 6 persons constituted 30% of the total sample, followed by those with 5-6 constituting 25%. The level of literacy was very low with barely 25% of the sampled population having basic literacy skills of being able to read and write, 10% having some vocational education skills and the rest(65%) being illiterate. In terms of incomes, fishing generated an average of 32% of total household income – this figure did not take into account the amount of fish used for household consumption and an important source of proteins. Other income sources included operating small businesses. Household expenditures were limited to food (79%), medication (10%) and school related expenditures (10%). Leadership of the fishing villages was mostly in the hands of the elders. Fishers engaged in different occupations – they changed from fishing to more of farming during the rough fishing seasons. Traditional resource control strategies were mostly enforced by the elders and lack of cooperation was slapped with sanctions and reprimand. Awareness of the controls was fairly high (52%).

Another important finding of this study was the role of women. In Kenya’s fishing communities, the role of women has so far been largely overlooked in the literature. The Digo community is matriarchal. The women here strongly influence household decisions while men determined
the overall village or community decisions – through the elder system. Although fishing was done exclusively by men, women dominated the dealing with fish – buying from the fishers and re-selling. This system has changed lately due to emergence of fish dealers who buy the fish in large quantities and market it in far flung areas. Further, the women were active in near shore activities like collection of shells, shrimps and oysters. But first of all they took care of the households in the absence of men who mostly were out fishing. These important roles of the women in fisher communities should be protected against entrepreneurs and traders intruding into the communal trade system.

Our findings underscore the conclusions by Alidina (2005) on local level fisheries management in our region “At present fisheries management in Diane-Chale is characterized by diminished government capacity for regulation, weakened local institutions, and little ability to exert control over the use of fisheries. Local level management requires the development and use of local institutions that can govern the use of fishery resources, the fish landing sites were identified to be at the appropriate level for resolving fishery management issues. A more formal role for these entities, the clarification of fishing ground tenure and access rights, and support for the development and enforcement of local fishing rules can further local management.”

Emerging concepts from both the natural and social study results

**The social ecology of coastal resource use systems**: The exploitation of the coastal resources represented here by artisanal fisheries presents a classic case of social ecology - the use ecological factors to study human behavior and community organization (Lawrence, 2006). Although ecology remains as the study of a rather complex interactions between living systems and their environments (Bradshaw, 1983), ecologists have accepted that organisms are not only ‘shaped’ by their surroundings but that their ‘active systems’ also influence those environments as well, so to paraphrase Wuketits (2006). Humans remain an active influence on the ecosystems particularly due to their cultural activities especially technology; thus making them have dramatic impact on the natural environment. This phenomenon is well illustrated here where artisanal fishers evolved strong cultural orientation and belief system to control access and exploitation of inshore fishery resources. However, this very human cultural evolution cannot be divorced from the ecological factors under which they were developed e.g. the availability of the fishery resources, their distribution and the influence of seasons on the amount of fish catches. Annette Horn (2006), and Wuketits (2006) both have agreed that cultural activities have been constrained by these factors and that the differences between cultures could be to a certain extent results of environmental factors.

Thus far, it is evident from the results of this study that natural conditions have strongly acted upon the lifestyles of the artisanal fishers of the study area. These conditions have also shaped their attitude towards different kinds of plants, animals, seasons, distributions and alignments in regard to influences from waves, tides, currents, seasonality of fisheries productivity within their marine environments.

**The socio-cultural dimension of coastal resource use systems**: further, the artisanal fishing communities of the study area developed myths, tales, taboos and customs about the inshore
fisheries upon which their survival depended. This enabled them to come up with various strategies of exploitation of the fisheries, institute rules and institutions to preside over use and mediate conflicts amongst themselves and other the users – like the visiting Pemba fishermen. As a result, such simple organizational structures largely based on elder system and enforced through the respect of the spirits and gods emerged. Further, authority for this kind of institutional arrangement was cemented by alienation of certain areas as out of bounds for the common members of the community and declared ‘holy’ or refuge for the ‘supernatural’ powers, mostly their gods and spirits. This latter phenomenon has since been captured by the emerging fields of ethno-ecology and gives hints on how human societies have learnt from nature and struggles to cope with the natural environments. This is an aspect that might become necessary to assist develop strategies for coping with, for example, the threats of climate change. The current heated debates on establishment of marine protected areas within the area; in my view is an upfront of this struggle and the realization that actions and development are largely pegged on the natural environment, the advancement of the technologies notwithstanding. Thus this concept of socio-cultural dimension of coastal resource use systems might become useful in designing a framework that potentially overcomes obstacles of engaging communities in management of common resources. Indeed, it might facilitate adaptation of methods based on complex adaptive systems combining approaches in which individual actors, social groups and institutions have on the environment and vice versa.

The biological dimension of coastal resource use systems: This study further makes an important contribution in this front: 1) by giving a broad understanding of the interaction of the artisanal fishers along the Kenyan coast and lagoon based fisheries as a representative of the coastal resources 2) analyzing the influence of the cultural orientations in the exploitation of the fishery resources 3) understanding the use of indigenous knowledge especially by examining the major tools with which they extracted those resources. Moreover, by examining the exploitation of fishery resources by crude artisan developed gears that are dominant within the study area, it gives an insight on the stability of the interaction between the resources and the people. The fishers showed inability to extract high amount of fishery resources due to the prevalent primitive gears. This aspect on one hand makes the fishers less capitalily endowed and poor while on the other hand, it enforces equilibrium between the human population and the resources. Comparing this kind of scenario with the current emerging semi-commercialized fisheries exploitation, a different picture emerges: unreasoned greed and haste to make more money and adoption of destructive gears like beach seines and spear guns with a potential for possible collapse of the inshore fisheries (Mangi et al., 2006; Tuda et al., 2008 and Maina et al., 2008). This loss of fishery resources in turn has the potential to affect the artisanal fishers’ lifestyle. In the worst case, it might lead to the demise of the artisanal communities dependent on inshore lagoon based fisheries.

The Indigenous knowledge and managerial dimensions of coastal resource use systems: The indigenous knowledge systems were employed by the artisanal fishers here as in most other parts of the world to enable them survive many years with the least disturbance to the stability of their resources. These knowledge systems existed in forms of collective memories, practices, daily activities, beliefs, artifacts, traditions, customs and ecoscapes of these communities and must have been useful in the conservation of the rich biological diversity common within this
area. Again, such knowledge also enabled and continues to sustain the livelihoods of these communities. These knowledge systems determined their reaction and adaptation to the environmental changes. Moreover, this interconnected development of community (natural and social) knowledge in time and space – provided non-individual frameworks for learning and increased the resilience of ecosystems by providing individuals with a sense of connectedness as has been observed by Ronald (2006) to respect and live within the limits of what the resources could provide.

An interesting dimension of the knowledge system and how it relates to social ecology is how the people perceive, feel, intuit information, become conscious of and form opinions. The knowledge that individuals’ hold affects how they exploit the resources and how they interact with their natural world. While the western way of knowing is predominantly through formal education, which entails several years of going to educational centers and scientific experimentation, the traditional system here mostly entailed trained senses. As with other typical indigenous groups, the artisanal fisher groups’ spiritual ways of knowing appeared to have been embraced and integrated into coherent patterns of behavior, daily practice and guided exploitation of the resources – see texts on kayas and mzimus. This further reinforced the worldview that the artisanal fishers of the study area were concerned with the perpetuation of the resources for the future of their children and prosperity.

OUTLOOK

The fourth objective of this study was to conceptualize a mechanism for sustainable artisanal fisheries management that harmonizes extractive use of marine resources – as advocated for by the fishermen and locals on one hand and conservation of biodiversity and beach protection on the other hand. The latter is mostly in the interest of tourism development as a rapidly emerging phenomenon within the study area. Any management policy has to be based on the following facts: The artisanal fisheries off the coast of southern Kenya is mostly within the shallow lagoon inshore waters – between the beach and reef flats. These waters are crucial for fish breeding and spawning. The lagoons and fringing reefs are of extremely high ecological, ethical and indirect economic value. The seasonality of the fishing periods ensured some relief from fishing during the rough ‘kusi’ period; these areas are becoming stressed due to increasing number of fishers with a possibility to fishery collapse if the situation is not checked (Mangi and Roberts, 2006). The rush to invest in the inshore fisheries of Kenya’s south coast need be done within the framework of careful analysis of the productivity of the stocks especially before further introduction of new gears.

It is reasonable to suggest that attempts should be made to relieve the inshore waters and their stocks of fishing pressure through the establishment of marine protected area(s) in this region. This will become more urgent if the onslaught by the foreign fishers and local rich people moving into fisheries exploitation as a trade together with the increasing number of fishers is not contained. This study has already demonstrated the failure of the Kenyan government to set up a marine protected area near Chale because of the resistance from the local communities against closure of their fishing grounds. A better way of introducing a marine protected area (MPA) in the study area would be to anchor it on the belief systems of the local
community. The ‘mzimus’ and other sacred sites within the waters which had been protected by traditions should be the places to start – protect them against fishing and other interference. These areas could later on be expanded as consensus is achieved. The involvement of the local community will be important, preferably acknowledging the presence of the elders at the village level and being aware of the active role of the Digo women at the household level. This appreciation of the traditional knowledge as well as their governance system would prevent the development of acrimony as was the case in 1990 - 1992. Further, the establishment of an acceptable MPA (Marine Protected Area) within the study area should allow limited fishery employing the four traditional fishing gears (traps, lines, gill nets and wise use of the controversial spears) and canoes. Further, access should be limited to the already available local artisanal fishers with a possibility of locking out new entrants within the MPAs. This kind of restricted access would be attractive to tourists and at the same time offer an option of supporting various families already dependent on the fragile lagoon fisheries within the study area.

The establishment of MPAs in the study area should benefit from the long history of their establishment within this region (Sue Wells et al., 2003 and Nyawira Muthiga et al., 2003, & Nyawira, 2006). This sensitivity to local issues need to be incorporated within the several MPA training initiatives within the expanded West Indian Ocean (WIO) countries – including Somalia, Kenya, Tanzania, Mozambique, South Africa, Madagascar, Comoros, Seychelles, Mauritius and La Re-union – like MPA managers training programs being implemented by WIOMSA (West Indian Ocean Marine Scientists Association) and SEACAM (Secretariat for Eastern Coastal Area Management based in Maputo Mozambique) see Coley et al. 2002; SEACAM, 1999 and Hambrey et al., 2000.

Consequently, those new entrants into fishing within this area – who are mostly rich local Kenyans and fishers with better fishing gears – could be allowed to fish outside the restricted MPAs, most likely within the EEZ offshore waters. This has the potential to relieve the inshore waters and their stocks by diversifying fishing effort. This however would require stronger and bigger motorized boats as well as new skills. So far such an expansion of the fishing range would not create major conflicts with the industrial fishers - as only a few Kenyan and foreign vessels operate in waters offshore the reef flats.

In recent years the decentralization of management has been advocated for the improvement of artisanal fisheries (Alidina, 2005). In the study area fisheries management has been carried out largely on community level so far but attempts are made by the government to replace the traditional decentralized system by enforcing national regulation that however recognizes local management systems. Care should be taken to ensure that involvement of local communities in the management of fisheries does not only alter the distribution of power and responsibility amongst different stakeholders but actually improve on governance (Bene, 2009; World Bank, 2002; Alidina, 2005). A weakness has already been observed in Niger where an attempt to decentralize and devolve governance – where traditional authorities have been included de jure in the decentralization process, thus allowing these traditional leaders to regain or reinforce their past influence without necessarily enhancing participatory governance. The scenario of fisheries management presented by study area is one that is deeply rooted in cultural beliefs and strong traditional resource governance and I contend that local decisions would be most
suitable in such a context. Not least, the need to ensure that this traditional leadership remains democratic and not hijacked by selfish leaders masquerading under the umbrella of traditional leadership. In this way the ability of local decisions to readily command acceptance and remain less antagonistic shall be enhanced. On the long run they will come with the least cost, and will be effective in involving the local community of users. This reality has further been strengthened by the observation of Rivera and Newkirk (1997) that the value and wisdom of community based management lies in its recognition that communities, by whatever we use, are potentially the best resource managers, since they have the biggest stake in sustainability of natural resources.

In terms of artisanal fisheries management three things become apparent:
1. The old traditional systems will certainly pass away especially with the demise of the elders and current old fishers.
2. The emergence of new fishery management systems, based on government policies and perhaps incorporating aspects of traditional fishery control systems.
3. The important role of documenting the traditional knowledge and artisanal fisheries management systems. This to a good extent has been achieved by this thesis.

The results of this study show that most of the artisanal fishers are considerably old – taking the lifespan of about 45 years. Since there is not an elaborate system of transferring power and knowledge to the up-coming fishers particularly with the weakened belief systems and reduced reverence to the elders, there is a great likelihood of collapse of the traditional systems.

From the subsequent analysis and discussion, it is visible that there is bound to be a shift in traditional fishing to another kind of fishing. This new kind of fishing will be most likely less dependent on the fishing traditions, elders leadership and rely less on the use of the current gears. Further, this new fishing will be dominated more by new entrants with better gears, good connections to markets, bigger influence on government regulatory policies and high capacity to reach beyond the reefs.

In response to this foreseen shift from traditional to a new kind of fishery – new fishery regulations needs to be evolved in advance. These regulations need to take care of regulating the number of persons involved in fishing as well as control of the use of gears – both within and without the MPAs. It is already explained that with the swelling of the coastal population there is a growing number of entrants into fishing. Again use of active gears like ring nets need be controlled both in number and season of use. Another important aspect to take care of is the enforcement of rules or code of conduct at the sea. With the demise of traditional fishing controls and elder system of control strongly anchored on beliefs, new rules might want to build on these systems. These might make these rules more acceptable, easy to enforce and more cost effective in terms of implementation. Again new rules need to be instilled by creating awareness amongst the fishers and taking effort to explain why they need be enforced. The enforcement needs to be consistent, firm and disciplined; cases of corrupt implementation will not help.

Further, new rules need to take care of the effects of climate change. This involves rise in temperatures as well as rise of both acidity and sea levels. All these three factors are
deleterious to the coral reefs which are major breeding and spawning grounds for the fisheries within the study site. Without proper planning about these changes we might witness the collapse of this fishery. The aftermath of such a collapse would definitely result into a great devastation of fishers and persons dependent upon fishery resources. Indeed, the collapse of the fishery could also come as a big loss in terms of biological diversity and loss of income from tourism which the Kenyan government and people are so heavily dependent on.

Most of the knowledge and experiences dealt with here about the artisanal Digo fishers probably will pass away with them. If that comes to pass, then this thesis shall have formed a great task of documenting some of the traditions and taboos involved in fishing, the amount of catches netted by the traditional gears, the traditional knowledge about the ecology of the fishery and the people dependent upon it. This work should perhaps inspire more effort in this direction – of eagerly documenting as much as possible of what can be salvaged now into a knowledge data bank that might help as inference in the days to come.

In all, this study describes the artisanal fishery along the Kenyan south coast, documenting some of the outstanding traditional knowledge and management systems used in exploitation of artisanal fisheries in the context of biological and socio-cultural interactions. The conclusions and outlook provides a synopsis of its major findings for fisheries management practitioners, scholars and government officers interested in understanding the nature of artisanal fisheries and its attendant characteristics within the south coast of Kenya.
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13 APPENDICES

13.0 Time plan used to undertake the main survey schedule

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13 All the data in electronic form are stored at Eco Ethics Int. – Kenya fisheries.communities data bank with open access (www.ecoethics-kenya.org).
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Where each row of the table describes one questionnaire and the columns are as explained below:

- **Column 1**
  provides a serial number. The number is indicated on the respective questionnaire. Ordering criterion is the date of the interview when the questionnaire was filled.

- **Column 2**
  specifies the date of the interview. The interview questionnaires were coded and the code numbers matched with dates when they were run in the field (exact dates were not possible since in a few cases questionnaires were left with respondents for a few days before recording and collection, thus a given set of questionnaires were allocated for a given time window.

- **Column 3**
  specifies the location (village name) where the interview was held and where the interviewed person lived. The locations are named on the original protocol sheet. The geographic information for a suitable site accession is available in a map provided within the thesis.

- **Column 4**
  specifies the type of data as “Questionnaire / survey”. The data type and structure sequence of questions etc. was identical for all questionnaires. (Please kindly note however that these questionnaires, as is the case with socio-cultural questionnaires in the field, were not and were never meant to be an end in themselves. They acted as guides on how the line of questioning was to go. Many other aspects were expounded on and other leads explored in the process of filling in each questionnaire. On some occasions, some questions, which had inadvertently been answered, were never asked again. The linearity or sequence of questions did not therefore apply in the strict sense of the word).

The interviews documented in the questionnaires were for the data collection scheme and genuinely developed by myself to be used in the context of the PhD thesis.

The data could also later be used to assist implement some of the recommendations in this thesis.

### 13.1 Time plan used to undertake the second batch of questionnaires for the fishermen/fishermen groups

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<td>July 02</td>
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</table>

- **Column 1**
  specifies the month of the data taken. The date of the data gathering was also recorded on the original file

- **Column 2**
  Specifies the location (village name) where the interview was held and where the interviewed person lived. The locations are named on the original protocol sheet. The geographic information for a suitable site accession is available in a map provided within the thesis.

- **Column 3**
  Specifies the type of data as “Questionnaire / survey”. The data type and structure sequence of questions etc.
13.2 Time plan used to undertake the ITK enquiries questionnaire (key informants used)

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</tr>
<tr>
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13.3 Time plan used to undertake the economic and household questionnaire (selected ‘typical’ artisanal fisher households)

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<td>Household structure, Incomes, Nature of fish marketing and Educational levels</td>
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<td>Household structure, Incomes, Nature of fish marketing and Educational levels</td>
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<td>8/12/04</td>
<td>As above</td>
<td>As above</td>
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</table>

Notes:
1. Questionnaires provided one month before collection, the period of which the households were visited for verification of pertinent details. Date recorded is that of collection.
2. Fishermen groups around Mvuleni landing site were chosen for more specific study because of the close income-generating project, which has been started within these groups. Thus income questions were generally accepted and did not generate much suspicion or animosity. Also because of the close relationship build with these groups under EEIU-Kenya’s project of alternative livelihoods, it was easier to be with the families and gauge income level.
13.4 Common Kiswahili terms used by artisanal fishers within the Kenyan south coast

1. **Kaskazi** - is a local term used by local fishermen to refer to the period between months of August to May when the ocean water is calm with less wind. Much of the fishing is done in this season as the dugout canoes can access the calm ocean contrary to the case of **Kusi**
2. **Kusi** – a local term used by the local fishers to refer to the period from the months of May to September when the waters are rough, weather is windy, lots of cloud cover and the winds are drifting south easterly. During this period, fishing activities are reduced as the dug out canoes become risky for fishing expeditions.
3. **Malema** - is a local name of basket traps of both small and large sizes
4. **Kiosk** - small retail shops selling fast selling consumer goods
5. **Usio** - Fixed fish fence which is a kind of traps
6. **Jarife** - a floating type of fishing net
7. **Mpweke** – gill net
8. **Kimia** – sardine net
9. **Jua kali** – artisan sector taking place in the open air
10. **Makuti** – thatching materials made from palm leaves
11. **Shetani** – a kind of spirit mainly for bad omen
12. **Jinni** – a kind of spirit
13. **Suhani** – a kind of spirit
14. **Mzimu** – a sacred place among the Digo
15. **Koya** – referring to a village in the Mijikenda language and is also used to refer to spirits
16. **Msimari** – kind of tree
17. **Mibanda ya minya** – materials from raffia for making fish traps
18. **Mbelewa** – materials for making fish traps
19. **Mchikichi** – tree of the palm family
20. **Kimji-mwepezi** – a kind of mango tree used in construction of a dugout canoe
21. **Mwembe wa dodo** – a type of mango tree used for construction of a dugout canoe
22. **Boma** – homestead
23. **Mkonzo** – spear guns
24. **Malema** - traps
25. **Vyambani** – extremely rocky areas under the waters
26. **Mavovo** - fish spawning grounds, especially within abundant younger cohorts and eggs
27. **Sadaka** – offering/sacrifice given during the ceremony of appeasing the spirits.
28. **Mashetani** – plural of shetani
29. **Urbanis** – referring to **ubani**
30. **Vikira** - an ancestral grave yard
31. **Mzuka** – Digo’s term for traditional worshipping place or area
32. **Mzee wa kichwa** – fortune teller
33. **Mzimu** – Swahili term for traditional worshipping place or area
34. **Ngambi** – a council of elders
35. **Mburuga**: This is the process of establishing the truth through the use of magical calabash or any other material by the elders
36. **Virumbi**: This is magical equipment and mostly a stick that is being used to give direction.
37. **Chano** - a traditional wooden basin or plate, which is used for washing clothes, which through time has been replaced by modern plastic or metallic plates
38. **Ubani** - a brownish substance that is burnt to yield aroma
39. **Mkate wa sinia** – baked bread
40. **Matamanio** – spiritual language spoken by the spiritual leaders
41. Kirumi – singular form of virumbi
42. Vitsaimbakazi – Digo word for spirits
43. Udi - a form of wood also referred locally as
44. Kufikiza – burning of ubani and udi
45. Panga - are like “Mzimu’s", but mainly for the purpose of inflicting suffering to others, i.e. for
killing others through the use of demons, to create grudges among community members
46. Mzee wa kilemba – spiritual elders
47. Vidzumba mlungu – spirit shelters
48. Mkone – special tree used for the cstruction of vidzumba mlungu
49. Mikanga – grass found in ponds used for in the construction of the vidzumba mlungu
50. Fingo – a place where charm and magic is barried within the Kaya
51. Moro – a very sacred place within the Kaya – Holy of holies
52. Juya – type of fishing net with very small mesh size used during the kusi in the lagoon
53. Mama karangas - women fish dealers, who normally bought the fish from male fishers at a
reduced rate and later sold them at the local markets at relatively higher margins.

13.5 Main survey questionnaires

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<tr>
<th>Survey Schedules</th>
<th>No of People</th>
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<tr>
<td>Number of females</td>
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Villages interviewed: 13

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<td>Kinondo</td>
<td>14</td>
</tr>
<tr>
<td>Magutu</td>
<td>16</td>
</tr>
<tr>
<td>Maweni</td>
<td>15</td>
</tr>
<tr>
<td>Mkawkwani</td>
<td>15</td>
</tr>
<tr>
<td>Mvumoni</td>
<td>20</td>
</tr>
<tr>
<td>Mwabungo</td>
<td>15</td>
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<tr>
<td>Mwakamba</td>
<td>20</td>
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<tr>
<td>Mwarambi</td>
<td>10</td>
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<tr>
<td>Mwaroni</td>
<td>19</td>
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</table>

1. Role in Community

<table>
<thead>
<tr>
<th>Role</th>
<th>No of People</th>
</tr>
</thead>
<tbody>
<tr>
<td>Village elder</td>
<td>35</td>
</tr>
<tr>
<td>Chief committee member</td>
<td>0</td>
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<tr>
<td>School Committee member</td>
<td>7</td>
</tr>
<tr>
<td>Kaya / Clan elder</td>
<td>15</td>
</tr>
</tbody>
</table>

| None | 101 |
| Other | 32 |

2. Main economic Activities

<table>
<thead>
<tr>
<th>Activity</th>
<th>No of People</th>
</tr>
</thead>
<tbody>
<tr>
<td>Farming</td>
<td>90</td>
</tr>
<tr>
<td>Fishing</td>
<td>26</td>
</tr>
<tr>
<td>Wage labour</td>
<td>23</td>
</tr>
<tr>
<td>Other</td>
<td>51</td>
</tr>
</tbody>
</table>

3. Purpose of economic Activity

<table>
<thead>
<tr>
<th>Activity</th>
<th>No of People</th>
</tr>
</thead>
<tbody>
<tr>
<td>Income generation</td>
<td>64</td>
</tr>
<tr>
<td>Subsistence</td>
<td>58</td>
</tr>
<tr>
<td>Both</td>
<td>68</td>
</tr>
</tbody>
</table>
4. Rules in exploitation of resources
   Yes 95
   Chipata - resting day 83
   When performing sea rituals 5
   Other 7
   No 95
   No Idea 95

5. Type of exploitation
   Modern 22
   Traditional 62
   Both 106

6. Members engaging in fishing
   Yes 142
   No 48

7. Amount of fish catch increased or fluctuated
   Increased 0
   Remained constant 0
   Fluctuated 172
   Decreased 18

8. Other economic activity common in the area
   Beach trading 56
   Oyster farming 0
   Mangrove cutting 4
   Others 130

9. Periods when fishing is restricted
   Yes 111
   No 50
   No Idea 29

10. Periods of restrictions
    Fridays 66
    Kusi periods 25
    During sea rituals 11
    No Idea 79
    Other 9

11. People in-charge of restriction
    Kaya elders 2
    Village elders 11
    Elderly fishermen 79
    Self restriction - 21
    Other 98

12. Cause of restriction
    To avoid bad spirits 79
    Ocean is rough to sail 23
    To attend Friday prayers 7
    No Idea 81

13. Who is a village elder?
    Elderly in age, with some traditional wisdom 190
    Elderly in age, with some modern times wisdom 0
    Other 0

14. Old members qualify to be elders
    Yes 2
    No 188
    No Idea 0

15. Qualification of good elder
    Elderly, well informed about past and present 0
<table>
<thead>
<tr>
<th>Question</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>16. Young generation keen in leadership</td>
<td>155</td>
<td>3</td>
</tr>
<tr>
<td>17. What is kaya?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A forest with spiritual powers; a homestead</td>
<td></td>
<td></td>
</tr>
<tr>
<td>18. What is a Mzimu?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A traditional place of worship</td>
<td></td>
<td></td>
</tr>
<tr>
<td>19. Differences between a Kaya &amp; a Mzimu?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kaya belong to the community while Mzimu belong to a family</td>
<td>65</td>
<td></td>
</tr>
<tr>
<td>Kaya is for performing traditional rights while</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Mzimu is for worshiping</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>A Kaya is in a forest while Mzimu is under a tree</td>
<td></td>
<td></td>
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<tr>
<td>Kaya is a homestead while Mzimu is for spirits</td>
<td>14</td>
<td></td>
</tr>
<tr>
<td>A Kaya is a homestead while Mzimu is a sacred place of worship</td>
<td>84</td>
<td></td>
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<tr>
<td>No Idea</td>
<td>2</td>
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<tr>
<td>20. People in charge of a Kaya</td>
<td>188</td>
<td></td>
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<tr>
<td>Kaya elders</td>
<td>2</td>
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<tr>
<td>No Idea</td>
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<tr>
<td>21. People in charge of a Mzimu</td>
<td>188</td>
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<td>Family elders</td>
<td>2</td>
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<tr>
<td>No Idea</td>
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<td></td>
</tr>
<tr>
<td>22. Is Kaya shared?</td>
<td>189</td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td></td>
<td></td>
</tr>
<tr>
<td>23. How is it shared?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>The communities assemble together and perform</td>
<td>166</td>
<td></td>
</tr>
<tr>
<td>the traditional rights</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>The spiritual leaders come together and perform the rituals</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>No Idea</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>24. Is a Mzimu shared?</td>
<td>18</td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td></td>
<td></td>
</tr>
<tr>
<td>25. How is it shared?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Anybody can use a Mzimu once granted permission by the owner</td>
<td>17</td>
<td></td>
</tr>
<tr>
<td>No Idea</td>
<td>1</td>
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<td>No</td>
<td>171</td>
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<td>No Idea</td>
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<tr>
<td>26. Criteria used to set up a Kaya</td>
<td></td>
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<tr>
<td>A forest is selected and then converted to a Kaya by the elders</td>
<td>82</td>
<td></td>
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<tr>
<td>No Idea</td>
<td>108</td>
<td></td>
</tr>
<tr>
<td>27. Criteria used to set up a Mzimu</td>
<td></td>
<td></td>
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<tr>
<td>A site is chosen which is then converted to a Mzimu by the elders</td>
<td>120</td>
<td></td>
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<tr>
<td>No Idea</td>
<td>70</td>
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<tr>
<td>28. Are new Kayas or Mzimu’s created</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>5</td>
<td></td>
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<tr>
<td>No</td>
<td>184</td>
<td></td>
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<tr>
<td>No Idea</td>
<td>1</td>
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</tr>
</tbody>
</table>
29. Function of a Kaya
A hideout during wars 121
Source of herbal medicine 69

30. Are offerings made at Kayas?
Yes 189
No 0
No Idea 1

31. Type of offering
Animals and cereals 189
No Idea 1

32. Process of offerings
"The spiritual leaders convene, lead in prayer, the animals are slaughtered and then the food is cooked" 153
No Idea 37

33. Importance of offerings
To appease the spirits and ward off evil 98
To appease the spirits and show appreciation 91
No Idea 1

34. Are there repercussion if not offered?
Yes 188
Name the repercussions
Diseases and lack of rain 137
Diseases and natural calamities 20
Diseases and poor harvest 6
Lack of rain and poor harvest 25
No 0
No Idea 2

35. Is importance of Kayas diminishing?
Yes 182
Reasons for diminishing
Islamization 161
Modernization 16
Failure of elders to perform the rituals 2
No Idea 3
No 16
The rituals are still practiced 8

36. Are there periods when fishing is banned?
Yes 4
Reason for the ban
During kusi period 3
Chipata - resting day 1
No 157
No Idea 29

37. Are there types of gears which are restricted?
Yes 117
Gears restricted
Trawler nets 90
Spear guns 27
No 15
No Idea 58

38. Is fish ban controlled with seasons?
Yes 7
Name the season
Kusi periods 7
No 142
<table>
<thead>
<tr>
<th>Question</th>
<th>Yes</th>
<th>No</th>
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</thead>
<tbody>
<tr>
<td>39. Are there types of fishes considered taboo to catch?</td>
<td>130</td>
<td>74</td>
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<tr>
<td>Yes</td>
<td>4</td>
<td>5</td>
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<tr>
<td>Which are these types of fish?</td>
<td>22</td>
<td>5</td>
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<tr>
<td>Turtles and fish siblings</td>
<td>29</td>
<td>5</td>
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<tr>
<td>Buju and Dolphin</td>
<td>74</td>
<td>55</td>
</tr>
<tr>
<td>Turtles and mamoids</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>No Idea</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>40. How do they avoid catching them?</td>
<td>78</td>
<td>5</td>
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<tr>
<td>Use recommended fishing nets</td>
<td>4</td>
<td>5</td>
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<tr>
<td>Release the fish back into the water</td>
<td>5</td>
<td>5</td>
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<tr>
<td>No Idea</td>
<td>5</td>
<td>5</td>
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<tr>
<td>41. Are there foreign fishers in your area?</td>
<td>142</td>
<td>4</td>
</tr>
<tr>
<td>Yes</td>
<td>69</td>
<td>2</td>
</tr>
<tr>
<td>No</td>
<td>65</td>
<td>3</td>
</tr>
<tr>
<td>42. Where do they come from?</td>
<td>118</td>
<td>4</td>
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<tr>
<td>Pemba</td>
<td>22</td>
<td>2</td>
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<tr>
<td>Msambweni</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>Shimoni</td>
<td>4</td>
<td>44</td>
</tr>
<tr>
<td>No</td>
<td>4</td>
<td>44</td>
</tr>
<tr>
<td>No Idea</td>
<td>4</td>
<td>44</td>
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<tr>
<td>43. Do they comply with beliefs and customs in the areas?</td>
<td>69</td>
<td>44</td>
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<tr>
<td>Yes</td>
<td>65</td>
<td>3</td>
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<tr>
<td>No</td>
<td>61</td>
<td>80</td>
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<tr>
<td>How do you resolve the situation?</td>
<td>5</td>
<td>48</td>
</tr>
<tr>
<td>Chase them from fishing ground</td>
<td>4</td>
<td>48</td>
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<tr>
<td>Pay money as fine</td>
<td>56</td>
<td>3</td>
</tr>
<tr>
<td>No Idea</td>
<td>2</td>
<td>4</td>
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<tr>
<td>44. Who policies against offenders?</td>
<td>142</td>
<td>48</td>
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<tr>
<td>Fishermen committee</td>
<td>4</td>
<td>48</td>
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<tr>
<td>No Idea</td>
<td>4</td>
<td>48</td>
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<tr>
<td>45. What are the fines and sanctions?</td>
<td>80</td>
<td>2</td>
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<tr>
<td>Pay money</td>
<td>28</td>
<td>80</td>
</tr>
<tr>
<td>Confiscate their nets</td>
<td>2</td>
<td>80</td>
</tr>
<tr>
<td>Stop them from fishing</td>
<td>4</td>
<td>80</td>
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<tr>
<td>No Idea</td>
<td>48</td>
<td>80</td>
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<tr>
<td>46. Have the fines or impositions been successful?</td>
<td>113</td>
<td>3</td>
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<tr>
<td>Yes</td>
<td>3</td>
<td>3</td>
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<tr>
<td>No</td>
<td>80</td>
<td>3</td>
</tr>
<tr>
<td>47. What could be the cause of the failure?</td>
<td>3</td>
<td>3</td>
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<tr>
<td>Some local fishermen collude with foreign fishers</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>48. What should be done to be successful?</td>
<td>3</td>
<td>74</td>
</tr>
<tr>
<td>Impose heavy fines on offenders</td>
<td>3</td>
<td>74</td>
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<tr>
<td>No Idea</td>
<td>74</td>
<td>3</td>
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<tr>
<td>49. What is the trend in fish harvest?</td>
<td>160</td>
<td>3</td>
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<tr>
<td>Upward trend</td>
<td>0</td>
<td>3</td>
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<tr>
<td>Production is always the same</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Fluctuates</td>
<td>29</td>
<td>3</td>
</tr>
<tr>
<td>Downward trend</td>
<td>160</td>
<td>3</td>
</tr>
<tr>
<td>50. Reason for downward trend</td>
<td>115</td>
<td>22</td>
</tr>
<tr>
<td>Over fishing</td>
<td>22</td>
<td>22</td>
</tr>
<tr>
<td>Poor fishing gears</td>
<td>22</td>
<td>22</td>
</tr>
</tbody>
</table>
Failure to perform sea rituals  
Sea pollution  
No Idea  
51. Are some fishing methods destructive?  
Yes  
No  
124  
52. Which are these?  
Use of poison  
Use of trawler nets  
No  
No Idea  
120  
4  
7  
59  
53. Do neighborhoods have similar traditions?  
Yes  
No  
127  
12  
54. How do they differ with yours?  
No comment  
No Idea  
12  
51  
55. How is the bordering waters exploited?  
Communally exploited  
No Idea  
90  
100  
56. Do you experience some negative border effect?  
Yes  
Mention the effects  
Decrease in fish catch  
Theft of fishing gears  
No  
No Idea  
33  
23  
10  
52  
105  
57. Does the council control the number of fishermen in an area?  
Yes  
No  
0  
58. How do they control them?  
No comment  
No  
0  
138  
52  
59. Do young people comply with taboos and rules?  
Yes  
No  
121  
69  
60. What is the reason for not complying?  
Consider them outdated  
No Idea  
69  
0  
61. Are there fishing grounds which have been declared National Parks?  
Yes  
No  
0  
62. What is the reaction from the community?  
Negative  
No Idea  
164  
26  
63. Do you make your views known to the government or KWS?  
Yes  
No  
165  
64. How do send your views?  
Talk directly to kws officials  
Talk to the chief about it  
No  
116  
49  
25  
65. What is the relation with tourist reserves?
Good and cordial  44
Fair  84
Bad  62

65. What is the reason if not Good and cordial?
Lack of job opportunities  44
Some locals are employed in the reserves  28
Harassment by the police  14
Do not involve in community projects  5
Sell the catch to the tourist reserves  5
No comment  50

66. Has there been interest to sub-divide or register land in Kayas / Mzimus?
Yes  148
No  17
No Idea  25

67. Has tourism led to some dislocation of some villages?
Yes
No  110

68. Name the Villages
Maweni area beach  18
Mwanyaza  1
Makonde fishing grounds  4
Kaya chale  2
Kaya chinondo  1
Chigomeni  5
Ali barbour area  2
Mvuleni  1
Mkwakwani  1
Mwaepe  4
Kambe area  1
Mwakamba  47
Mvumoni  11
Jadini area  1
Lagoon reef area  1
Chidze  3
Mwamambi  7
No  65
No Idea  15

68. Were there any disagreements by the parties involved in displacements?
Yes  97
Comment on the disagreements
No compensation  81
The matter was discussed with some elders  4
No comment  12
No  67
No Idea  26

69. Is the community happy with the government or its agency approach?
Yes  0
No comment  190
The locals are not benefiting from the projects  80
No compensation for the land taken  11
They were forcefully evicted from their land  19
Involve locals in decision making  26
KWS want to take land from us  2
Government should solve land issues  18
70. Has the relationship between government and its agency and the community solved the disputes?
Yes 3
No 31

71. In case where the community felt aggrieved, has there been attempt to show displeasure?
Yes 0
No 190

72. Reasons for their displeasure
Use violence to stop the projects 118
Discuss with the govt officials about it 32
Take legal action 18
No comment 11
No 179

73. What is the future of parks curved from former fishing grounds?
Good 0
Bad 0
Other 190

74. Do tourist hotels and infrastructure developed in the area have any better future?
Yes 27
No 24
Give reasons 0
They will collapse 24
No Idea 139

75. Are members willing to sort their problems with the government or its agency?
Yes 190
No 0
Give reasons 0
No comment 0

76. What can be done to maintain the sustainability of resources in the area?
Establish community based project to assist them 15
Provide financial support to local projects 30
Offer job opportunities in the hotels 17
Land disputes should be settled 3
Help the local exploit the available resources 66
Help them with loans to buy fishing equipments 12
Build a factory to process the food produce 3
Involve the locals in running the projects 7
The tourist reserves should participate in development projects 1
Create a market for the local products in the area 5
Create job opportunities in the area 1
Compensate for our land 2
Hotelier should help in financing community based projects 1
No communication 0
Name: Okeyo Benards
Ort, Datum: Mombasa – KENYA. 07/05/2010
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Email: okeyob@yahoo.com / okeyob@gmail.com

ERKLÄRUNG

Hiermit erkläre ich, dass ich die Arbeit mit dem Titel:

Artisanal Fisheries of Kenya’s South Coast: A transdisciplinary case study of a socio-ecological system in transition

selbstständig verfasst und geschrieben habe und außer den angegebenen Quellen keine weiteren Hilfsmittel verwendet habe.

Ebenfalls erkläre ich hiermit eidesstattlich, dass es sich bei den von mir abgegebenen Arbeiten um 3 identische Exemplare handelt.

..............................................................
(Unterschrift)