INDIGENOUS KNOWLEDGE IN PARTICIPATORY MAPPING OF ARTISANAL FISHING ZONES: A CASE STUDY OF ANGOCHE DISTRICT, NAMPULA PROVINCE IN MOZAMBIQUE

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Submitted in partial fulfilment of the academic requirements for the degree of Master of Environment and Development (Land Information Management – LIM)

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ABSTRACT

Indigenous knowledge use in identifying artisanal fishing zones is the core issue in this dissertation. It seeks, on one hand, to show the potentially of this knowledge and to establish the relationships between indigenous and scientific knowledge in fishing zones identification and, on other the hand, it is also a trend for alleviating those fishing zones surrounding beaches, estuaries and bays highly exploited by artisanal fishermen. Pushing artisanal fishermen upward offshore and/or into the open sea, they will fish more quality and high economic value fish contributing to enhance their income. By so doing, artisanal fishermen will uplift their living standard and, at the same time, they will contribute to sustainable artisanal fisheries management.

Angoche District in Nampula province, north of Mozambique is the study area. The study was carried out to describe the logical sequence underlying on the process of identifying artisanal fishing zones using indigenous knowledge. The relationship between indigenous and scientific knowledge is treated with particular attention. The nature of the study is descriptive and analytical based on qualitative and quantitative data. The method used for data collection was face-to-face interviews using structured and semi-structured open-ended questions.

Data on socio-economic, traditional and cultural practices, technological and climate characteristics were collected, analyzed and discussed. Factors underlying artisanal fishing zones were studied. Spatial and non-spatial information for artisanal fishing zones identification was recorded applying Global Positioning Systems (GPS) and, later, processed and analyzed employing Geographical Information Systems (GIS). Finally, a map showing the localization and distribution of the identified fishing zones in the study area was produced.

Results from the research show that identification of fishing zones offshore or open sea can be done simply based on local indigenous knowledge. The GIS technology employment facilitates the inclusion of indigenous knowledge into other knowledge which can be used for local decision-making. Sustainable fisheries management can only be achieved by developing a science based on the priorities of local people, and creating a technological base that includes both traditional and modern approaches to problem-solving.

DECLARATION OF ORIGINALITY

This dissertation results from a research project carried out through a Masters' Programme in the Centre for Environment, Agriculture and Development (CEAD), University of Natal, Pietermaritzburg. Dr Denis Rugege, the Director of the Land Information Management programe (LIM), supervised the project.

With appropriate acknowledgements in the text where the work of others had to be used, the present study represents the original work by the author and it has not been submitted in any form for any degree to any other university.

Signature Date

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Ernesto Poiosse Hele

Signature Date

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Denis Rugege

Signature Date

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Dorman Chimhamhiwa

ACKNOWLEDGEMENTS

This dissertation could not be completed without the positive involvement of specific people and institutions both in South Africa and in Mozambique. The author is indebted to all whose who directly or indirectly contributed to this study.

At the Centre for Environment, Agriculture and Development (Pietermatizburg) the author expresses much gratitude to his supervisor, Dr Denis Rugege, for the outstanding advice that maintained the study in line with the research aims and objectives. In their capacity of Director of Land Information Management department, Dr Denis Rugege and Mr. Dorman Chimhamhiwa, deserve another warm word of acknowledgement for conducting an innovative programme through which it was possible to finalize this project in time. To the whole administrative staff, a word of thanks for their remarkable attention and promptness to ensure a responsive and inclusive working environment.

In Mozambique, the author thanks the NORAD, through the Ministry of Fisheries, for fully sponsoring his studies, and the National Institute for the Development of Small Scale Fisheries (IDPPE) for granting permission to be part-time absent from work for such long period. A very special word of thanks is reserved for all those fishing community members, government officials and research assistants with whom the author worked in Angoche District. Gratitude is also expressed to the Nampula IDPPE Delegation in Angoche for all unpredictable logistics offered to the author that made this research possible.

Last but not least, the author thanks warmly his lovely family, especially, his wife who accepted staying alone in Maputo with kids, as well as all other relatives and friends who interacted with him during his stay in Maputo and fieldwork in Angoche district.

DEDICATION

This dissertation is dedicated to you my "*unknown*" father **CHIGOHE MANGUEZE HELE** who passed away few months after I was born. To you my mum **EMELINA MANDUNDO** who was early forced to leave me in childhood with my grand-mother and later you passed away in 2000. To you my unforgettable grand-mother **NHANCUNDELE** for your immeasurable love, from the earliest my childhood until 1973 when death came also to you. Although late, at least, I have been with you mum from 1982 to 2000 but, unfortunately, I never knew my father. After my grand-mother passed away in 1973 whose grew me up in rural area, I still remember I was completely exposed to tremendous and unpredictable suffering. I also remember that to meet conditions to complete my primary and further studies was extremely hard and tough. I never thought I could achieve the present academic degree.

Extended dedication goes to you my lovely wife **MARIA ALBERTO MOAMBA "HELE"**, particularly, for your long extended patience, especially when you had to be alone with the kids.

God, thank you so much for all.

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GLOSSARY OF TERMS

Artisanal Fisheries (AF)

It is defined as local fishing. It may use or not boats up to 10 metres with or without outboard or inboard marine engines. It may also use or not ice for fish conservation and, normally, it use traditional fishing gears. As proposed on PESPA, 2006 artisanal fisheries comprise two distinguished branches: - subsistence; and, - commercial fisheries;

Artisanal Fishing Zone (AFZ)

It is an area in maritime and/or inland waters (inshore and/or offshore) - beach, bay, sandy banks, open sea, estuarine, river, lagoon, etc. - identified by Artisanal fishermen (women and men) where they, normally, fish (*personal*);

Ethnoecology (**EE)**

It is the study of local or native people's interaction with the environment in which they live and work, including their perceptions, use and management, and knowledge. Sub-disciplines of ethnoecology include ethnobiology, ethnobotany, ethnozoology, and ethnopharmacology. Local people, social scientists, and natural scientists ideally conduct ethnoecological research together, as a team (*NOAA, 2004*);

Fisheries Sustainable Management (FSM)

It is management of fishing activity that meets the needs of the present without compromising the ability of future generations to meet their own needs;

Fishers' Ecological Knowledge (FEK)

It is local knowledge concerning interannual, seasonal, lunar, diet and food-related variations in the behaviour and movements of marine fishes and mammals. Such knowledge is passed from generation to generation of fishers and influences the nature, timing, and location of their fishing (*NOAA, 2004*);

Fishery Sector (FS)

It is the combination of the industrial sub-sector and the small scale fisheries sub-sector with institutional apparatus as well as the connected fisheries activities that enable the interaction and the operation of the fishing process in the country. The small scale fisheries sub-sector, on the other hand, encompasses semi-industrial and Artisanal fisheries (IDPPE, 2006);

Fishing Unit (FU)

It is a combination of fishing boat and fishing gear or one of these items (boat or gear) alone employing fishermen or a fisherman (woman and/or man) with or without a fishing boat employing fishing gear (IDPPE, 2006);

Geographical Information Systems (GIS)

It can be seen as a system of hardware, software and procedures designed to support the capture, management, manipulation, analysis, modelling and display of spatially-referenced data for solving complex planning and management problems. In the strictest sense, however, a GIS is a computer system for capturing, storing, checking, integrating, manipulating, analyzing and displaying data which are spatially referenced to the earth, i.e. data identified according to their locations on the earth surface. It comprises a set of processes leading from observation and collection of data through analysis, to produce information useful in decision-making (LIM, 2006);

Gillnet (GN)

It is fishing gear composed by nets in rectangular form, vertically maintained in water by physical weights put under the inferior rope and by buoyant in the upper rope to enable fish capture (IDPPE, 2006);

Global Positioning System (GPS)

It is a constellation of orbiting satellites maintained by the United States Government for the purpose of defining geographic positions on and above the surface of the earth. It consists of three segments:

-a**)** user segment; -b**)** control segment; and, -c**)** space segment. GPS was developed by US Defence as a worldwide navigation resource for military and civilian use (LIM, *2006*).

Hand Line (HL)

It is a fishing gear encompassing one or more fishing hooks, normally, operationalized by using fisherman's hand (IDPPE, 2006);

Indigenous Knowledge (IK)

It can be viewed as having two sources: traditional knowledge and nontraditional knowledge. … 1) aboriginal people also possess knowledge and experiences not grounded in traditional lifestyles, spirituality, philosophy, social relations, and cultural values; and 2) indigenous knowledge is the articulation, and frequently the dialectic, of traditional and nontraditional knowledge (NOAA, 2004);

Local Ecological Knowledge (LEK)

LEK is similar to traditional ecological knowledge (TEK) in that it is tied to place (e.g., specific hunting or fishing grounds) and is knowledge acquired through experience and observation. It can be acquired over a single lifetime or over many generations. LEK differs from TEK in that it does not require an ancient or even a multi-generational accumulation of knowledge, it does not require that the population be indigenous, and it does not require embedding in a broader shared culture. In other words, an individual can accumulate LEK over the course of one lifetime interacting with a local environment (*NOAA, 2004)*;

Local Fisheries Knowledge (LFK)

It is a similar to local ecological knowledge in that it is tied to place, is acquired through experience and observation, and may be acquired over a single lifetime or passed down over many generations. Unlike local ecological knowledge, LFK includes non-ecological knowledge related to fisheries, including but not limited to business aspects of fishing, economics, social dynamics, and local fishing culture (*NOAA,2004*);

National Institute for the Development of Small-Scale Fisheries (IDPPE)

It is a national state institution entitled to judicial and administrative autonomy from the Ministry of Fisheries. Its independent legal status was granted by Council of Ministers Decree nr. 62/98 of 24 November. The Main objective of IDPPE is to promote practices which contribute to the development of small scale fisheries, to help improve the livelihoods and working conditions of fishing communities and to increase the level of national production of protein-rich nutrition. The main areas of intervention are the socio-economic, fishing technology and planning related issues, respectively (*IDPPE, 2006)*;

Nontraditional Knowledge (NTK)

It is derived from "interactions with non-aboriginal people and institutions; television and other modern media; formal schooling in numeracy and literacy; the adoption of Western scientific thinking; and exposure to foreign values, attitudes, and philosophies. In contrast, traditional knowledge systems are based on the shared experiences, customs, values, traditions, subsistence lifestyles, social interactions, ideological orientations, and spiritual beliefs unique to aboriginal communities. Together, these two foundations of knowledge articulate to form a worldview … that provides meaning and value to the lives of contemporary aboriginal peoples (NOAA, 2004);

Planning Area (PA)

It is a coastal geographical area encompassing a number of fishing villages and fishing centres. It stretches from coastal base line to the interior at a diameter of about 30 km long. The planning area is characterized by presenting common socio-economic characteristics and local norms and, normally, under the same traditional leadership. The coastal width of any PA varies from one to another based on the frontiers established according traditional principles. The definition of Planning Area is participatory and assessed by IDPPE but validated by local communities in a general meeting (IDPPE, 2006);

Scientific Knowledge (SK)

It is knowledge developed in schools, universities, research institutions and industrial firms which is systematic and originated in the industrialized countries in the Northern hemisphere (*Grenier, 1998*).

Stakeholder Participation (SP)

Participation must be centred on the typology forwarded by some authors consisting on seven (7) main types of participation. Such types are "*passive participation*", based on telling people what is going to happen or what has already happed; "*participation in information giving*", simply people answer questions posed by outsiders using surveys, questionnaires etc.; "*participation by consultation*", people are simply used as sources of information by being consulted by outsiders who define both problems and solutions; "*participation for material incentives*", people mainly used as labour force in return for food, cash or other incentives; "*functional participation*", people are either volunteer or conformed to form groups to meet objectives determined by outsiders; "*interactive participation*", direct people involvement on participation by being involved in analysis, formulation of action plans and form new or strengthen existing local institutions; "*empowerment*", people taking over the leadership of the process by taking initiatives independent of outsiders to change their situation (Breakwell and Petts, 2001, & Jonsson, 2004);

Traditional Ecological Knowledge (TEK)

It is a body of knowledge and beliefs transmitted through oral tradition and first-hand observation. It includes a system of classification, a set of empirical observations about the local environment and a system of self-management that governs resource use. Ecological aspects are closely tied to social and spiritual aspects of the knowledge system. The quantity and quality of TEK varies among community members, depending upon gender, age, social status, intellectual capability and profession (hunter, spiritual leader, healer, etc.). With its roots firmly in the past, TEK is both cumulative and dynamic, building upon the experience of earlier generations and adapting to the new technological and socioeconomic changes of the present (Inglis, 1993);

TEK is a cumulative body of knowledge and beliefs, handed down through generations by cultural transmission, about the relationship of living beings (including humans) with one another and with their environment. Further, TEK is an attribute of societies with historical continuity in resource use practices; by and large, these are non-industrial or less technologically advanced societies, many of them indigenous or tribal (NOAA, 2004).

As the candidate's Supervisor I have/have not approved this dissertation for submission:

Signed	Name	Date
_____	Denis Rugege	_____

CHAPTER 1

Introduction

1.1– Introduction

The Government of Mozambique's fisheries sector (FS) embarked on fisheries management decentralization from early 1990's. The government's adoption of decentralised fisheries management aims to improve social and economic conditions and raise the living standard of fishing communities, especially at artisanal fisheries (AF) level. This can only be achieved through the involvement and participation of all different stakeholders (governor's of institutions, private sector, civil society and fishing communities). The reason for focusing on artisanal fisheries management rather than semi-industrial fisheries (SIF) and industrial fisheries (IF) is because government has played an insignificant role in the past for better and sustainable artisanal fisheries management. It had also excluded and devalued the fishing communities' use of indigenous knowledge (IK) in the process of fisheries management. In the last few decades, there has been noticed also reduction in fish production, particularly, in the artisanal sub-sector.

Although the programme of decentralising management is in process, government still largely favours management based on scientific models rather, than combining and/or creating synergies between scientific and indigenous knowledge. According to Diegues (2002:12) "the lack recognition of the value of traditional fisheries knowledge is that some government managers and some in the academic and conservation agencies as well continue to assume that "primitive societies" are unable to produce "scientific" and valuable knowledge".

1.2 – The problem statement

Nationally, there is very little information on participatory mapping of artisanal fishing zones in the offshore zones. The knowledge that exists is more concerned with semi-industrial and industrial fisheries. Reviewed data also reveals that there is no documented information on the existence of mapping of artisanal fishing zones where fishing communities had been directly involved or had contributed to the process using their indigenous knowledge. Thus there is a gap on participatory mapping of artisanal fishing zones using indigenous knowledge.

By ignoring the use of the indigenous knowledge in the process of fisheries management, particularly, at artisanal fisheries management level, government is experiencing limitations in making important decisions for artisanal fisheries management on which the wellbeing of fishing communities and development are dependent. Including IK in arttisanal fisheries management, as part of the fisheries management decentralisation programme will enable government make improved decisions for sustainable fisheries management.

1.3 – Contextualization

Mozambique has a coastal line of about 2, 750 km. The fishery sector is experiencing a shortage of financial, material, human resources as well as a lack of institutional presence in the field to cover the entire coastal area (maritime and inland waters) for effective interventions. For this reason, government is not able to apply and implement, effectively and efficiently, fisheries management measures in artisanal fisheries, especially those based solely on scientific models. Although, there is clear recognition of these difficulties on government's side, not much has been done to validate the use of indigenous knowledge and fully incorporate it into the process of artisanal fisheries management.

The effects of government limitations as well as the institutional absence in the field lead to weak responses to problems of fishing communities whether these are socio-economic or fisheries/ecological related. At the same time, it also leads to minimal application of administrative measures for fisheries law enforcement. The lack of institutional support for fishing communities and their organizations leads to the high concentration of fishermen in urban areas where there are services or in more productive fishing areas such as bays, estuaries, rivers or around some islands. Concentration of fishing activities in specific areas has led to localised overexploitation of natural resources in some of these areas. Additionally, such concentrations have led to conflicts in coastal zones, both among artisanal fishermen and/or semi-industrial and industrial fisheries sectors.

Initiatives to establish new systems of protected areas in coastal habitats are also altering and having detrimental impacts on the livelihoods of traditional fishermen leading to the increasing number of conflicts between fisheries and the tourism sector (Diegues, 2002). Furthermore, the moves for prospecting for oil as well as proposed mining ventures in coastal zones are likely to exacerbate the ongoing conflicts in coastal zones among the different interest groups and sectors.

Worldwide, there has been an increasing trend towards use of IK in fisheries management, specially, in small-scale, artisanal fisheries and subsistence fisheries. IK has been also acknowledged as efficient especially when it is applied jointly with scientific knowledge as integrated knowledge for fisheries management. Based on worldwide experience, the present study argues that the idea of using indigenous knowledge for artisanal fisheries management, especially in situations where government has difficulty in applying conventional scientific models for effective and efficient sustainable fisheries management makes both economic and political sense in order to achieve its goals. In such contexts IK needs to be officially recognized and validated in order to be an integral part of knowledge for artisanal fisheries management.

1.4 – The structure

The dissertation is organized into six chapters. *Chapter 1* is the introductory chapter giving brief information on the background, problem formulation and objectives of the study. The importance and the study's probable contribution to the body of knowledge are also given in this chapter. *Chapter 2* gives background information about Mozambique and the study area, specifically. *Chapter 3* gives an overview on fishery sector of Mozambique. More emphasis is given on the artisanal fisheries sub-sector. *Chapter 4* deals with the research topic as well as of the research methodology used. *Chapter 5* chapter deals with data analysis and *chapter 6* deals with the discussion of the results and conclusions from the study.

1.5 – Conclusion

In this chapter emphasis has been given to the need for integrating and/or combining both indigenous and scientific knowledge for effective and efficient fisheries management. In achieving such integration and/or combination, fisheries management arrangements are likely to be more proficient and socioeconomic conditions for fishing communities, particularly for women, as the more disadvantaged social layer in the fishing communities, as shown in plate 1, can be improved and/or raised more acceptable living standards.

Women in fishing

Commercialization of marine products

Plate 1 – Women participation in artisanal fisheries in Angoche fishing villages

CHAPTER 2

Description of the study area

2.1 – Introduction

This chapter gives brief information on geographical localization, demography, political administration and a summary of national economy of the country as a whole. Emphasis is given to geographic and administrative description, demographic and/or socio-economic related issues as well as environmental aspects of Angoche district as the study area.

2.2 – Geographical localization

Mozambique is located on the southeast coast of the African continent. The whole of its eastern border is fronted by the Indian Ocean. The country lays between parallels 10º 27' S in the north (Quionga in Cabo Delgado) and 26º 52' S in the south (Catuane in Maputo) and, longitudes 40º 51' E in the east (Matibane in Nampula) and 30º 31' E in the west (Zumbo in Tete). Mozambique is west of Madagascar Island, which is separated by the Mozambican channel. The total surface area of the country is 799.380 km² of which 786.380 km² is land and 13.000 km² comprises inland waters. The maritime boarders comprise territorial waters which stretch up to 12 nautical miles (about 20km), jurisdictional waters (the Exclusive Economic Zone), which stretch up to 200 nautical miles (about 370km) from the lowest water mark (IDPPE, 2000).

Mozambique shares borders with Tanzania to the north, Zambia and Malawi to the northwest, Zimbabwe to the west, and South Africa and Swaziland to the southwest. It has a total coast line of 2,750 km from the Rovuma river mouth (north) to Ponta de Ouro (south). Behind the coastlines a vast low plateau rising towards mountains in the west and north accounts for nearly half the area of Mozambique. The landscape of the plateau is savannah - more or less dry and open woodlands with tracts of short grass steppes. The western and northern highlands are patched with forest. The major concentrations of population are along the coast and in the fertile and relatively productive river valleys (Dambiane, 1999). The geographical localization of Mozambique is shown in figure 1.

Figure 1: - Geographical location of Mozambique – (IDPPE, 2007)

2.3 – Demography

According to the preliminary results of the third general census of population and housing (INE, 2007), the population of the country is 20, 5 million located on a total area of 799.380 Km², giving a density of 25.7 people/km². Like other developing countries, Mozambique's population has been growing steadily as shown in figure 2. The population consists, mainly, of a number of different speaking peoples. The most influential are the Tsonga and Shona people. However, the largest group is the Makua-lomwé in the north of Mozambique. The official language is Portuguese, which is spoken by only 15% of the population while the rest, especially in rural areas speak other local languages. With regard to religion, the main religious groupings are Christian (mainly Roman Catholic), Muslim, Hindu, and many traditional beliefs (Dambiane, 1999).

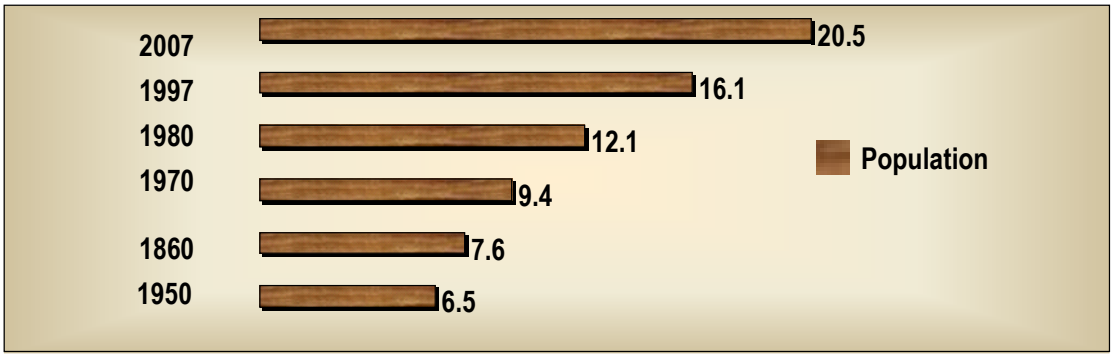

Figure 2: Growth in total population for Mozambique, 1950–2007 - (INE, 2007)

2.4 – Political administration

Mozambique is divided into ten (10) administrative provinces as follows: three in the south, namely Maputo, Gaza and Inhambane; four in the center, namely Sofala, Tete, Manica and Zambézia; and three in the north, namely Nampula, Cabo Delgado, and Niassa. Seven (7) of ten provinces have maritime borders. Niassa, Tete and Manica are the only inland provinces. There are a total of 128 districts within these provinces distributed as follows; (30) in South, (49) in Center and (49) in North, respectively. There are 23 declared cities, 7 in the south, 8 in the center and 8 in the north. There are a total of 68 villages as follows: 23 in the south, 22 in the center and 23 in the north. All these are administered by 393 administrative posts (95 in South, 143 in Center and 155 in the North) as shown in figure 3 (Pililão, 1989)

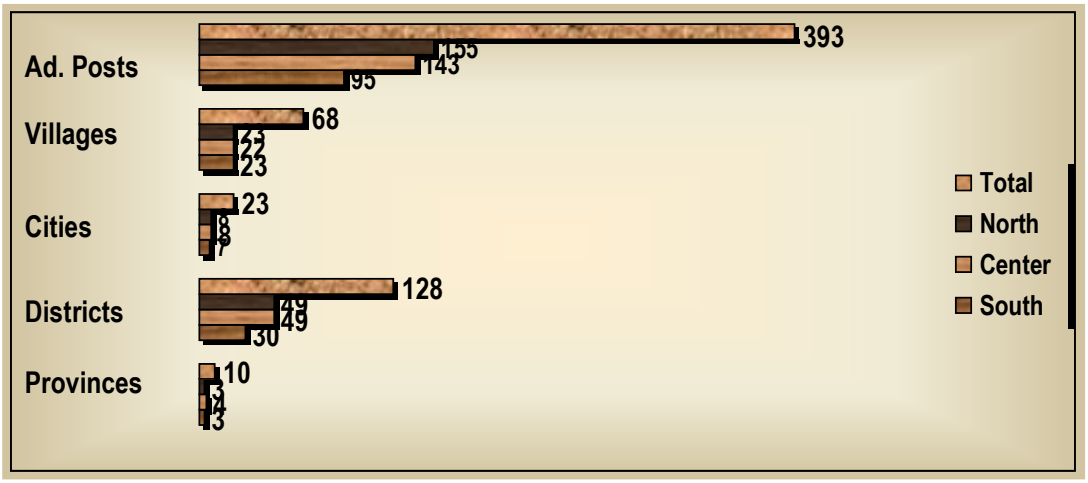

Figure 3: - Structure of political administration in Mozambique - (Pililão, 1989)

13.000 km² of surface is occupied by inland waters. Of these, Lake Niassa, west of Niassa's province is the biggest. Lake Niassa is the third biggest lake in Africa, with an area of about 30.800 Km². Tete, another of the three inland provinces, possesses the second biggest mega dam in Africa (38 Km at its widest), the Cahora Bassa which is used for generating Hydro-electricity. The dam occupies about 2.700 Km² in area, with an average depth of 26 meters. The capacity of the dam is of 2000 megawatts (MW) supplying 250 MW to Mozambique, 1.100 MW to Republic of South Africa and 400 MW to Zimbabwe. Tete province is on the Zambezi River which runs for 250 Km. The Zambezi River crosses Zimbabwe into Tete and then stretches into the Zambézia province emptying its waters into the Indian Ocean in Chinde district in the same province. Manica province, with its great fluvial soils, is considered as the cradle of the fish culture because is the only inland province with a great number of fish culture activities at household level.

The Tete dam has got multiple benefits like the production and supply of the electricity; fishing and transportation of the important nutrients for shrimp spawning areas at Sofala Bank; natural irrigation for farming, although, sometimes, it brings problems for the communities when is flood.

Each of the ten provinces is headed by a Provincial Governor appointed by the central government. The provinces, in turn, are divided into districts. From the 128 districts, about 91 districts have strong fishing economies. Of these 91 fishing districts, 48 are maritime and 43 districts are inland water fishing districts. The districts are headed by District Administrators.

The districts are further divided into administrative posts (393) which are headed by a chief of administrative post. By the proclamation and adoption of democracy in the country (1994), all provinces and some eligible districts have working municipality councils headed by the presidents of the municipalities. The administrative posts are divided into localities and areas. The localities are managed by the president of the locality and the areas are ruled by the secretaries of villages. At Administrative post, locality and area levels, formal and traditional leaders are found and they work together and in combination or coordination of political and/or traditional local administration (Pililão, 1989 & Dambiane, 1999).

2.5 – The national economy

Mozambique is an agricultural society, where almost 85% of the rural population is directly involved in agriculture. Most of the rural people are small scale farmers, with production at subsistence level (Dambiane, 1999). In 2006, the global production attained 8.2% where agriculture rose up to 6.9% and fisheries rose to 3.3%. For 2007 is expected that the rise of the global and sector production attains 7.2%. Agriculture is expected to attain 12.2% and fisheries 3.5%. Agriculture, transport and communication and investments sectors are determinants for the planned economic growth (Govt, 2007). Besides those mentioned there are also other remarkable economic sectors, as shown in figure 4, contributing for the national economic growth and, amongst them the following are, particularly, expressive:

- The fishery sector is expected to register a growth of about 3.5%. It is expected that industrial and semi-industrial fisheries will produce 32,872 tones of diversity fish products; this corresponds 5.4% including 7.0 tones of inland waters. Artisanal fisheries alone is expected to produce 54,475 tones, about 8.9%;

- The extractive industrial sector is expected to contribute 11,0% to economic growth. In this sector, there are about 22 classified and important mineral resources that will account for economic growth. However, to attain the planned percentage (11,0%), the sector requires to increase the production of “calcareous” by 58,3% which corresponds to 50% of the sector increment.

- The electricity and water sector is expected to contribute to the national economic growth by 9.0%. The production of electric energy from Hydro-electric of Cahora Bassa (HCB) and

Electricity of Mozambique (EDM) will increase by 10.0%. To meet the needs resulting from rural and urban population growth, water production is projected to increase by 2.4%;

- The construction sector is expected to increase by 8.0% as a result of the public investment planned for this purpose. About 297 Km of the main roads are expected to be rehabilitated. 17.200 Km of roads will benefit from the routine maintenance and 1.197 Km, from periodic maintenance. Additionally, 610 Km of local roads will be rehabilitated;

- The commercial sector is projected to grow by 5.4%. Accounting for this increment, the sector is expected to increase the importation of goods, excluding those of the mega-projects ongoing in the country like Mozal (Maputo), Sasol (Inhambane) and Heavy Sands (Nampula) (Govt, 2007).

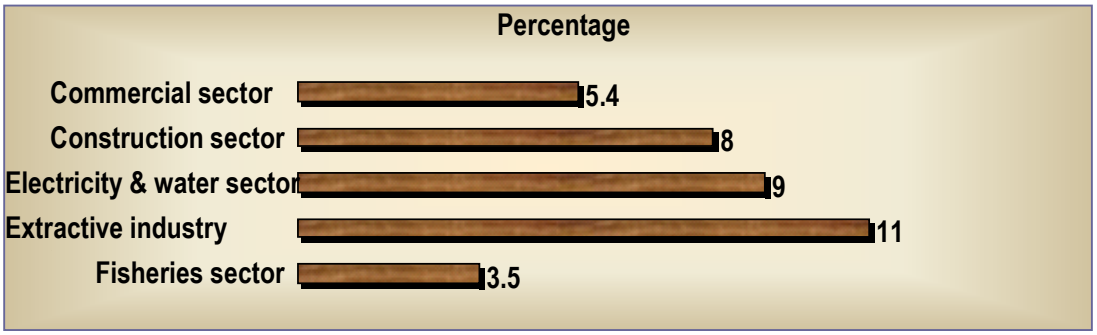

Figure 4: - Expected economic growth in 2007 for some economic sectors - (Govt, 2007)

In the last few years, the national economic growth has shown the tendency to increase towards two digits. The reason for this high growth rate is due largely to the peaceful political environment since the proclamation of the "Roma Peace Accord" signed in 1992 after 16 years of civil war. Since then, government turned all its attention to reconstruction and development of the economy for the nation as a whole.

2.6 – Angoche district (the study area)

Angoche, one of the eight coastal districts of Nampula, is the selected area for this study. Nampula province has 21districts including three cities (Nampula headquarters, Nacala and Mozambique Island). Eight (8) of the districts are maritime coastal districts and Angoche is one of the three maritime coastal districts in the south of the province. Angoche is one of the most productive districts in terms of fishing.

2.6.1 – Geographical localization

The Angoche district is located along the coast South of Nampula Province between the parallels 15º 52,9' and 16º 21,8' S and between the meridians 039º 54,2' and 039º 45,2' E. Angoche occupies an area of 3.535 km². It is bordered by the Mogincual district in the north, the Moma district in the south, the Indian Ocean in the east and the Mogovolas district in the west. Angoche district is part of the Micro-region South of Nampula Province, in partnership with Moma, Mogincual and Mogovolas Districts. In this geographical unit, Angoche occupies the fourth position in terms of the territorial extension, but it is the most important sócio-economic centre (Angoche, 2005). The area cover by the research study comprises, mainly, the seven (7) Planning Areas distributed into the Namaponda, Nametória and Aúbe Administrative Posts as shown in figure 5.

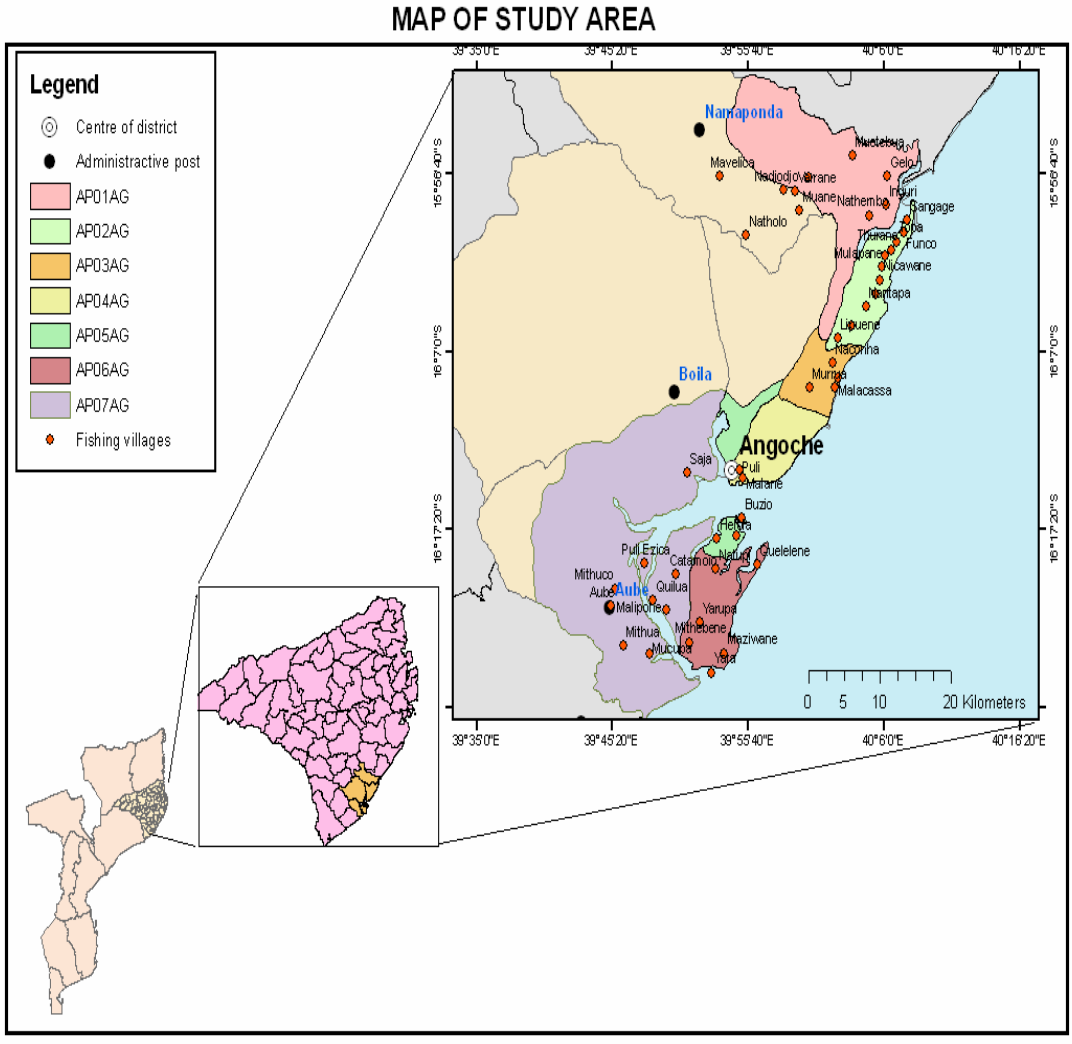

Figure 5: Map of the study area - (IDPPE, 2006)

2.6.1.1 – Climate

The Angoche climate is typically tropical, characterized by great pluviometric variation annually and over a period of years. There are mainly two climate seasons along the year: - warm and rainy season characterized by high temperatures which vary from 27ºC - 33ºC. The rainfall in this season can be significant and can reach 212 mm/month and the relative air humidity is about 79% through out the year. The warm and rainy season stretches from November to April and it is during this period that the North West heavy wind is, generally, observed. The fresh and dry season stretches from May to October and it is during this period that the South East heavy wind is, normally, observed. During this period, there is low rainfall and the temperatures vary from 17ºC - 25ºC, with the relative air humidity about 78% (MDN, 1986). It is in warm and rainy season that catches for artisanal fishermen are good. The problem though is that it is difficult to preserve the fish, meaning that the fishers tend to fish less than they should be doing in order to take advantage of the good catches.

2.6.1.2 – Topography

Angoche is characterized by low altitude which does not exceed 200 metres so it is practically flat, with exception of a few areas where small elevations exist like, Parapato. Close to the sea, the savannah is formed by sediments and alluviums which have been formed recently and are inundated by the sea water. In the sea area of Sangage and the south part of the Angoche urban area the beaches are constituted by mangrove forest. Part of the mangrove areas is being progressively destroyed by human action. At present, there is uncontrolled cutting of mangroves in areas located close to urban areas. Among the most destructive activities affecting the mangroves is cutting of these for coal production, for firewood and for building houses. The last activity might not be such a big threat if it can be carefully controlled (IDPPE, 2000).

There are important Indian Ocean estuaries surrounding Angoche (capital of district). The estuaries are well known for their high productivity and so play an important ecological role in the transportation of nutrients and organic material for other ecosystems. The estuaries give shelter for many commercial species and serve as spawning areas for migratory species. In the district there are also important rivers which run into the Ocean Indian such as the Sangage and Quilua. The average depth of the artisanal fishing area, including the offshore, is about 20 meters. However, hand line fishermen can go up to 45 metres deep although this can be dangerous for them because

of their poor means of transport (non-motorized boats). The amplitude of tides within the region is about 2 metres and the maximum is about 4 metres (ibis, 2000).

2.6.1.3 – Erosion

Angoche district presents a critical situation in terms of the actions of erosion processes. A recent example of the effect of erosion is the appearance of a sand bank close to Kwirikwidge coastal zone from 2000. In Thamole, the existing dunes are in an advanced stage of degradation. Some of the estuary areas are also in advanced stages of erosion, with formation of sand banks starting. Other parts of the coastal region are also suffering erosion, with a lot of casuarinas being destroyed by sea water and the appearance of sand banks in areas where these did not exist in the past. Due to the high state of soil degradation, there are some islands that were inhabited before, but are now being abandoned by the resident population (ibis, 2000).

Generally speaking, the cleaning of the coastal vegetation, particularly the mangrove and the arboreal cover of the dunes, effect of the high amplitude sea waves during the windy season influenced by the tidal movement, the rise of the sea level; and, the lack of consistency of the sandy dunes, account for some of the main reasons for vulnerability of the region to erosion.

2.6.1.4 – Pollution

The marine pollution is changing, sometimes in an irreversible manner, the natural equilibrium that the humans and other organisms' life depend on. In Angoche, the main form of the marine pollution frequently observed is due to the chronic human and animal residuals (IDPPE, 2000).

In the N'guri and other surrounding centers of Angoche, the "bush toilet" on the beaches and mangrove's areas is one such form of pollution. These areas are mainly used for landing and launching of boats and also for fish processing. It is very curious that even some people who have conventional houses do not have toilets within their residential area. Local information indicates in such regions and/or places diseases like cholera are very common (ibis, 2000).

However, in some areas like Gelo, Sangage, Kwirikwidge, and Quelelene Island, the water is clean and shows little indication of pollution. Probably, this is because the majority of the boats used are

not motorized and, also due to the low industrialization which results in the absence of the agricultural and industrial residuals (ibis, 2000).

2.6.2 – Demography

Angoche has a population of 277,412 people in an area of 3.535 Km², giving a population density of 78 inhabitants/Km². Due to the Arabic influence that the coastal area had been subjected from long years ago, Angoche is predominantly Islamic in terms of religion. "Macua" is, the predominant spoken language and also in the name of the biggest ethnic group in the entire province of Nampula (De Melo, 1984). There are some language sub-groups derived from "Macua" like Lomues, Mulais, Marrovones, Mpamelas, Mugovolas and Niwarronis, and the Amacas which are found in Angoche headquarters and the "Akoti" in Sangage. The most spoken language in Angoche and surrounding the islands is "Koti" (Angoche, 2005).

2.6.3 – Political administration

Administratively, Angoche is composed of four administrative posts, namely, Angoche (the district capital), Aúbe, Boila/Nametória and Namaponda. The four administrative posts all together are further divided into seven localities. The local government is assisted by district directorates such as Districtal Services for Economic Activities covering Agriculture, Fisheries, Industry and others; Education; Health, Finance, Public Work and Housing, inter alias. The district is also served by the Police, a District Court, the Maritime Administration and Customs at the port, the Civil Registry and the Telecommunications Company. The district administrator coordinates activities of the various departments through regular meetings of the district government. At the local level are traditional leaders (the chiefs and the village headmen). The traditional leaders have great influence and administer issues areas of local concern. They cooperate with government officials, especially in solving conflicts over community and other resources (UNDP, 1997).

2.6.4 – The economy of the district

The Angoche district economy is based on agriculture, practiced, mainly, at household level. The potential arable area in the district is about 211.548 hectares. The area designed for agriculture accounts for 61.019 hectares. Of this, 357 hectares is for household farming, 19.550 hectares is

designed for livestock, 45.310 hectares is forest area; and 5.312 hectares accounts for other purposes (see figure 6). Farmers grow both cash and subsistence crops. Cashew nuts and cotton account for cash crops. Before the civil war, which ended on 1992 and seriously affected the economy, the cash crops played an important socio-economic role at district level as it employed a large number of the local population especially women. For many reasons, the cash crops are not important in the district's economy. This has resulted in increased unemployment. Cassava, maize, rice, beans, groundnuts, and suite potatoes are mainly grown for subsistence use. The cashew nuts, groundnuts, rice and maize are the main cash crops grown by farmers (Angoche, 2005).

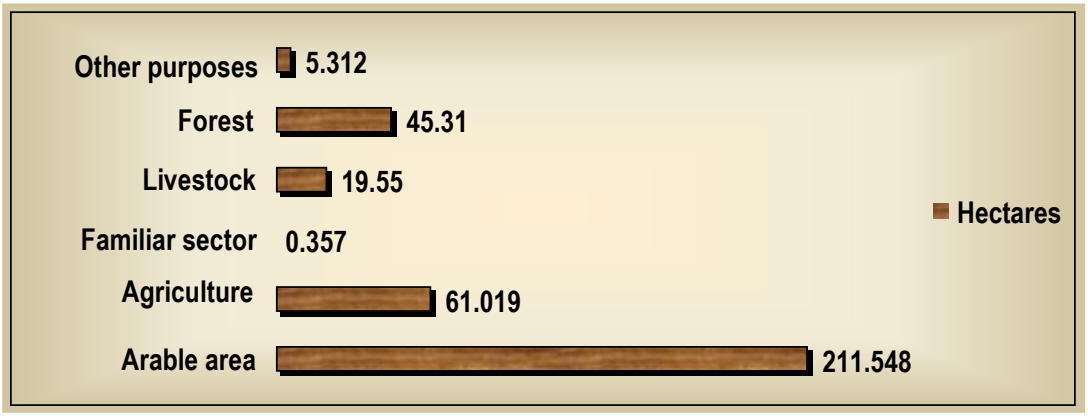

Figure 6: - Use patterns of potential arable area in Angoche District - (Angoche, 2005)

Fishing is another important activity in the district economy. The sea is rich in marine resources like shrimp, lobster, crab and other fish species. Fish constitutes a large part of the household diet not only at district level but also outside the district. The potential and traditional areas of fishing are Sangage, Quelelene, Yathá and Kwirikwidge. For fishing, the district mainly depends on artisanal fishermen, whose fishing activities and production are oriented towards the local market and other regional markets including the provincial capital of Nampula (Angoche, 2005).

In terms of industrial fishing, the district has Pesca-Norte: - a semi-industrial company doing shrimp fishing for export; Gel-Mar: - a company which specialises in buying and processing fish and shrimp for export; Mawipi: - a company producing and selling ice. The company has also got one industrial boat for line fishing and is planning to go into shrimp fishing. Other small fishing companies are also emerging. The district has a fishing port which is important infrastructure for fishing.

Although the economy of Angoche district is slowly recovering after a period of recession, it is unlikely if it will reach its former levels of economic growth before the civil war.

2.6.4.1 - Transport and Communications

The district is served by a network of national, rural, unclassified and traditional roads totalling about 450 Km. As shown in figure 7, nearly 220 Km of the roads are considered as national (Angoche-Nametil and Angoche Moma). About 147 km of roads are classified rural; 50 km as unclassified roads and 33 km designed as traditional roads. In terms of construction and/or rehabilitation, a total of 370 km were under direct responsibility of the district and 80 km including traditional roads, were under IDPPE responsibility. About 33 km out of 80 km designed as traditional roads were fully constructed by direct involvement and/or participation of the local community under IDPPE mobilization and supervision. Angoche is also served by sea transport. In terms of telecommunications, there are fixed and mobile telephones, radio and television links. The impact of the roads has been in facilitating activities in trade, agriculture, health care as well as in bringing assistance to the rural population of Angoche district.

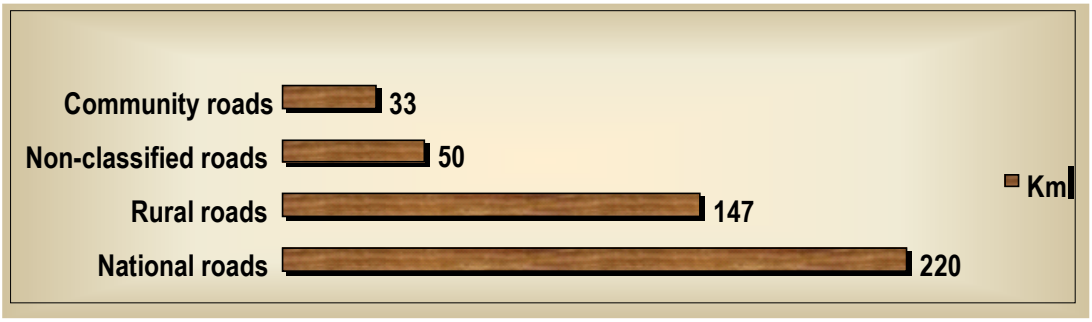

Figure 7: - Classification of the Road Network – (IDPPE and Angoche, 2007)

2.6.4.2 – Health

In terms of health infrastructure, Angoche possess 21 health units which have got 147 beds all together. In these 21 health units, 9 units possess conditions for attending to pregnant women; 12 are equipped with minimum conditions for meeting the health needs of the population at large; 18 are of the hospital are able to administer vaccinations at any required time. One of the 21 health units is a rural hospital (RH) encompassing with a capacity of 110 beds; 10 are classified as health centers (CSI-V) varying from I to V categories and they have all together 37 beds; the other 10 health units are designated as health posts (PSR/PSLR) and they do not have beds at all, as shown in figure 8.

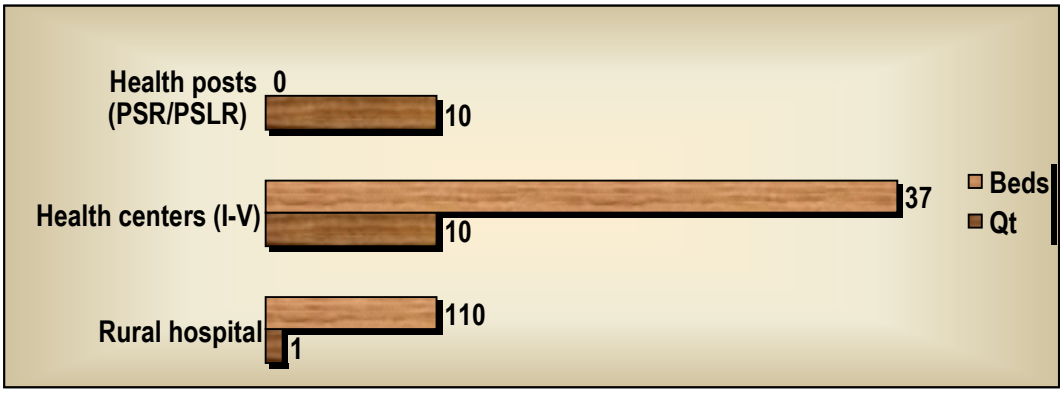

Figure 8: - Classification of Health units in Angoche District – (IDPPE and Angoche, 2007)

Most of these health units were under government responsibility in terms of its construction and/or rehabilitation. However, IDPPE (2 CS and 1 PS), Missionaries (1 CS) and some NGO's (2 CS) also have contributed a lot in the construction and/or rehabilitation of health units. The impact on a good health care network is part of the conditions of serving the local population, and has contributed significantly to the reduction deaths in rural areas. This therefore is an important aspect of government's development programme for rural areas.

2.6.4.3 - Water supply

In the last ten years there has been a noticeable increase in access to clean water in Angoche district. A total of 129 water improved water points (wells or boreholes) have been either constructed and/or rehabilitated. 21 of these water sources have presented seasonal problems and can thus be considered as non operational, but the remaining 108 were operational at the time of this study. Government responsibility in clean water supply to the community was in the construction of 82 of these water sources (51 in Namaponda and 31 in Namitória Administrative Posts). The IDPPE is the district partner in clean water supply, having contributed to the construction of 47 points water sources, (36 in Angoche area and 11 in Aube Administrative Posts). The majority of these are localized in coastal zones for the benefit of fishing communities, as shown in figure 9.

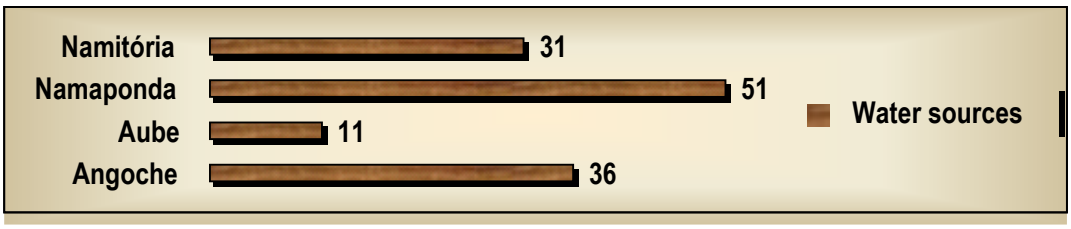

Figure 9: - Number and location of improved water supply points – (IDPPE and Angoche/07)

Although the effort is being made to provide communities with a clean water supply, there are villages and communities that still depend on river water and shallow wells with all health threats associated with these. However, the existing and operational clean water sources, statistically, are able to benefit about 54.000 people.

2.6.4.4 - Education

There is one institution for tertiary education and three secondary schools in Angoche district, which are located at the district capital. There are also upper primary schools (E2) offering sixth and seventh grades. These schools are at Angoche, Aube, Boila and Namaponda Administrative Posts. There are a total of seventy (70) schools distributed as follows; Angoche (18), Namaponda (17), Boila/Namitória (27) and Aube (8) as shown in figure 10. It is estimated that there are a total of 296 teachers. In terms of pupils, boys account for over 70% of the school enrolment.

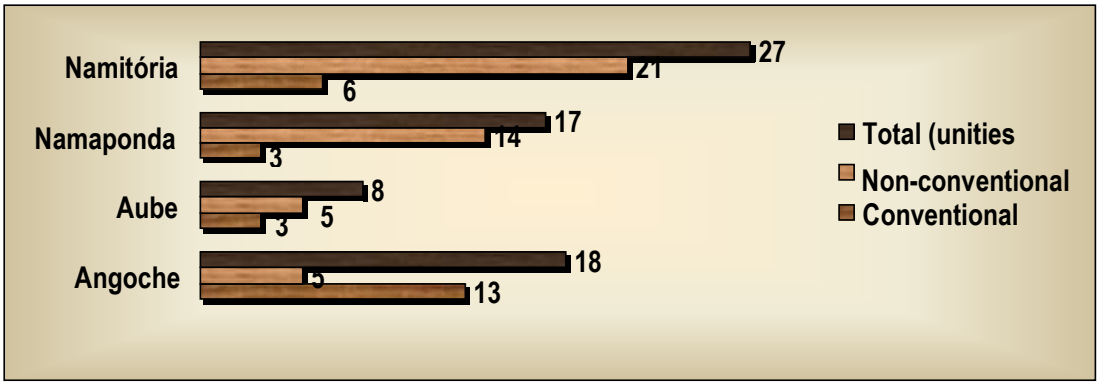

Figure 10: - School network in Angoche District – (IDPPE and Angoche - 2007)

It has been observed the community participation in the education sector, which takes the form of construction and maintenance of educational infrastructure. In the process of construction, of educational infrastructure, IDPPE is one of the leading the government partners for the district. Uplifting community education it is believed to be one of the ways of guaranteeing sustainability of local development.

2.7 – Conclusion

In this chapter emphasis has been given to the government responsibility to meet social and economic conditions for fishing communities. Community development in the study area has been taken in an integrated approach to minimize social constraints. Community health care and improved

water supply are some of the social related issues IDPPE is also promoting in artisanal fishing villages in Angoche, as shown in plate 2. The overall trend is to meet the fishery sectorial goal: “the improvement of the social and economic conditions of the fishing communities”.

Bicycle ambulance for community health care (IDPPE)

Improved water supply point (IDPPE)

Plate 2 – Community development in artisanal fishing villages in Angoche coastal zone

CHAPTER 3

Fisheries in Mozambique: An overview

3.1 – Introduction

The fisheries sector is currently under the Ministry of Fisheries (MF) created by decree in 6/2000. The Ministry of Fisheries is composed of three National Directorates (Fisheries Administration, Fisheries Economy and Human Resources) and three other autonomous units (Administration and Finance; International Co-operation and Aquaculture). Five other administratively autonomous institutions are also part of the Ministry of Fisheries. These are: the Fisheries Development Fund which is responsible for financial support and small credit to Small-Scale Fisheries, the National Institute for the Development of Small-Scale Fisheries designated for administration and management of artisanal fisheries and the socio-economic development of fishing communities, the National Institute for Fisheries Research responsible for fisheries research, the School of Fisheries focusing on fisheries training and the National Institute for Fisheries Inspection mandated to deal with fish quality control.

At the provincial level the Ministry of Fisheries is represented by the Provincial Directorate of Fisheries and/or Provincial Fisheries Administrative Services which are mandated to monitor and control fisheries activities. The National Institute for the Development of Small-Scale Fisheries (IDPPE), the National Institute for Fisheries Research (IIP) and the Fisheries Development Fund (FFP) have their own representatives at provincial level. The Maritime Administration (ADMAR) is an old institution under the Ministry of Transport and Communication which was historically delegated to exercise maritime and in some inland water bodies, control and surveillance activities. This institution is also represented at provincial level and at district level (*Gervásio and Hele, 2002)*.

3.2 – Background

Gonçalves, (2004) points out that Mozambique's historical fisheries development can be characterised into two broad periods; before and after independence.

Before independence, the colonial government mainly preferred the import of fish from overseas for internal consumption. In this regard, fish consumed in Mozambique was mainly sardine and cod from Portugal (the colonial power), horse fish, tuna and sardine (from Angola) and "*pescada*" from South Africa. There was no fisheries policy-making organ in the country. Mozambique Fisheries Mission for Bioceaonologic Studies (MEBPM) and Maritime Administration (ADMAR) were the only institutions

for fisheries arrangements. Beach seine nets and industrial fishing were prohibited. It was only in the mid 1960's that Portugal started to promote semi and industrial shrimp fishing in the country, mainly, for commercial purposes.

The second period, after independence, is characterized by five phases stretching from 1975 (the year independence was granted) to 2007. The phases are as follows:

The period 1975 to 1980 can be considered as the phase for the "adoption of the tools" for fishery policies establishment. At independence in 1975, Mozambique had 80 fishing fleets and 3000 peoples working in fisheries. Following the proclamation of independence there was a massive exodus of Portuguese fishermen from Mozambique leaving behind chaotic a situation. In order to overcome this situation the independent government created the Ministry of Industry and Commerce. It was within this ministry that the National Fisheries Directorate (NFD) was then created as the first fisheries institution in the country's history to deal with all fisheries related issues. Since then, the fisheries sector has grown and has facilitated the writing of legislation, international cooperation, and promotion of entrepreneurs.

The landmark for 1976 was established the Exclusive Economic Zone (EEZ) extending 200 nautical miles out to sea. Fishing accords between Mozambique and former Union Soviet of Socialistic Republics (USSR) as well as with Germany Democratic Republic were established;

- In 1977, PESCOM – the National entrepreneur for fisheries product commercialization was created and EMOPESCA – National entrepreneur for capture fisheries and have delegations in Angoche (NPL), Quelimane (ZAB), Beira (SOF) and Maputo (MPT). These were created to organize all semi and industrial fleets abandoned by colonizers. The National Fisheries Directorate delegations were established in the provinces of Sofala, Zambézia and Maputo. First marine resource evaluation in Mozambique in the scope of Norwegian Marine Investigation Institute cooperation took place;

- In 1978, a legal Decree establishing the functions of the Secretariate State of Fisheries under the Ministry of Industry and Energy was published. The regulation for foreign fleets in the Mozambican jurisdictional waters was established in this phase. PESCOM INTERNATIONAL, the national entrepreneur, especially, for marine resources export and import was created. The

Fisheries School Center was created in the scope of UNDP/FAO cooperation. Constitution of the shrimp joint venture between Mozambique and TAIYO Japanese entrepreneur was established;

- In 1979, the first artisanal fisheries census was undertaken. About 44.000 fishermen with 12.000 boats were identified. Of these, only 1% of boats were motorized. SULPESCA, the National semi-industrial shrimp entrepreneur was constituted.

1980 to 1986 can be considered "the implementation phase of the "adopted tools"". The Secretariate of Fisheries under the Ministry of Industry and Energy started to materialize the established policies. The strategy adopted for the implementation of the "adopted tools" was to give particular attention to investigation and training for the development of artisanal and Industrial fisheries, service provision and production of fisheries equipment. The Small-Scale Fisheries Directorate (UDPPE) was created in this phase in order to develop policy for artisanal and Semi-industrial fisheries development. This was done through the establishment of the "Para state" Artisanal Fisheries Entrepreneurs mostly known as "Combinados Pesqueirso (CP's)". MOSOPESCA – a joint venture entrepreneurship for shrimp fishing between Mozambique and former USSR (Sovrybflot) and PESCAMAR (Spanish).

The phase 1987 to 1994, it was the "free market phase". It is during this period that the country, under international pressure, was compelled to adopt a structural adjustment programme (the "free market package") announced in 1986 by government, locally, know as Economic Rehabilitation Programme (PRE). In response to (PRE) the fisheries sector was subjected to internal adjustments resulting on the scrapping of all Directorate Units and the establishment of IDPPE (in the process inheriting UDPPE's social development functions) and the creation of SFP (Fisheries Development Association) which assumed management of productive activities of CP's. In 1992, The Roma Peace Accord was signed ending the 16 years of civil war the country. In 1994, first democratic elections were held for consolidation of peace in the country.

1995 to 1999 is considered as the "fishery sector tragedy phase" as this period was characterized by the abolition of the Secretariat State of Fisheries and incorporation of the fisheries sector into the new Ministry of Agriculture and Fisheries created by the new democratic government following the first democratic election in 1994. The experience of merging the fisheries sector into agriculture was disastrous and led to the degradation of the fisheries sector (Gonçalves, 2004). From the middle 1990's, IDPPE embarked on an "Integrated Approach" form of intervention to better assist the fishing communities.

The period from the year 2000 onwards is considered "the restoration phase of fishery sector". Fishery sector ascended to a high position and is currently housed under the Ministry of Fisheries created by decree in 6/2000 (Gonçalves, 2004). For this phase has resulted in the creation on the new National Institution for Fisheries Inspection (INIP). The IDPPE, through a consultancy undertaken in 2006 adjusted its strategy and, as a result, the Strategic Plan for the Artisanal Fisheries (PESPA) was produced. Institutionally, the "Integrated Approach" form of intervention in the fishing communities was then formalized in PESPA.

Thirty two years after independence (1975 - 2007), indications are that economic and political changes in the fishery sector have taken place towards societal well being as detailed in the proceeding section. However, there still exist many constraints to overcome.

3.3 – Fisheries overview

The fisheries sector in Mozambique is divided into two main sub-sectors: 'Industrial Fisheries and 'Small-Scale Fisheries'. The Small-Scale Fisheries sub-sector is further divided into segments, namely, Semi-industrial and Artisanal Fisheries. Thus the sector as a whole has three main productive sectors: - industrial; - semi-industrial and artisanal fisheries.

In the entire fisheries there were 8,127 licensed boats in 2006 categorised as follows: 233 industrial boats (3%), 320 semi-industrial boats (4%) and 7,574 artisanal boats (93%). Of the 8,127 licensed boats, 1,584 boats (19,5%) were licensed to target shrimp; 35 boats (0,4%) were for gamba (prawn) and 6,508 boats (80%) were for fin fish in general.(see table 1)

Table 1 - The fishery sector - licensed boats (NDFA, 2006)

Fisheries	Shrimp	Prawn	Fish	Total	Percentage (%)
Industrial	65	24	144	233	3%
Semi-industrial	88	0	232	320	4%
Artisanal	1,431	11	6,132	7,574	93%
TOTAL	1,584	35	6,508	8,127	100%

Boats in the Industrial fisheries sub-sector are mainly, privately owned through joint-ventures between Mozambicans and foreign shrimp companies based in Beira and Quelimane ports, with the Sofala Bank as the main fishing area for industrial shrimp fleets. As shown in table 2, there were 233 industrial boats in 2006 showing an increase of 3 fleets compared to 2005. Of the 233 industrial fleet

boats, 82 (35%) were trawlers targeting shrimp, 142 (61%) were targeting tuna, 9 (4%) were other fishing (2 for line fishing, 4 for experimental fishing and 3 for other fishing operations). Thus the Industrial fleet mainly targets high value commercial shrimp and tuna Species.

Table 2: - Industrial fisheries fleets - (NDFA, 2006)

Fishing type	Shrimp		Prawn		Fish		Total	
	2005	2006	2005	2006	2005	2006	2005	2006
Industrial	**71**	**65**	**25**	**24**	**134**	**144**	**230**	**233**
Trawler	62	58	25	24	0	0	87	82
"*Cerco*" (Tuna)	0	0	0	0	44	47	44	47
Long line (Tuna)	0	0	0	0	86	95	86	95
Line	0	0	0	0	4	2	4	2
Experimental fishing	5	4	0	0	0	0	5	4
Connected operations	4	3	0	0	0	0	4	3

In 2006, there was a slight reduction of the industrial trawlers because of the management measures put in place intended to stabilise shrimp catches. In this regard, no more new licences will be issued for shrimp trawlers. For the existing licensed industrial trawlers, the annual quota distribution system is one of the administrative measures for controlling industrial fisheries. Quotas are based on the Total Allowed Catches (TAC) proposed by National Institute for Fisheries Research (IIP) and approved by the Minister of Fisheries (NDFA, 2006).

The entire industrial fisheries production is for export and strategically, for foreign exchange contribution to the country. The figures show that there has been no significant increase in shrimp production as shown in figure 11. There is concern that these figures are not reliable and more investigation on the shrimp resource fishing needs to be done in order to validate these figures.

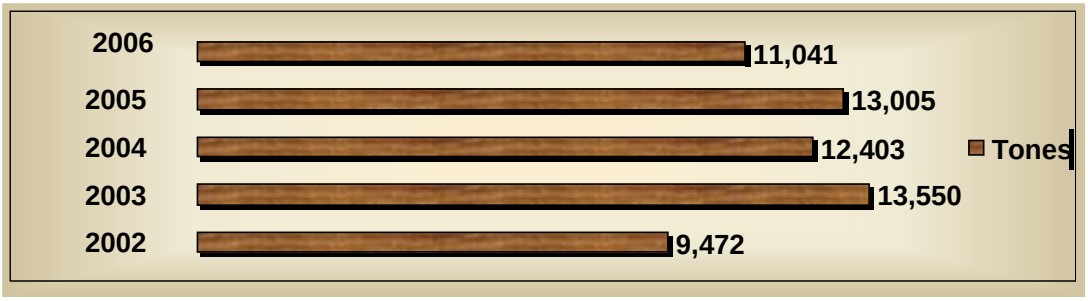

Figure 11 - Total shrimp production from 2002 to 2006 - (NDFA, 2006)

The semi-industrial fisheries sub-sector is, mainly, for national fish supply to the urban areas. According to *Gervásio & Hele, 2002:6,* the semi-industrial fishing boats are mainly based in the ports of Beira (26%) and Maputo (40%). There are also fishing ports at Cahora Bassa (16%), Quelimane (11%), Inhambane (5%), Angoche and Vilanculo (1%). 66% of the semi-industrial fishing boats practise shrimp trawling, 17% hand line fishing and other 17% are kapenta catching rigs in Cahora Bassa Dam.

For artisanal fisheries, data from the national census undertaken in June, 2007 indicates that there are 135,529 fishermen with boats, 144,511 fishermen without boats and 53,980 people in other fishing activities working in approximately 1,217 fishing centers. As shown in figure 12, there are 39,398 artisanal boats and 42,268 artisanal fishing gears in the 1,217 fishing centers (IDPPE, 2007). Based on the information in table 1, the 7,574 licensed artisanal boats corresponds to 19% of the total artisanal boats (39,398) registered in the census. The small percentage on licensed artisanal boats is *per se,* a clear indicator of the very low level of government intervention in this sub-sector.

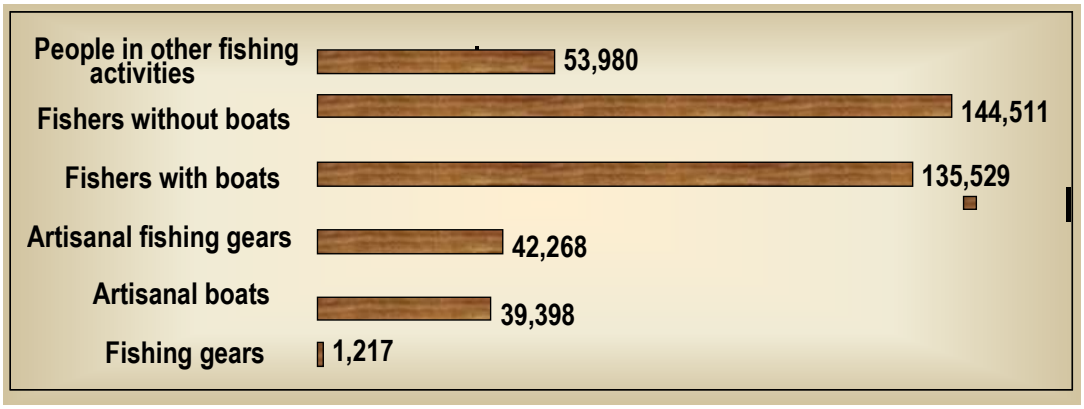

Figure 12 – National artisanal fisheries census for 2007 - (IDPPE, 2007)

The main types of artisanal boats used are dug canoes. Beach seines, gill nets and hand line are the main types of fishing gears used in the sector. Apart from these fishing gears, there is a large group of collectors who use sticks and harpoons as fishing implements. Artisanal diving is also largely practised almost in all coastal zones.

As shown in figure 13, the fishery sector, produced 91,899 tones of marine and inland water products valued at 247,1 million American dollars. Of this, the Industrial and semi-industrial fisheries, landed 27,926 tones (30% of global production) valued at 91,5 million American dollars. The artisanal fisheries sector in the most important as it landed 63,973 tones (corresponding to 70% of

the total catch) valued at 155,6 million of American dollars. Thus the artisanal sector contributes twice as much as the other two sectors both in terms of landings and more than one and half times in terms of the value to the national economy.

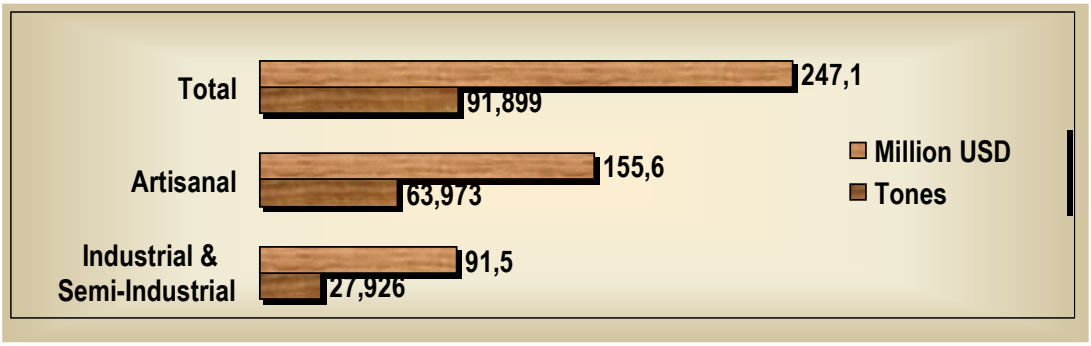

Figure 13 - Total catches and economic contribution for 2006 - (NDFE, 2006)

Fishery sector also plays important role in national development. Industrial fisheries sub-sector, by exporting shrimp and fish, contributes about 4% to the GDP; semi-industrial fisheries is responsible for supplying fish to the urban areas and artisanal fisheries are a very important source of employment to many unskilled people and also help provide food security by supplying fish to the most vulnerable social layers of the population in the rural areas. As shown in figure 12, about 334,019 people are directly employed either in Artisanal fishing or in its other fishing connected activities. Assuming an average of five (5) people per rural household, about 1,670,000 rural people corresponding 8% of the national population are depend on Artisanal fishing for employment and fish food security. Based on the above described figures, it is pertinent and urgent that government pays particular attention to this sub-sector as it is very important for rural development and/or poverty eradication.

3.4 – Conclusion

This chapter described the fishery sector in Mozambique. The emphasis on fisheries historical background was to give the picture from colonial era up to now. The three main fisheries sub-sectors (industrial, semi-industrial and artisanal) are also analysed and their contributions to the national economy are evaluated. From the description it is evident that the fishery sector in Mozambique is relatively new. However, government development policies for the sector should be more holistic and implemented in an inclusive manner, and in such way that they are able to create opportunities and good a working environment (safety means of production), as shown in plate 3, for fisheries sub-sectors as well as for other potential stakeholders.

Industrial fleet

Artisanal fishing boat

Plate 3 – Industrial fleet and artisanal fishing boat – (IDPPE, 2006)

CHAPTER 4

Research methodology

4.1 – Introduction

This chapter deals with the research topic as well as the research methodology used in the study. Emphasis is given to the conceptual framework and the methodology used. A summary of literature review as well as a justification, the objectives, the research hypotheses and the research questions are also dealt. The research phases and the organization of the field work of the study are described.

4.2 – Research topic

"*Indigenous knowledge in participatory mapping of artisanal fishing zones"* is the topic for the study. The Angoche District in Nampula Province in the northern part of Mozambique is the place where the study was undertaken.

4.3 - Literature review

The literature on the use of indigenous knowledge widely recognizes that it is potentially useful to fisheries researchers and managers, especially when used in conjunction with conventional scientific data. Some authors argue that indigenous knowledge is useful in coastal management far more than its role in providing the baseline ecological data required for planning purposes. Others go further, arguing that the failure of development projects, not only in the Pacific but also in other parts of the world, is probably more commonly the result of the failure to understand local cultural systems than of inadequacies in ecological, technological or market research (Hamilton and Water, 1999).

With regard to Geographical Information Systems (GIS), database can be used to incorporate socio-spatial information, such as indigenous knowledge and artisanal fisheries data, along with biophysical and other relevant information to assist "fisheries management". The use of GIS techniques together with social and natural science research promises to deepen our understanding of important anthropological questions like how diverse ethnic groups culturally construct the spatio-temporal characteristics of their landscape and how indigenous land and sea tenure systems are spatially distributed in particular regions and how they change across time (Aswai and Lauer, 2006).

Converting peoples' knowledge and socioecological behaviour into geo-spatial representations allows researchers to distinctively conceptualize human foraging strategies spatio-temporally. It illustrates how human cognitive maps of the seascape and marine organisms translate into actual resource classification, use, and allocation geographically. It also recognizes local ecological processes, including habitat structure (habitat delineation), species composition and distribution, and spatio-temporal biological events (spawning aggregation) spatially. Plausibly, it identifies sites that incorporate the ecological processes that support biodiversity, including the presence of exploitable species; vulnerable life stages and inter-connectivity among habitats (*ibis, 2006*).

For participatory mapping, a combination of socio-spatial knowledge is significant because it can assist in formulating hypotheses regarding human responses to inter- and intra-behaviour variability, along with other marine ecological processes; and it can also help in the design and implementation of resource management strategies in a cost-effective and participatory way, bridging the gap between indigenous and Western cognitions of seascape (Jennings and Lockie, 2002).

In practice though, indigenous knowledge, is usually either ignored or used inadequately by fisheries researchers and managers. Reasons put forward are that indigenous knowledge exists as an inseparable part of complex cultural systems, and requires anthropological methods to describe and interpret this information in a meaningful manner. These skills are usually difficult, time consuming and well beyond the professional training of most fisheries scientists, resource planners and project managers. Further, frequently, when scientists have attempted to incorporate indigenous knowledge into their baseline research, the result has been a naive reporting of interview data or observations taken out of their cultural and historical context (Hamilton and Water, 1999).

It is difficult to assess the completeness and accuracy of anecdotal data, but this does not detract from its importance for consideration when assessing a traditional fishery. Integrating traditional knowledge and anecdotal information with the scientific information derived from literature surveys and biological surveys has been a positive experience that has lead to better understanding of the dynamics of the (fisheries resources) and the impacts of (artisanal fishermen) activities (Lessard, et al.,1999).

Western techno-scientific approaches are (in themselves) an insufficient response to today's complex web of social, political, and environmental challenges. IK systems suggest a different approach to problem solving. Whereas Western science attempts to isolate a problem – to eliminate

its interlinkage with various other factors and to reduce a problem to a small number of controllable parameters - traditional approaches usually examine problems in their entirely, together with their interlinkage and complexities (ex.: physical, spiritual, sociocultural, psychological, etc.) (Grenier, 1998).

Fishermen, in particular those involved in the fishing, present their gifts to Goddess before their nets are launched from the shore. According to those fishermen, those who do not praise the goddess of the sea will have small catches. Traditional practices that limit overexploitation of resources can be considered to enhance or support biological conservation, in modern, scientific sense. Under these conditions, those practices mediated by beliefs in mythological beings purposely chosen to avoid overfishing may play an important role in modern fisheries management (Samudra, 2006).

Traditional ecological knowledge (TEK) contains baseline information on local ecologies including information on what is present in the local ecosystems, and its temporal and spatial patterning. By drawing on TEK at the early stage of research, scientists are able to develop testable models, and so target their research and efficiently budget their time and other resources. TEK and customary marine tenure (CMT) evolved over generations of direct interaction between human communities and their environment and are likely to contain information and ideas not currently contained within scientific models. If properly understood, there is a potential for resource managers to use CMT systems directly to manage stocks in development projects (Hamilton and Water, 1999).

Indigenous knowledge is unique to given cultures, localities, and societies. Indigenous knowledge is acquired by local peoples through daily experience. They deal with the experiential reality of the world. They are forms of knowledge that reflect the capabilities, priorities, and value systems of local peoples and communities. An important dimension of indigenous knowledge relates to how traditional forms continue to merge and coexist in diverse situations and settings as part of local people's response to colonial and imperial intrusions (Dei, et al., 2002).

Indigenous peoples develop and employ GIS tools; they are able to add their own cultural imprint to existing applications. Making use of participatory methods involving a number of traditional organizations and individuals, can establish a number of culturally acceptable methods for recording and making available information on traditional organizations values in a textual and computerized form (Harmsworth, 1998).

Participation by the local community in development initiatives is critical for achieving sound natural resource management to utilize the full potential of IK systems. The main premise of (involving local community) on the approach of integrating indigenous knowledge with Geographic Information System as a way of promoting participatory natural resource management and giving opportunity to the local community to participate in development programs and decision-making both as contributors and as users of knowledge (Tripathi and Bhattarya, 2004).

Local ecological knowledge (LEK) directly linked to the problems users are facing, and ecological sustainability has better chances of being achieved if allocation issues are being addressed as an integral part of the process. *The backbone of a good adaptive fisheries management system is a good data collecting system that enables multi-disciplinary analysis and provides the assessment to support to management institutions*. To make an effective contribution, however, such information can only be revealed as part of comprehensive studies involving ongoing interactions between fishers, scientists and other stakeholders (Wilson, et al., 2006).

Maps are tools that shape our perception of place. All humanity is challenged to protect, enhance and create healthy social and natural environments. Community mapping provides an inclusive and graphic framework for people to affirm and pool their experiences and knowledge about their home place. Through participatory mapping, local experience and knowledge about issues becomes a valuable resource base for researchers and managers inside and outside the community (Aswai and Lauer, 2006).

As conclusion, indigenous knowledge is an enormously valuable resource base but one which is often treated in a far too casual manner by research scientists and managers.

4.4 - Conceptual framework

The study was carried out to describe the logical sequence underlying the process of identifying artisanal fishing zones using indigenous knowledge. The focus then is the use of indigenous knowledge for fisheries management. The relationship between indigenous and scientific knowledge is, in this study, of particular interest. Factors and/or conditions influencing fishing activity are considered as paramount in understanding the extent to which indigenous and scientific knowledge

can be related to the identification of artisanal fishing zones. The theoretical approach developed in conceptualizing the study framework was based on the following authors:

Grenier (1998) developed a theory of indigenous knowledge as a guide for researchers. According to him, the development of IK systems, covering all aspects of life, including management of the natural environment, has been a matter for survival to the peoples who generated these systems. Comparing scientific and indigenous knowledge approaches, he argues that Western technoscientific approaches are (in themselves) an insufficient response to today's complex web of social, political, and environmental challenges. He goes further arguing that a society is sustainable, "only", when the human condition and the condition of the ecosystem are satisfactory or improving.

Hamilton and Water, (1999) did research the relationship between indigenous and scientific knowledge in the fisheries field. According to their findings, local knowledge combined with specialized knowledge of the outside researcher is considered by advocates of the PAR [participatory action-research] to be more potent than either of the two knowledge types alone in understanding reality. In this regard, traditional ecological knowledge is widely recognized as potentially useful to fisheries researchers and managers, especially when used in conjunction with conventional scientific data. The authors argue that unfortunately, indigenous knowledge is usually either ignored or used inadequately by fisheries researchers.

Dei et al., (2002) dealt with indigenous knowledge in global contexts. Their views show that globalization has accelerated the flow of cultures across geographical, political, and cultural borders; it has also transformed knowledge into a commodity to which the most powerful in society usually lay unjustifiable claim. For indigenous people, the 'crisis of knowledge' can be seen in, or has resulted in, the following: fragmentation of traditional values and beliefs; erosion of spirituality; distortions in local, regional, and national ecosystem and economies; and tensions related to cultural revitalization and reclamation.

The nature of this study is, simultaneously, descriptive and analytic and is based on both qualitative and quantitative data. Using indigenous knowledge, artisanal fishermen identify fishing zones (inshore and/or offshore) where, traditionally, they fish. Information on factors, conditions and characteristics taken as the basis for the identification of fishing zones were collected through direct interviews with fishermen. Coordinates (longitude and latitude) for the identification of artisanal fishing zones, were recorded applying a GPS. Information related to artisanal fishing zones

identification was, later, processed and analyzed employing GIS. Finally, a map showing the localization and distribution of the identified fishing zones in the study area was produced.

Based on the data analysis, discussion was developed around the findings in order to draw up conclusions. Recommendations and suggestions are proposed for the validation and integration of the indigenous knowledge into the process of fisheries management, mainly, for sustainable artisanal fisheries management.

4.5 - Justification

Knowledge based on indigenous communities in coastal zones for artisanal fisheries management in Mozambique has been unfairly neglected by managers and researchers. Diegues (2002) argues that government fisheries development agencies, as well as government environmental agencies, have been heavily influenced by certain natural scientists that take Western science and research on biodiversity priorities (in a strict sense) as the world's only basis for "sound marine management". Based on the above argument, government has been more in favour of scientific knowledge models for its interventions, rather than creating synergies between scientific and indigenous knowledge in artisanal fisheries management.

The problem with applying only scientific knowledge is because this knowledge leaves out traditional ecological knowledge (TEK) paying less attention to the dynamics or behaviour of fishers as an integral part of the system. At the same time, government interventions based only on scientific knowledge models have failed to address effective sustainable fisheries management, mainly, because:

- There has been limited capacity to assess and survey the state of the coastal environment;
- Little is known about tropical fish resources in order to assess the impact of artisanal fisheries on marine and inland water biodiversity;
- There has been a failure to enforce the compliance of fishermen with regulations;
- There has been a failure of the management system, often directed at obtaining the maximum sustainable yield and not towards the ecological stability of the system;
- Artisanal fishing knowledge has been judged and/or seen as pre-logical or pre-scientific;

- Formal fisheries regulations imposed by management agencies have tended to favour mechanized fishing industries and consolidating their power leading to the formation of a new class of "sea lords" (Freire and Garcia-Allut, 1999).

Grenier (1998) argues that paying attention to local indigenous knowledge (IK) can:

- Create mutual respect, encourage local participation, and build partnerships for joint problem resolution;
- Facilitate the design and implementation of culturally appropriate development programs, avoiding costly mistakes;
- Identify techniques that can be transferred to other regions;
- Help identify practices suitable for investigations, adaptation, and improvement, and
- Help build more sustainable fisheries in the future.

Historically, local fishermen have been, not only successfully but also sustainable, for centuries, fishing using their indigenous knowledge without any "scientific" support. According to Diegues (2002), local knowledge can be understood as a system of power, and thus can provide a basis for the empowerment of communities to undertake community-based resource management. This is particularly important in tropical, multi-species fisheries and their environments, for which scientific knowledge is still relatively poor. So, using indigenous knowledge and values within a system that, at least, integrates indigenous knowledge and scientific forms of knowledge can result in sustainable fisheries management, particularly, for artisanal fish resources.

This study seeks to contribute to knowledge about the use of indigenous knowledge in fisheries management by investigating and understanding the artisanal fishermen's logic underlying identification of artisanal fishing zones where they usually fish using their indigenous knowledge taking into account the case of Angoche.

4.6 – The purpose of the study

The aims of the study are:

- To investigate how artisanal fishermen identify fishing zones in artisanal fishing areas using their indigenous knowledge without any scientific support; and,

- Using GPS and GIS techniques, map the identified artisanal fishing zones and see whether these scientific approaches would come up with the same results (and thus confirm) fishermen's positioning of the fishing zones or discredit the positioning of the zones as identified by fishers using the indigenous knowledge.

4.7 – The objectives of the study

The main objective for the research is:

- To find out the extent to which indigenous knowledge can be scientifically correlated and to what extent it can be feasibly used for artisanal fisheries management purposes in marine and inland water bodies in Mozambique.

The specific objectives are:

- To explore how artisanal fishermen identify fishing zones using their indigenous knowledge;
- To ascertain the extent to which indigenous knowledge is scientifically correlated;
- To establish the potential of indigenous knowledge in decision-making for artisanal fisheries management by government and other development agencies; and,
- To establish the potential of GPS in recording artisanal fishing zones' coordinates and in employing GIS as software for collecting, treating, visualizing and outputting the information results from artisanal fishing zones for management purposes.

4.8 – The research hypotheses

To validate the findings underlying on the research study, the following hypotheses were tested:

H1*:* Using indigenous knowledge in identifying fishing zones in artisanal fishing villages is not effective;
H2*:* There is no relationship between indigenous and scientific knowledge in identifying artisanal fishing zones;
H3*:* Integrating indigenous knowledge in artisanal fisheries management does not play any role in fisheries management.

For the purpose of the study, the key research questions were:

- How do artisanal fishermen identify fishing zones using their indigenous knowledge without any scientific support?
- What are the factors, conditions and characteristics underlying artisanal fishing zones identification?
- How do artisanal fishermen relate different phenomena such as physical, ecological, environmental and climatic with the species they catch in the identified fishing zones?

4.9 – Research methodology

This section outlines the sampling procedures, the process of conceiving and testing questionnaires and the methods used in data collection.

4.9.1 – Sampling procedures

As stated by De Vos, (1998:189) "as the concept of sampling is one of the most important in the total research endeavour, it is imperative that we understand it clearly before studying certain aspects thereof". Based on the above premise, the sample must be representative of the object of research and the minimum sample size must be proportional to the total number of fishermen in the selected area of study.

The district of Angoche in Nampula province is the area chosen for the present case study. The unit of analysis is the Planning Area (PA). There are seven (7) Planning Areas identified in Angoche district. A Planning Area is an area within the district encompassing a number of fishing villages bound together by pre-identified common characteristics such as proximity and fishing in the common fishing centers, sharing the common and/or same local norms and belonging to the same local headmen. Each fishing village contains a number of fishing centers and from each fishing center fishermen fish in different fishing zones in the sea, mainly, inshore.

As shown in figure 14, the sampling process was based on the list of the seven identified and existing Planning Areas in Angoche district. In those seven existing PA's, a total of fifty (50) fishing villages were identified.

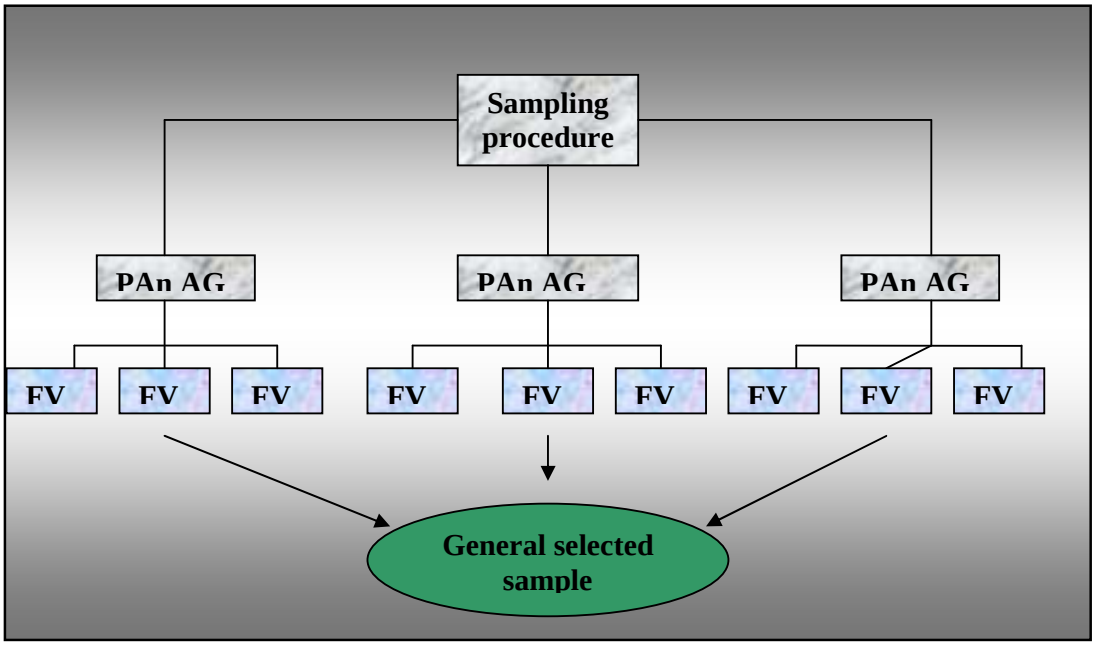

Figure 14: - Flowchart on sampling procedures[1]

Applying the guidelines for sampling as suggested by De Vos, (1998:192-3) for population equal or above fifty (50) but less than 100, the percentage suggested for sampling is 64%. In the present case, 64% of 50 (the total number of the fishing villages found in the seven PA's in Angoche district) is equal to 32 fishing villages. The selection of the 32 fishing village from 50 was made by applying the random sampling technique.

4.9.2 - The exploratory survey

To get the total sample eligible from the population of 1,286 units, an "*exploratory survey*" was conducted in the study area from 20th to 28th March, 2007. Field work was then undertaken in the 32 selected fishing villages to list the total eligible number of fishers (men and women) for the survey. The listing exercise identified 1,286 fishers using different types of fishing gears. The final results were as shown in table 3.

[1] PA – Planning Area; n – number of each PA (ex: 1, 2 .... to 7); and AG – it is a code meaning ANGOCHE. FV – Fishing Village.

Table 3: – Total eligible population in the 32 selected fishing villages in Angoche district

PA's	*B/seine*	*Gillnet*	*H/line*	*Quinia*	*Diving*	*Collecting*	*Cages*	*TOTAL*
GELO	132	10	31	32	0	0	0	**205**
SANGAGE	98	70	61	25	8	0	0	**262**
KWIRIKWIDGE	72	6	0	0	0	0	0	**78**
THAMOLE	76	1	60	0	6	9	0	**152**
INGURI	40	24	5	0	0	0	18	**87**
QUELELENE	82	63	8	0	0	0	0	**153**
CATAMOIO	64	98	121	17	0	0	49	**349**
TOTAL	**564**	**272**	**286**	**74**	**14**	**9**	**67**	**1.286**

De Vos', (1998:193) guidelines for sampling and sampling methods, state that for the population equal or above 1000 but less than 10,000, a 14% sample size is recommended. Based on the above principle, from the 1,286 units (fishers), the sample population of 14% is equivalent to 180 units (fishers) that were to be surveyed. According to De Vos, (1998:195) two possible sampling procedures can be used: -1) probability and -2) non-probability sampling. The former is based on random selection while the later one is not based on random selection. The research study used probability sampling procedure. In the probability sampling procedure, each unit in the eligible population has the same known probability of being selected.

Once the fishermen, the total eligible population for sampling, have been listed and the sample size of 14% had been decided upon, there was a need to adopt an interval to be used in selecting the fishermen to be interviewed using the probability sampling procedures. This interval was determined by dividing the total eligible population for sampling by the defined sample size (*1,286/180 = 7*). Thus, every 7th sample unit (fisherman) was selected until 180 units had been selected to be interviewed. Applying the probability sampling method, the first sample unit (fisherman) randomly selected from the list was number three (3) and the rest were selected by applying the interval of seven (7). At the end of the sampling process, the results achieved were as shown in table 4.

Table 4: – Total eligible sample size in the 32 selected fishing villages in Angoche district

PA's	*B/seine*	*Gillnet*	*H/line*	*Quinia*	*Diving*	*Collecting*	*Cages*	*TOTAL*
GELO	16	2	5	5	0	0	0	**28**
SANGAGE	12	9	11	4	1	0	0	**37**
KWIRIKWIDGE	10	1	0	0	0	0	0	**11**

THAMOLE	11	0	9	0	1	1	0	**22**
INGURI	7	2	1	0	0	0	2	**12**
QUELELENE	13	8	1	0	0	0	0	**22**
CATAMOIO	9	14	16	2	0	0	7	**48**
TOTAL	**78**	**36**	**43**	**11**	**2**	**1**	**9**	**180**

To determine how many fishermen were to be randomly selected from each of the selected 32 fishing villages in order to ensure representativeness of the sample size, the mathematical proportional principle described below was applied and the results achieved were the same as those shown in table 4.

The adopted formula to ensure representativeness of the sample size was: *(D = (C x B)/A)* where: *(A)* is equal to the total eligible population for sampling (1,286) in all the 32 randomly selected fishing villages in the study area and *(B)*, is the overall sample size (180) randomly selected from the total eligible population for sampling and *(C),* is the total eligible population for sampling for each randomly selected fishing village and *(D),* is the *(unknown)* number of sample size units (fishermen) to be drawn from each of the 32 fishing villages to make up the total sample size of 180 units.

Only 27 fishing villages in all were surveyed. The remaining 5 out of the original 32 fishing villages no longer existed. The fishermen from these 5 (five) defunct fishing villages had been forced to move to other suitable fishing villages due serious threat resulting from accelerated soil erosion. This was particularly the case for the island fishing villages.

The "exploratory survey" was conducted in each of the randomly selected fishing villages (32) in the study area. To facilitate the "survey", a pre-prepared form was used containing information such as "the name of the fisherman, gender, category, type of the fishing gear used and place where fishermen normally fish (e.g.: in beaches, open sea, islands, etc.). The "exploratory survey" was multi-beneficial. It gave the researcher the realities to be taken into account during the real survey in terms of the required time, budget and the required logistics.

4.9.3 – The pilot study

Having determined the number of fishing villages (27) from which the sample size of 180 units was to be drawn, questionnaires to be used for gathering data and/or information were developed. The

questionnaires were pre-tested before the actual research. In this regard, four (4) distinct questionnaires, namely, one for group, the second for individual, the third for scientists' interviews and the fourth one for geographical and non-geographical data, were all tested in this phase.

Basic and related fishing information later used in the questionnaires, such as the type of traditional and cultural beliefs and winds' local names, it had to be familiarized with during the pilot study. After adjustments of the questionnaires and working out the estimated budget, the field work was then undertaken in all 27 selected fishing villages covering the pre-defined sample size of 180 units.

4.10 – Data collection

Based on Roger and Victor, (2006) to collect data and/or information for the research study, three distinct phases were required:

- The "exploratory survey", designed to get the list of the entire eligible population for sampling in the 27 selected fishing villages out of 50. This phase was conducted from 20th to 28th March, 2007. The results were the identification of 1,286 eligible units (fishermen) and from these units, a sample size of 180 units, was later drawn;

- The data collection was carried out under second phase undertaken between 07 and 28 August 2007. It was under this phase that fishermen and scientist key informants were interviewed. 161 out of the required 180 units were interviewed. The difference, accounting for 19 units (180 – 161 = 19 units) could not be interviewed because this number of respondents were not found in the respective villages at the time the interviews were conducted;

- The third phase, designated to the identification and recording of coordinates (latitude and longitude) and other information on the artisanal fishing zones, was undertaken between 15 October and 04 November 2007.

Four types of research instruments (*see appendices 1 to 4*) were designed, namely:

- Questionnaire designed to gather data and/or information targeting artisanal fishermen's views on fishing zones identification and characterization involved in different types of fishing gears;

- Questionnaire designed to gather data and/or information targeting elders as key informants with long experience on fishing at fishing villages;

- Questionnaire designed to gather data and/or information targeting scientists as key informants on fishing zones identification and characterization;

- A form, specifically, designed for coordinates (latitude and longitude) recording and other information at sea during the fishing process.

The data and information collection process was through interviewing the identified and selected individuals and fishing villagers' key informants. The main method used was direct ("*face-to-face*") interviews based on structured and semi-structured open-ended questions. The coordinates (latitude and longitude) on fishing zones identification and characterization were recorded by direct involvement of the artisanal fishermen using their indigenous knowledge interpretation. The main aspects dealt with during the interviews account for indicators, factors, conditions and main characteristics influencing artisanal fishing in the fishing zones. Besides "face-to-face" interviews, direct observation was indispensable for complementing information gathering, especially, the information uncover by questionnaires.

4.11 – Questionnaires

Generally, the content of the four questionnaires enabled to explore and gathering, as much as possible, the expected information from the respondents. The questionnaire targeted individual views on artisanal fishing zones identification and characterization was the basis for the majority of the data and/or information collected. Questionnaires for data and/or information collection targeted to group and scientific views have been taken as complementary to substantiate the individual respondents' views. The last questionnaire was conceived, especially, for coordinates (latitude and longitude) recording.

Some problems on the questionnaires were the time consuming process, especially, when translation into local language was needed for those respondents unable to understand and speak the Portuguese language. Very little information was collected from the scientist's key informants, mainly, because, the existing knowledge on artisanal fishing zones identification using GIS is still on

embryonic stage in the National Fisheries Research Institute (IIP). However, IIP is well advanced on recording, processing and analyzing statistics of artisanal fisheries production as well as reporting feedback at sector level including artisanal fishermen, civil society and fisheries private sector.

4.12 – Conclusion

The indigenous knowledge use is the central aspect dealt in this chapter. Emphasis has been given to the research methodology applied for the study. The literature reviewed shows that, besides scientific knowledge which is acquired at universities and schools, there is another body of knowledge from local people's experiences based on their historical and daily use of the resource that is also important, but is usually marginalized by scientists and/or managers. This knowledge is locally used for decision-making for community-based fisheries management purposes. As shown in plate 4, artisanal fishermen based on their own knowledge are using fishing gears such as gillnet and hand lines which do not have negative impact on fishing. This is an example of an indicator for the objectives of this study to establish relationship between scientific and indigenous knowledge and to see to what extent local people's indigenous knowledge can be feasibly used for artisanal fisheries management purposes.

Gillnet fishing gear

Hand line fishing gear

Plate 4 – Selective artisanal fishing gears – (IDPPE, 2006)

CHAPTER 5

Data analysis

5.1 – Introduction

In this chapter, data and information collected are interpreted and analyzed. The analysis seeks to show the potential of indigenous knowledge in artisanal fishing communities. The results are, mainly, shown in tables trying to give the reality found in the fishing villages. Data and information collected on socio-economic, traditional and cultural practices as well as on technological characteristics analyzed herein do not have, sometimes, direct applicability on the physical identification of artisanal fishing zones but they do have strong influence and they are determinant on the process. Understanding the way fishing communities are socially, economically and culturally organized it enables to understand the logic underlying on their indigenous knowledge use in the process of fishing zones identification.

The core issue is about the use of indigenous knowledge in identification of artisanal fishing zones. The process of identification is, essentially, based on qualitative and quantitative information. In this regard, qualitative data is not easy to be measured statistically. Winds, lunar and tidal cycles as well as traditional and cultural practices possess strong fishing influence, so they deserve particular attention in the analysis because they are determinant in the process of fishing zones identification. In the data processing, there were found missing values in some variables which led to less than 161 (100%) of respondents in some of the tables here analyzed. The unit of the data analysis is the "Planning Area". Some of the collected and analyzed data are, mainly, used as complementary to substantiate qualitative and/or oral information on the process of artisanal fishing zones identification. For data analysis, the "Statistic Programme for Social Science" (SPSS), was used.

5.2 – Planning Areas (PA's)

All seven (7) Planning Areas (PA's) existing in the study area were considered. In these PA's there are fifty (50) fishing villages. Thirty two (32) of 50 fishing villages were randomly selected. In the 32 fishing villages surveyed, only 27 were inhabited and the work was able to be done there. The five (5) defunct fishing villages no longer existed. In the 27 fishing villages, 1.286 eligible fishermen (men and women), with different fishing gears, were identified and surveyed. From 1.286 eligible fishermen, a sample size of 180 fishermen was drawn. As shown in table 5, from the drawn sample size of 180 units, 161 respondents were directly interviewed.

Table 5: - Data collection coverage by Planning Area

Items/PA's	Catamoio	Gelo	Inguri	Kwirikwidge	Quelelene	Sangage	Thamole	Total
Sample size	48	28	12	11	21	38	22	180
Achieved	45	28	12	10	16	33	17	161
Difference	-3	0	0	-1	-5	-5	-5	-19

5.2.1 – General information

In terms of coverage, 89% (161) of the sample size (180) was interviewed as shown in table 5. The results indicate that 86% (139) of the total respondents were the property owners of the fishing units (boats and/or fishing gears). Crew members appear as the second social and professional layer of respondents interviewed. Skipper and others respondents are in third place. Catamoio (41), Sangage (33), Gelo (29) and Inguri (20), are, relatively, the PA's having the most fishers engaged in fishing activities. Kwirikwidge (11) and Thamole (12) are the PA's with comparatively less fishers and thus fishing activities as shown in table 6.

Table 6: - Categories of fishermen by Planning Areas

Category	Planning Area							Total
	Catamoio	Gelo	Inguri	Kwirikwidge	Quelelene	Sangage	Thamole	
Owner	33	20	18	11	15	30	12	139
Skipper	2	2	1	-	-	-	-	5
Crew	4	7	1	-	-	3	-	15
Other	2	-	-	-	-	-	-	2
TOTAL	41	29	20	11	15	33	12	161

5.2.2 – Language, religious and marriage status

"*Macua*" is the predominantly spoken language but also represents the largest ethnic group in the entire province of Nampula." As shown in table 7, most respondents 117 (73%) are koti and macua speaking. Contrary to the south zone of the district which is composed, mostly, by Islands, the north coastal zone, namely, Kwirikwidge (4), Sangage (9) and Gelo (8), which is, basically, continental, there are respondents who are only macua speaking. This ensures that "Koti" is spoken, mostly, in Islands.

Table 7: - Language spoken by respondents by Planning Area

Language spoken	Planning Area							Total
	Catamoio	Gelo	Inguri	Kwirikwidge	Quelelene	Sangage	Thamole	
Koti (A)	-	-	1	-	2	1	-	4
Macua (A)	-	8	-	4	-	9	-	21
Koti and macua	34	19	16	7	10	21	10	117
(A), (B) & Portuguese	7	2	3	-	3	2	2	19
TOTAL	41	29	20	11	15	33	12	161

In all PA's there are artisanal fishermen understanding and speaking Portuguese (Official language) although in much reduced number. This information is an important indicator for government development programmes.

Angoche is predominantly Islamic. As shown in table 8, almost, all respondents interviewed 150 (96%) follow Islam. There are other new religious beliefs that are coming up in recent year, which appear to be negatively influencing the traditional way of living in the fishing communities. This new phenomenon is a result of in-immigration from the Great Lakes region and Central Africa. Besides Islamic religious belief, there is a small number of people belonging to catholic (3) and other (3) religious beliefs (table 8).

Table 8: - Religious beliefs of respondents by Planning Area

Religious beliefs	Planning Area							Total
	Catamoio	Gelo	Inguri	Kwirikwidge	Quelelene	Sangage	Thamole	
Islamic	40	24	20	10	13	32	11	150
catholic	-	3	-	-	-	-	-	3
other	1	2	-	-	-	-	-	3
TOTAL	41	29	20	10	13	32	11	156

Islamic religious belief influence is the most dominant among artisanal fishing villages in all of seven PA's. As shown in table 9, most of the respondents interviewed 124 (85%) revealed that they have only one wife and/or husband. Meantime, there were also respondents married to two wives and, curiously, one respondent has got three wives. Some of the reasons given for marrying more than

one wife is that it is a symbol of economic power, looking for more children and having more labour force for subsistence farming. The influence of religious beliefs deserves careful treatment because they may be either detrimental or beneficial for local development.

Table 9: - Number of spouses per each respondent by Planning Area

Nr. of Spouses	Planning Area							Total
	Catamoio	Gelo	Inguri	Kwirikwidge	Quelelene	Sangage	Thamole	
1.00	30	25	18	8	11	22	10	124
2.00	6	1	-	2	3	8	1	21
3.00	-	-	-	-	-	1	-	1
TOTAL	36	26	18	10	14	31	11	146

5.2.3 – Socio-economic characteristics

Although Angoche is a coastal district, the socio-economic characteristics indicated that the main economic occupations in the area were fishing, agriculture and commerce. Economically, Angoche is mainly dependent on agriculture, practiced, mainly, at household level. The potential arable area in the district is about 211.548 hectares. The area designed for agriculture accounts for 61.019 hectares with 357 hectares for familiar sector (Angoche, 2005). Data collected shows that the majority of the population in the study area depend on fishing. However, fishing activities are complemented by other economic activities. As shown in table 10, only 43 respondents (27%) said that they relied exclusively on fishing. The majority of the respondents 106 (66%) said that they practiced both fishing and agriculture. 10 respondents (6%) said they were involved in fishing, agriculture and commerce (most of these processed and marketed their own catch rather than selling the catch to middlemen). Based on this finding, local development programmes must, as much as possible, pay attention to both fishing and agricultural related issues.

Table 10: - Main occupations of respondents by Planning Area

Main occupations	Planning Area							Total
	Catamoio	Gelo	Inguri	Kwirikwidge	Quelelene	Sangage	Thamole	
Fishing (A)	3	2	13	6	11	1	7	43
Informal commerce	-	-	1	-	-	1	-	2
(A) & agriculture(B)	33	26	3	5	4	30	5	106
(A), (B) & commerce	5	1	3	-	-	1	-	10
TOTAL	41	29	20	11	15	33	12	161

Gender related issues also deserved attention. As shown in table 11, nine women (6%) were involved in fishing activities while the rest 152 (94%) were men.

Table 11: - Gender on respondents by Planning Area

Gender on fishing	Planning Area							Total
	Catamoio	Gelo	Inguri	Kwirikwidge	Quelelene	Sangage	Thamole	
Fishermen	38	25	20	11	15	31	12	152
Fisherwomen	3	4	-	-	-	2	-	9
TOTAL	41	29	20	11	15	33	12	161

Traditionally, the involvement of women in fisheries has mainly been in fish processing and marketing. However, recent trends have pointed to the increasing involvement of women in the ownership of fishing infrastructure (unit owners) other than being only involved in post-harvest activities.

5.2.3.1 – Demography

Collected data shows that the number of the households varies from one to 20 persons per family in the fishing villagers. As shown in table 12, most of the families have between 4 and 7 people per household. 25 families (17%), declared having four (4) people each within their households; 21 (14%), said they had 5; 22 (15%), said that they had 6 people; and 18 (12%) said they had 7 people in their households. The average number of people per household was 6. The households analyzed here mainly comprised of parents and their children.

Table 12: - Number of people per household

Nr of people/household	1	2	3	4	5	6	7	8	9	10	11	12	13	14	17	20
Frequencies	1	5	13	25	21	22	18	12	9	10	7	2	1	1	1	1
Percentage (%)	1	3	9	17	14	15	12	8	6	6.7	4.7	1	1	1	1	1

5.2.3.2 – Education

As shown in table 13, 56 respondents (39%) were illiterate and had not been to school in the previous ten years. Only 5 respondents (3,5%) had children studying in secondary schools. A significant number of respondents 81 (57%) had children studying in primary schools. Catamoio, 20 (14%) and Sangage, 13 (9%) were the PA's with the most number of illiterate people.

Table 13: - Level of education of the respondents' family by Planning Area

Levels	Planning Area							Total
	Catamoio	Gelo	Inguri	Kwirikwidge	Quelelene	Sangage	Thamole	
Primary	19	19	8	8	4	15	8	81
Secondary	-	1	1	1		1	1	5
Other	-	1	-	-	-	-	-	1
Illiterate	20	4	8	-	9	13	2	56
TOTAL	39	25	17	9	13	29	11	143

The provision of infrastructure, including schools, has been critical in ten years in reducing the rate of illiteracy especially in coastal areas and in fishing villages specifically. The civil war which lasted 16 years and ended in 1992 was most detrimental as the cause of illiteracy. It was only towards the end of the 1990s that an integrated development project funded by the Mozambican government and International Fund for Agriculture and Development (IFAD), coordinated and implemented by IDPPE, intervened in social and infrastructures re-construction at Angoche and Moma districts. Although the government is giving especial attention to infrastructural development and rehabilitation, the results are not satisfactory.

5.2.3.3 – Economy

Cassava, maize, rice, beans, groundnuts, and sweet potatoes account for the main subsistence crops produced in Angoche district. The cashew nuts, groundnuts, rice and maize are, at the same

time, some of the main commercial crops. Data collected in the fishing villages ranked cassava in first place; rice in second place; beans in third place and groundnuts in fourth place. As shown in table 14, a total of 114 respondents said that they produced cassava and 99 (87%) of these said that the period for production of cassava was between July and September. Others, 5 (4%) and 10 (9%) put April to June and between October and December as the main production periods for cassava.

Table 14: - Best cassava production seasonal within an annual cycle, by Planning Area

Productivity period	Planning Area							Total
	Catamoio	Gelo	Inguri	Kwirikwidge	Quelelene	Sangage	Thamole	
Apr-Jun	3	2	-	-	-	-	-	5
Jul-Sep	26	19	8	5	6	30	5	99
Oct-Dec	5	3	1	1	-	-	-	10
TOTAL	34	24	9	6	6	30	5	114

105 respondents said that they produced rice. As shown in table 15, 90 (86%) respondents mentioned that between April and June was the most productivity period for rice. Only 12 respondents (11%) said that the best rice production period was between July and September. Catamoio (33), Gelo (18) and Sangage (18) were the PA's with more fishing respondents whose families produce rice.

Table 15: - Best rice production season by Planning Area

Productivity period	Planning Area							Total
	Catamoio	Gelo	Inguri	Kwirikwidge	Quelelene	Sangage	Thamole	
Jan-Mar	-	-	-	-	-	1	-	1
Apr-Jun	33	18	8	4	5	18	4	90
Jul-Sep	3	1	2	-	4	1	1	12
Out-Dec	1	-	1	-	-	-	-	2
TOTAL	37	19	11	4	9	20	5	105

Regarding beans, 96 respondents said that they grow beans mainly for consumption. As shown in table 16, almost half of respondents (45 corresponding to 47%) mentioned between April and June as the most productive period for beans and 40 respondents (42%) said that the bean production period is between July and September. Curiously, between the period between April and June, as

shown in table 16, was also mentioned as the period when rice was a good crop and, also between July and September was mentioned as good for cassava, as shown in table 14. According to Artisanal fishing villagers, cassava and beans productivity periods go together.

Table 16: - Best beans production season by Planning Area

Productivity period	Planning Area							Total
	Catamoio	Gelo	Inguri	Kwirikwidge	Quelelene	Sangage	Thamole	
Jan-Mar	1	-	-	-	-	1	-	2
Apr-Jun	10	5	2	4	4	17	3	45
Jul-Sep	13	11	7	-	2	7	-	40
Oct-Dec	9	-	-	-	-	-	-	9
TOTAL	33	16	9	4	6	25	3	96

Peanuts or groundnuts are in fourth place according to the fishing villagers' ranking. A total of 83 respondents pointed out to have dealt with this kind of crop. As shown in table17, the period April to June is the main productivity period for peanuts according to 61 respondents (74%). Catamoio (23) and Gelo (13) presented the most respondents involved in the peanuts production. Peanuts productivity period, table 17 coincides with beans productivity period as shown in tables 16.

Table 17: - Best peanuts production season within an annual cycle by Planning Area

Productivity period	Planning Area							Total
	Catamoio	Gelo	Inguri	Kwirikwidge	Quelelene	Sangage	Thamole	
Jan-Mar	-	2	-	-	2	1	1	6
Apr-Jun	23	13	8	2	3	9	3	61
Jul-Sep	3	3		1	1	8		16
TOTAL	26	18	8	3	6	18	4	83

5.2.3.4 – Housing

Housing conditions in the fishing villages is, in general, not so bad. However, houses are, mainly, made using local material like those from mangrove and palmer trees. In terms of internal and external structures, these houses are well conceived. They have, normally, between 3 and 4 divisions corresponding, at least, to two rooms, one lounge and kitchen. The critical situation found in fishing villagers' houses is the absence of "latrines". There is strong traditional influence of not using

"conventional latrines" and, the "bush toilet" has been the general alternative used in, almost, all coastal fishing villages, particularly, in the northern part of the country which is mainly Islamic.

Table 18: - Type of house of respondents by Planning Area

Class	Planning Area							Total
	Catamoio	Gelo	Inguri	Kwirikwidge	Quelelene	Sangage	Thamole	
Non conventional	37	27	18	9	13	30	12	146
Conventional	-	-	-	1	1	2	-	4
TOTAL	37	27	18	10	14	32	12	150

As shown in table 18, 146 respondents (97% of the houses) are made from local material and only 4 respondents (3%) had conventional houses. Sangage (2), Kwirikwidge (1) and Quelelene Island (1) are the fishing villages where these conventional houses were found. The quality of the houses found as well as the tendency in having improved houses in the fishing villages reflect the positive impact of the artisanal fishing activity.

Table 19: - Main assets owned by respondents as a household by Planning Area

Type of assets in house	Planning Area							Total
	Catamoio	Gelo	Inguri	Kwirikwidge	Quelelene	Sangage	Thamole	
motorcycle	-	-	-	1	-	1	-	2
Bicycle (b)	1	9	1	1	-	8	1	21
Radio (c)	16	8	7	3	11	10	1	56
furniture	3	1	2	1	1	4	-	12
(b) and (c)	6	4	1	1	-	5	1	18
others	-	1	-	-	-	-	1	2
(b), (c), motto, and furniture	-	-	2	1	-	1	2	6
TOTAL	26	23	13	8	12	29	6	117

Income from fishing can also be reflected in assets apart for the fishing villagers' housing conditions. In this regard, respondents were asked what kind of assets they have manage to buy in the last 5 years. As shown in table 19, radios (48%), bicycle (18%), and a diversity of furniture (10%) were assets fishing villagers spent their income on. The bicycle is, effectively, the most preferable means of transport in many of the fishing villages, particularly, in the northern part of the country.

Information shows that 5% of the respondents possessed all these assets, namely bicycle, radio, motorcycle and furniture simultaneously.

5.2.4 – Traditional and cultural practices

Traditional and cultural practices were studied to understand how they influence the fishing activity and to what extent they contribute to the fishing zones identification. According to respondents, the strict observation of certain traditional and cultural beliefs is a determinant for fishing success. The following practices were identified by respondents: "*Cleaning cemeteries*"; "*Hijabo*"; "*Olomba*"; "*Lihuco*" and "*Inkutho*" ceremonies. However, there was a feeling that these practices are losing their traditional and cultural power due to the great influence of outsiders' religious beliefs. It was also mentioned that, there was less importance given to these practices by local youth due to the heavy western influence, especially, at this period of the so called "*the age of globalization*".

It must be pointed out that in the field, there were no data collected for fish capture from those respondents "always and sometimes" observing traditional and cultural practices for confirming the relationship between the volume of fish captures and the observation of these beliefs. Meanwhile, there is strong belief that those observing these practices were more successful in their fishing activities relative to those who do not observe the practices. It is suggested that investigations around this should be done in the future studies to fill the gap in knowledge.

i) - "Cleaning cemeteries"

It is a belief that cleaning the burial places where the fishermen's ancestors are resting is a way of giving them adequate respect and high consideration they deserve. By doing so, ancestors respond in different ways like protecting fishermen from evil spirits and bringing to them luck in their fishing activities. In this regard, as shown in table 20, 56 respondents (35%) declared that they observed the ritual of "always" "cleaning cemeteries" and 43 respondents (27%) said they observed this practice "sometimes". 61 respondents (38%) declared that they "never" observed this practice.

Table 20: - Observation of the 'Cleaning cemeteries practice' by Planning Area

Scale	Planning Area							Total
	Catamoio	Gelo	Inguri	Kwirikwidge	Quelelene	Sangage	Thamole	
Always	14	11	3	4	3	16	5	56
Sometimes	13	10	1	2	4	11	2	43
Never	14	8	16	5	8	6	4	61
TOTAL	41	29	20	11	15	33	11	160

ii) - "Hijabo ceremony"

This practice consists of organizing food and/or drinks and inviting family and/or other closer relatives and friends to participate in prayer and/or evocation to the ancestors. Local information says that everyone and according to necessity or need, can organize and do this practice without observing many detailed pre-requisites. The core aspect underlying this belief is the "remembering" those who, in real life lived with us. There is a belief that by "remembering" them, they will also remembering us and they will give us luck we are looking for. For fishermen, observing this practice makes them believe that they will have luck in their fishing activities.

Table 21: - Observation of the 'Hijabo ceremony practice' by Planning Area

Scale	Planning Area							Total
	Catamoio	Gelo	Inguri	Kwirikwidge	Quelelene	Sangage	Thamole	
Always	16	10	3	4	2	17	6	58
Sometimes	13	9	1	3	6	8	2	42
Never	12	10	16	4	7	8	3	60
TOTAL	41	29	20	11	15	33	11	160

As shown in table 21, 58 respondents (36%) were "always" observing, while 42 respondents (26%) were "sometimes" observing "*Hijabo ceremony*" practices for fishing purposes. The high percentage (38%) corresponding to 60 respondents declared they "never" observed this practice. Sangage (17), Catamoio (16) and Gelo (10) had the most respondents believing that observing "Hijabo ceremony" practice contributes to and influences the level of their fish captures. In contrast, Inguri (16), Catamoio (12) and Gelo (10) show high number of respondents who declared that they never observed this practice.

iii) - "Olomba ceremony"

This belief is based on "asking a favour" or "appealing" to the ancestors for anything someone or the community would like to see solved. The ceremony can be done either by a single family or involves the entire community. When it involves the entire community, it is led by local and/or traditional leaders. This practice is mainly about appealing for luck, social and economic protection in a very broad sense. The ceremony takes seven (7) days. The entire community goes to the traditional leader's house and for 2 to 3 days, participants dance and do cleaning of all sacred places. After cleaning all sacred places, the ceremony extends to the beach where (prototypes of boats and other fishing toys) including traditional food is taken and scattered into the pre-determined places on the sea bed. To discover where exactly to spill the prepared things, one person in the community, suddenly, gets attacked by traditional spirits "*winhuwa".* It is exactly there where everything has to be scattered and then the ceremony ends. "*Olomba ceremony*" practice is carried out every year, normally, at the end of the year.

Table 22: - Observation of the 'Olomba ceremony practice' by Planning Area

Scale	Planning Area							Total
	Catamoio	Gelo	Inguri	Kwirikwidge	Quelelene	Sangage	Thamole	
Always	19	9	15	7	8	22	4	84
Sometimes	8	10	1	2	2	6	2	31
Never	14	10	4	2	5	5	5	45
TOTAL	41	29	20	11	15	33	11	160

A total number of 160 fishing villagers were interviewed on this practice. As shown in table 22, 84 respondents (corresponding to 53%) said they "always" observed this ceremony, 31 respondents (corresponding to 19%), said they observed it "sometimes" and 45 respondents (28%) declared they "never" observed this practice at all. It must be realized that the high number (84) of those "always" observing this ceremony was because going to mosque for praying is also considered as practicing "*olomba*".

iv) - "Lihuco ceremony"

This consists of fishing unit's treatment using witch's roots and/or other traditional "medication" to protect fishing unit (fishing gear and/or boat) from being easily damaged by any kind of evil and also to habilitate fishing unit to catch more fish. For this practice, there are strong pre-requisites given by the witch that have to be observed. The pre-requisites must be rigorously and carefully observed and mistakes on complying with these pre-requisites will have negative consequences ranging from losing your mind or even death of some close relatives.

Table 23: - Observation of the 'Lihuco ceremony practice' by Planning Area

Scale	Planning Area							Total
	Catamoio	Gelo	Inguri	Kwirikwidge	Quelelene	Sangage	Thamole	
Always	2	2	2	1	1	4	3	15
Sometimes	4	9	1	2	-	5	1	22
Never	35	18	17	8	14	20	7	119
TOTAL	41	29	20	11	15	29	11	156

For "Lihuco ceremony" practice, 156 respondents were interviewed. Very few fishing villagers (15 corresponding to 10%) said they "always" observed "Lihuco" and 22 (14%) said they "sometimes" observed this ceremony. The majority of respondents 119 (76%) declared they "never" observed the "Lihuco ceremony" practice as shown in table 23. The high number of fishing villagers who did not observe "Lihuco ceremony" practice is, mainly, because of the negative consequences if pre-requisites are not strictly observed.

v) - "Inkutho ceremony"

This is typically familiar ceremony. Traditionally, it must be held and led by the elder kinship member of the family. It consists mainly of organizing different types of traditional food and drink in very little quantities. Under the pre-identified tree at home, "considered as a sacred place", all family members set around this tree and the kinship elder member leading the ceremony starts evoking all the ancestors' spirits offering them the food and the drink prepared and, at the same time, telling them everything the family is seeking to see solved. Ancestors, after this ceremony, feel themselves dignified and, positively, they answer all the families' preoccupations including luck on fishing activities.

Table 24: - Observation of the 'Inkutho ceremony practice' by Planning Area

Scale	Planning Area							Total
	Catamoio	Gelo	Inguri	Kwirikwidge	Quelelene	Sangage	Thamole	
Always	4		2	1	2	1	1	11
Sometimes	7	9	1			6	1	24
Never	30	18	17	10	13	17	7	112
TOTAL	41	27	20	11	15	24	9	147

From 147 respondents interviewed on "*Inkutho ceremony*" practice, only 11 respondents (7%) said they "always" do "Inkutho" and 24 (16%), said they "sometimes" observed the ceremony. A high number of respondents 112 (76%) declared they "never" practiced the ceremony at all as shown in table 24. The high number of fishing villagers who do not practice "Inkutho ceremony" is because the ceremony must only be held and led by the kinship elder member of the family. In this regard, most of the respondents interviewed said they were not, traditionally, eligible to hold and lead this ceremony.

5.2.5 – Coast physical characteristics

Data on this matter was collected, mainly, to understand if there was any relationship between these characteristics and the species caught in the fishing zones. Understanding the existing relationship (if any) enables understanding the logic underlying the fishing zones identification and localization. Mangrove, river, dense forest and undulating terrain cover, were some of the analyzed characteristics among others. The measurements established for these variables were "very strong" and "strong" influence on species.

Table 25: - Mangrove influence on species characteristics by Planning Area

Levels	Planning Area							Total
	Catamoio	Gelo	Inguri	Kwirikwidge	Quelelene	Sangage	Thamole	
V/strong	39	29	20	11	14	33	12	158
Strong	2	-	-	-	-	-	-	2
TOTAL	41	29	20	11	14	33	12	160

For "*mangrove cover*", 160 respondents were interviewed and, as shown in table 25, almost all respondents 158 (99%), said that the mangrove cover had a "very strong" influence on the species caught in the fishing zones.

Relative to *"river presence*", 159 respondents said that the river presence has a "very strong" influence on the species caught in the fishing zones, as shown in table 26.

Table 26: - River influence on species characteristics by Planning Area

Levels	Planning Area							Total
	Catamoio	Gelo	Inguri	Kwirikwidge	Quelelene	Sangage	Thamole	
V/strong	40	29	20	11	14	33	12	159
Strong	1	-	-	-	-	-	-	1
TOTAL	41	29	20	11	14	33	12	160

Contrary to mangrove cover and river presence, "*dense forest*" and "*undulating terrain*" cover, as shown in tables 27 and 28, respectively, most of respondents declared that these two coastal characteristics have "no" influence on the species caught in the fishing zones.

Table 27: - Dense forest influence on species characteristics by Planning Area

Levels	Planning Area							Total
	Catamoio	Gelo	Inguri	Kwirikwidge	Quelelene	Sangage	Thamole	
Strong	1	9	-	-	-	3	-	13
None	40	20	20	11	14	30	12	147
TOTAL	41	29	20	11	14	33	12	160

The results on "dense forest" and "undulating terrain" cover, show similar behaviour either in global or by Planning Area.

Table 28: - Undulating terrain influence on species characteristics by Planning Area

Levels	Planning Area							Total
	Catamoio	Gelo	Inguri	Kwirikwidge	Quelelene	Sangage	Thamole	
Strong	1	8	-	-	-	3	-	12
None	40	21	20	11	14	30	12	148
TOTAL	41	29	20	11	14	33	12	160

5.2.6 – Technological characteristics

The fishing gears, fish productivity period and fish species are the technological characteristics analyzed in this section. Respondents interviewed ranked three fishing gears, namely, beach seine, gillnet and hand line, as the most used in the study area. Others like cage, quinia and diving, appeared in a second category. Definition of the most used fishing gears is given in the glossary.

As shown in table 29, 85 respondents (53%) were beach seine users; 35 (22%) of the respondents were using gillnet; 22 (13,7%) of the respondents were linked with hand line; and 9 for cage, 1 for diving and 9 for quinia (all together, accounting for 19 respondents) corresponding 11,8%, were using these diverse fishing gears. Catamoio (41respondents), Sangage (33 respondents), Gelo (29 respondents) and Inguri (20 respondents) were the PA's with the most fishing gears. Sangage (16) is the leading PA in use of beach seine; Catamoio (14) had the most gillnets and also accounted for the most hand lines (7) and cages (7).

Table 29: - Fishing gear types in use by Planning Area

Gears	Planning Area							Total
	Catamoio	Gelo	Inguri	Kwirikwidge	Quelelene	Sangage	Thamole	
B/seine	11	14	11	11	13	16	9	85
Gillnet	14	4	5	-	1	9	2	35
Hand line	7	6	1	-	1	6	1	22
Cage	7		2	-	-	-	-	9
Diving	-	-	1	-	-	-	-	1
Quinia	2	5	-	-	-	2	-	9
TOTAL	41	29	20	11	15	33	12	161

In relation to fish productivity period as shown in table 30, 157 respondents were interviewed and 69 respondents (44%) said that January to June is the period when fish is most abundant and 39 respondents (25%) mentioned the period between January and March as the most productivity period. In general, fish productivity is best in the first six months of the year.

Table 30: - Opinion on best fishing season by Planning Area

Productivity period	Planning Area							Total
	Catamoio	Gelo	Inguri	Kwirikwidge	Quelelene	Sangage	Thamole	
Jan-Mar	19	6	4	1	2	7	-	39
Apr-Jun	4	2	1	2	2	2	2	15
Jul-Sep	3	2	4	-	-	6	1	16
Oct-Dec	1	3	4	-	1	3	-	12
Jan-Jun	12	13	7	7	9	12	9	69
Jul-Dec	2	2		1	-	1	-	6
TOTAL	41	28	20	11	14	31	12	157

Concerning species, fishing villagers were asked to list the main species they catch according to fishing gear used. Results show that "Anchoveta" (ocaris) is the leading species caught as it had been mentioned by 84 respondents. Thirty four species were mentioned and in terms of frequency, most of the species appeared in the beach seine. It must be noticed that "*SPECIES' NAMES*" are in official language (Portuguese) and not in scientific language. The idea is to show its frequency by fishing gear.

Table 31: - Most common species caught by fishing gear

Order	Species	Fishing gears						Total
		Beach seine	Gillnet	Hand line	Cage	Diving	Quinia	
1	ANCHOVETA	63	11	2	1	0	7	84
2	PESCADINHA	45	22	9	5	0	1	82
3	SARDINHA	48	24	4	3	0	0	79
4	PX. ESPADA	48	18	2	1	0	2	71
5	CARAPAU	45	21	1	2	0	0	69
6	PX. PEDRA	37	7	12	4	0	0	60
7	PX. SERA	39	6	10	1	0	0	56
8	PX.AGULHA	38	12	3	1	0	0	54
9	CAMARAO	35	5	0	6	0	7	53
10	MAGUMBA	31	15	1	3	0	1	51
	TOTAL	**429**	**141**	**44**	**27**	**0**	**18**	**659**

As shown in table 31 and for illustration, only, the ten top species are listed. These top ten species were counted 659 times in the fishing gears over the survey period. Most of the species accessible to artisanal fishing activity are caught in estuaries, beaches and open sea localized surrounding Islands situated not far from the continental shelf. The fishing Islands frequented most by artisanal fishermen are Mafamede, Pupa-puga, Njovo and Caldeira which also serve as safe places if fishermen are exposed to dangerous sea, mainly, winds.

5.2.7 – Climate characteristics

Atmospheric and oceanic factors influencing fishing activity account for climate characteristics. Rainfall, drought, wind occurrence and lunar cycle account for atmospheric factors; and, tidal cycle, dirty and water transparency account for oceanic factors. Periods of occurrence as well as the influence on fishing of these factors are analyzed in this section. Knowing periods of occurrence and influence on fishing of climate characteristics contributes the understanding of the fishing villagers' logic underlying artisanal fishing zones identification and influence fishermen's choice and planning about where and when to fish without fatal consequences. There are also other climatic characteristics like state of water (temperature, churnings, and deepness) and state of day/night (cloudy, stormy, hot or cold) that influence such decisions which are not analysed or described in this section.

5.2.7.1 – Period of occurrence

i) - Atmospheric factors

From table 32 concerning the "rainy" period, 110 respondents were interviewed and 90 of them (89%), said that from January to March is the rainfall period. 19 respondents (17%) said that rainfall occurs from October to December. Generally, respondents' views suggest that the rainy season normally stretches from October to March.

Table 32: - Characterisation of rainy season by Planning Area

Rainy period	Planning Area					Total
	Catamoio	Inguri	Quelelene	Sangage	Thamole	
Jan-Mar	41	1	15	33	-	90
Jul-Sep	-	-	-	-	1	1
Oct-Dec	-	19	-	-	-	19
TOTAL	41	20	15	33	1	110

In relation to the "dry season" as shown in table 33, 106 respondents were interviewed and 43% (46 respondents) said that April to June was the dry season, 27% (29 respondents) said that dry season was between July and December and 21% (22 respondents) mentioned July to September as the dry season. From the data, it is generally understood that the dry season normally stretches from April to September.

Table 33: - Characterisation of dry season by Planning Area

Dry period	Planning Area					Total
	Catamoio	Gelo	Inguri	Quelelene	Thamole	
Apr-Jun	31	-	-	15	-	46
Jul-Sep	3	-	19	-	-	22
Oct-Dec	7		1	-	1	9
Jul-Dec	-	29	-	-	-	29
TOTAL	41	29	20	15	1	106

For the "Windy factor", only, northern and southern wind periods are analyzed and described here for illustration. Meanwhile, (west, east, north west, north east, and south west, south east) winds have also got influence on fishing. In this regard, as shown in table 34, 106 respondents were interviewed and 87 (82%), said that from October to December there is a predominantly northerly wind period and 19 respondents (18%) thought the period for the northerly winds was July to December.

Table 34: - Characterisation of 'Northerly wind' season by Planning Area

Windy period	Planning Area					Total
	Catamoio	Gelo	Inguri	Quelelene	Thamole	
Oct-Dec	41	29	1	15	1	87
Jul-Dec	-	-	19	-	-	19
TOTAL	41	29	20	15	1	106

Thus according to the experience of artisanal fishermen, July to December is considered as the period when northerly wind predominates.

Table 35: - Characterisation of 'Southerly wind' season by Planning Area

Windy period	Planning Area						Total
	Catamoio	Gelo	Inguri	Quelelene	Sangage	Thamole	
Jan-Mar	7	-	-	15	-	-	22
Apr-Jun	28	29	20	-	33	1	111
Jul-Sep	6	-	-	-	-	-	6
TOTAL	41	29	20	15	33	1	139

Data from the table 35 indicates that 139 fishermen were interviewed and of these 111 respondents (80%) thought April to June was the main period for southerly winds while 22 respondents (16%) thought January to March was the main period for these winds. Thus the data shows that from January to June is the period when southerly winds predominate.

ii) – Oceanic factors

Tides have an effect on artisanal fishing activity. The tidal cycle is composed by two main types, namely, rising and falling tides. Each of these two types occurs twice in a month. There is a very strong relationship between tidal and lunar cycles. According to artisanal fishermen, lunar cycle aggregates, normally, thirty days and the second day of the lunar cycle is the first day of the tidal cycle. In this regard, the tidal cycle accounts for almost 29 days.

Table 36: - Characterisation of 'Rising tides' periods in a month by Planning Area

Tidal period	Planning Area							Total
	Catamoio	Gelo	Inguri	Kwirikwidge	Quelelene	Sangage	Thamole	
9-15/24-30	41	29	20	11	15	33	12	161
TOTAL	41	29	20	11	15	33	12	161

According to the fishing villagers' experience, rising tides, on one hand, occur between the 9th and 15th and between the 24th and 30th and, on the other hand, falling tides, occur between the 1st and 8th day and between 16th and 23rd day of a lunar cycle as shown in tables 36 and 37, respectively.

Table 37: - Characterisation of 'Falling tides' periods in a month by Planning Area

Tidal period	Planning Area							Total
	Catamoio	Gelo	Inguri	Kwirikwidge	Quelelene	Sangage	Thamole	
1-8/16-23	41	29	20	11	15	33	12	161
TOTAL	41	29	20	11	15	33	12	161

As shown in tables 36 and 37, artisanal fishing villagers have common perceptions on tidal and lunar cycles.

5.2.7.2 – Influence on fishing

i) – Atmospheric factors

Eight (8) kinds of winds were identified but only six (6) are dealt with here, namely: - North (*Kaskhazi*); South (*Kussi*); West (*Manthe*); East (*Madulai*), South East (*Phalalazi*) and South West (Olani) winds. According to respondents, these six types of winds have greater fishing influence than others.

Table 38: - Opinion on 'Northerly wind' influence on fishing by Planning Area

Scale	Planning Area							Total
	Catamoio	Gelo	Inguri	Kwirikwidge	Quelelene	Sangage	Thamole	
Very good	39	28	15	11	13	25	12	143
Reasonable	1	1	3	-	-	3	-	8
Bad	1	-	2	-	2	5	-	10
TOTAL	41	29	20	11	15	33	12	161

A total of 161 respondents were interviewed about both northerly and southerly wind conditions for fishing. As shown in tables 38 and 39, 89% (143 respondents) were in favour of northerly wind conditions, while 91% (147 respondents) were against southerly wind conditions for fishing. Southerly wind is generally characterized by heavy winds with high waves and strong churning water which do not offer any conditions for any fishing activity. The southerly wind is commonly considered very dangerous for sea water activity.

Table 39: - Opinion on 'Southerly wind' influence on fishing by Planning Area

Scale	Planning Area							Total
	Catamoio	Gelo	Inguri	Kwirikwidge	Quelelene	Sangage	Thamole	
Very good	3	-	-	-	1	1	1	6
Reasonable	2	1	3	-	-	1	1	8
Bad	36	28	17	11	14	31	10	147
TOTAL	41	29	20	11	15	33	12	161

West (*Manthe*) and East (*Madulai*) winds are considered very preferable winds for fishing. According to fishing villagers west and east winds are not violent and allow fishermen to fish peacefully.

Table 40: - Opinion on 'Western wind' influence on fishing by Planning Area

Scale	Planning Area							Total
	Catamoio	Gelo	Inguri	Kwirikwidge	Quelelene	Sangage	Thamole	
Very good	39	27	19	11	15	32	12	155
Reasonable	1	1	-	-	-	1	-	3
Bad	1	1	1	-	-	-	-	3
TOTAL	41	29	20	11	15	33	12	161

As shown in tables 39 and 40, respectively, almost 100% of the respondents classified both west and east winds as "very good" because they offer excellent conditions for fishing.

Table 41: - Opinion on 'Eastern wind' influence on fishing by Planning Area

Scale	Planning Area							Total
	Catamoio	Gelo	Inguri	Kwirikwidge	Quelelene	Sangage	Thamole	
Very good	39	29	20	11	15	33	12	159
Reasonable	1	-	-	-	-	-	-	1
Bad	1	-	-	-	-	-	-	1
TOTAL	41	29	20	11	15	33	12	161

Southerly East (Phalalazi) as well as Southerly West (Olani) wind conditions are generally a mix of winds. South East is either influenced by south or east winds. When strongly influenced by the south wind, it does not offer good conditions for fishing. It is reasonable or good in fishing when it is

influenced by the east wind. The south West wind is also influenced either by south or west wind. If it is strongly influenced by the south wind, it does not also offer good conditions for fishing. South West wind offers reasonable or good fishing conditions only when it is influenced by the west wind.

Table 42: - Opinion on 'South-East wind' influence on fishing by Planning Area

Scale	Planning Area							Total
	Catamoio	Gelo	Inguri	Kwirikwidge	Quelelene	Sangage	Thamole	
Very good	5		3	-	-	-	-	8
Reasonable	2	1	1	-	1	-	-	5
Bad	34	28	16	11	14	33	12	148
TOTAL	41	29	20	11	15	33	12	161

According to fishing villagers, the South East wind is very bad when compared with South West wind. While for South West (Olani) wind fishermen can, sometimes, go for fishing, they never do so in the South East (Phalalazi) winds. In general, both South East and South West winds are, mainly, characterized by violent winds.

Table 43: - Opinion on 'South Westly' wind influence on fishing by Planning Area

Scale	Planning Area							Total
	Catamoio	Gelo	Inguri	Kwirikwidge	Quelelene	Sangage	Thamole	
Very good	2	-	2	-	1	-	-	5
Reasonable	35	10	9	4	14	11	5	88
Bad	4	19	9	7	-	22	7	68
TOTAL	41	29	20	11	15	33	12	161

As shown in tables 42 and 43, respectively, 148 respondents (92%) revealed that the South East wind offer extremely bad fishing conditions and 68 respondents (42%) said that Southerly West wind conditions are bad for fishing. Meanwhile, 88 respondents (55%) said that Southerly West wind conditions were reasonable for fishing.

Concerning rainfall and drought factors, respondents expressed their preference for the rainy season. As shown in table 44, 143 respondents (90%) said rainy that the season offers "very good" conditions for fishing. Meanwhile, fishing villagers argue that, although fish productivity is very high in

the rainy season, they do not fish as much as they can because of harvest losses. Artisanal fishermen do not have the required capacity to avoid harvest losses in the rainy season.

Table 44: - Opinion on influence of 'Rainy season' on fishing by Planning Area

Scale	Planning Area							Total
	Catamoio	Gelo	Inguri	Kwirikwidge	Quelelene	Sangage	Thamole	
Very good	40	24	18	9	14	28	10	143
Reasonable	1	2	1	-	-	3	-	7
Bad		3	1	2		1	2	9
TOTAL	41	29	20	11	14	32	12	159

In relatively to the dry season, 159 fishing villagers were interviewed. A number of 131 respondents (82%) said that drought negatively influenced fishing. According to fishermen, although conditions for fishing are bad in the dry season as shown in table 45, high fishing effort is observed at this period because artisanal fishermen can make use of the entire fish production they can obtain. They went further arguing that the dry season is the ideal period for artisanal fish processing for those who do not have conditions for conventional processing infrastructures.

Table 45: - Opinion on influence of 'Dry season' on fishing by Planning Area

Scale	Planning Area							Total
	Catamoio	Gelo	Inguri	Kwirikwidge	Quelelene	Sangage	Thamole	
Very good	-	2	1	2	-	1	1	7
Reasonable	3	13	-	-	-	5	-	21
Bad	38	14	19	9	14	26	11	131
TOTAL	41	29	20	11	14	32	12	159

With regard to the moon factor, lunar cycle encompasses four sub-lunar cycles, namely, new moon, first quarter moon, full moon and second quarter moon phases. Moon and tides are major factors and heavily determine and influence fishing activity. According to artisanal fishermen, they easily decide whether or not going for fishing when they know which phase of the sub-lunar and/or sub-tidal cycle it is within the month. Lunar and tidal cycles have very a strong relationship and greatly influence fishermen's' decision about whether to go out fishing or not.

Table 46: - Opinion on influence of 'New moon' on fishing by Planning Area

Scale	Planning Area							Total
	Catamoio	Gelo	Inguri	Kwirikwidge	Quelelene	Sangage	Thamole	
Very good	14	2	2	1	2	-	-	21
Reasonable	3	19	1	-	1	10		34
Bad	24	7	17	9	11	22	12	102
TOTAL	41	28	20	10	14	32	12	157

For the new moon phase as shown in table 46, 157 fishing villagers were interviewed and 102 respondents (65%) said this phase is "bad" for fishing; 34 respondents (22%) said that the new moon is "reasonable" for fishing and 21 (13%) said new moon phase offers "very good" conditions for fishing.

Table 47: - Opinion on influence of 'Full moon' on fishing by Planning Area

Scale	Planning Area							Total
	Catamoio	Gelo	Inguri	Kwirikwidge	Quelelene	Sangage	Thamole	
Very good	23	3	8	9	9	16	12	80
Reasonable	3	18	1	-	4	13	-	39
Bad	15	7	11	1	1	3	-	38
TOTAL	41	28	20	10	14	32	12	157

In regard to the full moon phase, a total number of 157 fishing villagers were interviewed. 80 respondents (corresponding to 51%) considered the full moon phase as offering "very good" conditions for fishing; 39 respondents (corresponding to 25%) said that conditions for fishing in full moon are "reasonable" and 38 interviewees (corresponding to 24%) said that the full moon phase is "bad" for fishing, as shown in table 47.

Full moon phase offers "very good" conditions for fishing, mainly, for fishermen who also fish at night. This is so because they argue, at night fishing gear contact with water normally produces light which makes fish run away. With the full moon, there is light at night and this "phenomenon" does not happen and this allows "fish to easily get caugh". Diegues (1999) argues that such phenomenon is due to the "scintillation produced by shoals of certain pelagic fishes (sardines) during the nights without moon light".

Table 48: - Opinion on influence of 'First quarter moon' on fishing by Planning Area

Scale	Planning Area							Total
	Catamoio	Gelo	Inguri	Kwirikwidge	Quelelene	Sangage	Thamole	
Very good	21	2	1	-	3	2	-	29
Reasonable	14	21	1	-	6	10	-	52
Bad	6	5	18	10	5	20	12	76
TOTAL	41	28	20	10	14	32	12	157

In relation to the first quarter moon phase, 157 artisanal fishermen were interviewed about the fishing condition offered by this phase. As shown in table 48, 76 interviewees (48%) considered first quarter moon phase "bad" for fishing; 52 respondents (33%) said that conditions in this phase are "reasonable" and 29 fishermen (18%) said that fishing at first quarter moon phase is "very good".

Table 49: - Opinion on influence of 'Second quarter moon' on fishing by Planning Area

Scale	Planning Area							Total
	Catamoio	Gelo	Inguri	Kwirikwidge	Quelelene	Sangage	Thamole	
Very good	20	2	10	1	-	6	-	39
Reasonable	9	21	4	7	8	15	10	74
Bad	12	5	6	2	6	11	2	44
TOTAL	41	28	20	10	14	32	12	157

Concerning to second quarter moon, 157 fishing villagers were interviewed on this lunar phase. As shown in table 49, 74 respondents (47%) said that fishing in second quarter moon phase is "reasonable"; 44 fishermen (28%) said that it was is "bad" fishing in second quarter moon while 39 interviewees (25%) considered second quarter moon as phase as offering "very good" conditions for fishing.

ii) – Oceanic factors

According to fishermen, one sub-tidal cycle corresponds to one sub-lunar cycle and each of the sub-tidal cycle stretches for, almost, seven to eight days which, normally, coincides with seven days of the sub-lunar cycle. Generally, rising tides occur from 9th to 15th day and this period is, normally,

coinciding with first quarter moon phase and from 24th to 30th day which corresponds second quarter moon phase.

Table 50: - Opinion on influence of 'Rising tides' on fishing by Planning Area

Scale	Planning Area							Total
	Catamoio	Gelo	Inguri	Kwirikwidge	Quelelene	Sangage	Thamole	
Very good	2	1	-	-	-	-	-	3
Reasonable	-	4	1	-	-	2	-	7
Bad	39	24	19	11	14	30	12	149
TOTAL	41	29	20	11	14	32	12	159

From a total of 159 respondents interviewed on rising tides conditions for fishing and as shown in table 50, 149 (94%) argued that when tides are rising it is not good for fishing. Rising tides are, normally, characterized by churning water which is not good for fishing for most of the fishing gears.

Table 51: - Opinion on influence of 'Falling tides' on fishing by Planning Area

Scale	Planning Area							Total
	Catamoio	Gelo	Inguri	Kwirikwidge	Quelelene	Sangage	Thamole	
Very good	40	26	19	11	14	30	12	152
Reasonable	-	2	1	-	-	2	-	5
Bad	1	1		-	-	-	-	2
TOTAL	41	29	20	11	14	32	12	159

Falling tides occur from the 1st to 8th day which is new moon phase and from 16th to 23rd day coinciding with full moon phase. As shown in table 51, from a total of 159 fishermen interviewed on falling tides condition for fishing, 152 respondents (96%) said that falling tides offer "very good" conditions for fishing. Generally, falling tides are considered peaceful allowing fishing practices for most of the fishing gears.

In terms of dirty water influence of fishing and as shown in table 52, 159 fishing villagers were interviewed. A number of 143 respondents (90%) said fishing in conditions where water is dirty offers "very good" fishing conditions; 12 fishermen (7,5%) said that dirty water offers "bad" conditions for fishing and a small number of informants 4 (2,5%) said that dirty water offered "reasonable" conditions for fishing.

Table 52: - Opinion on influence of 'Dirty water' on fishing by Planning Area

Scale	Planning Area							Total
	Catamoio	Gelo	Inguri	Kwirikwidge	Quelelene	Sangage	Thamole	
Very good	40	27	18	9	14	24	11	143
Reasonable	1	1		-	-	2	-	4
Bad	-	1	2	2	-	6	1	12
TOTAL	41	29	20	11	14	32	12	159

Of 159 interviewees asked about water transparency influence on fishing, 141 informants (89%) said that catches are "bad" when fishing in places where water is transparent; 11 interviewees (7%) said that fishing in transparent water results in "very good" catches while 7 fishermen (4%) said there are "reasonable" catches when fishing in transparent water as shown in table 53.

Table 53: - Opinion on influence of 'Water transparency' on fishing by Planning Area

Scale	Planning Area							Total
	Catamoio	Gelo	Inguri	Kwirikwidge	Quelelene	Sangage	Thamole	
Very good	-	1	2	2	-	5	1	11
Reasonable	1	2	-	-	-	4	-	7
Bad	40	26	18	9	14	23	11	141
TOTAL	41	29	20	11	14	32	12	159

Arguments put forward by respondents were that in dirty water, fish is not able to see the fishing gear and can therefore be easily captured. However, in conditions where water is transparent, fish can easily see the fishing gear and quickly swimming away.

5.2.8 – Management measures

General indicators for artisanal fisheries management were also collected. In this regard, respondents were interviewed about the best and worst months for fishing and also on the best areas or zones for fishing activities and limits according to type of fisheries such as artisanal, Semi-industrial and Industrial fisheries. Information on areas or zones of activities as well as respective limits is not given here. Only information on best and worst months is described in this section.

As shown in table 54, a total number of 156 informants were interviewed. From a total number of informants 89 informants (57%) said that January to June were the best months for fishing; 27

fishermen (17%) said that the period from January to March gives best fishing results; 14 respondents (10%) said that the best months for fishing were from April to June; 10 artisanal fishermen (6%) indicated October to December as best months for fishing; 9 respondents (6%) saw July to September as best months for fishing while 7 people (4%) said they catch more fish during the last six months (July to December) of the year.

Table 54: - Opinion on 'Best season' for fishing by Planning Area

Period	Planning Area							Total
	Catamoio	Gelo	Inguri	Kwirikwidge	Quelelene	Sangage	Thamole	
Jan-Mar	14	7	1	1	1	3	-	27
Apr-Jun	4	1	1	2	2	2	2	14
Jul-Sep	1	1	4	-	-	2	1	9
Oct-Dec	1	2	4	-	1	2	-	10
Jan-Jun	17	16	10	7	10	20	9	89
Jul-Dec	4	1	-	1	-	1	-	7
TOTAL	41	28	20	11	14	30	12	156

Generally, 130 fishing villagers (83%) indicated the first six months of the year as best period for fishing while 26 respondents (17%) said that July to December were the best months. Comparing table 30 (fishing period by PA) and table 54 (best months for fishing), there is similarity in the responses given by the respondents.

Table 55: - Opinion on 'Worst months' for fishing by Planning Area

Period	Planning Area							Total
	Catamoio	Gelo	Inguri	Kwirikwidge	Quelelene	Sangage	Thamole	
Jan-Mar	-	1	1	1	1	1	1	6
Apr-Jul	-	1	-	-	-	-	-	1
Jul-Sep	8	-	-	-	-	2	6	16
Oct-Dec	3	3	2	2	-	4	1	15
Jan-Jun	5	2	7	-	1	3	-	18
Jul-Dec	24	21	10	8	12	20	4	99
Total	40	28	20	11	14	30	12	155

Concerning the worst fishing months as shown in table 55, 155 fishing villagers were interviewed. Most of them 130 (84%) indicated the second six months as the worst period for fishing. As shown in table 55, those 130 fishing villagers are distributed as follows: - 99 informants (64%) for July to December; - 16 fishermen (10%) for July to September and -15 interviewees (10%) for October to December, respectively.

5.3 – Winds identification

The identification of winds is an important step in the process of fishing zones identification. Wind is an important determining factor for fishing. Type of clouds, their disposition in the sky; stars, direction and the speed in movement of the clouds and the sea birds species are basis for identification of winds**.** Clouds, stars, sea birds and human body temperature are indicators identified by local fishermen for winds identification. In this regard, local indigenous knowledge in the study area identified eight (8) types of winds although only six types of winds are described in this section because of their particularities:

i) – South wind (*Kussi*)

It is the wind which blows from south to north. It has been always taken as reference for the identification and characterization of other winds. Normally, south wind is characterized by very heavy winds with big waves which do not offer conditions for any fishing activity. According to local knowledge, April to June is the period the south wind, normally, occurs.

For south wind identification, fishermen observe the sky, very early in the morning (2 to 4 o'clock am). If there are cloud formation in the south part of sky line this is taken as a strong indication that south winds will occur, depending also on the type, tonality and movement of these clouds. Dark cloud formation moving quickly northward results, frequently, in a sudden occurrence of the south wind. Bright cloud formation and stacking at the sky-line normally means that the south wind will occur later on. South wind also occurs when a "known star" is observed at night or early morning rising from south and quickly moving, as an arrow, to the north part of the sky and then suddenly disappears. The stars' strong scintillation at night observed in the sky is also a potential indicator for occurrence of the south wind.

Sea birds are another strong indicator for the occurrence of the south wind. "Gaivotas" (maruerue), are the sea birds species known as good indicators of the winds occurrence, specially, for those very

heavy and dangerous winds, particularly, south or south east winds. As soon as "*maruerue*" (local name), leave the islands to the continent in large numbers, fishermen or other people in the sea must quickly giving up everything they are doing and go for very quickly to safe places for their protection because the heavy wind will, suddenly start to blow. Also, sea waves' noise heard from any direction is also a strong indicator for wind occurrence.

In this regard and according to local indigenous knowledge, if fishermen are fishing, they have to take precautionary measures as soon as they observe the formation and/or appearance in the sky of the very dark clouds in the southern part of the sky-line and very quickly the clouds start moving towards the northerly direction. When this happens, fishermen are, immediately obliged to give up fishing and look for some safe places because the south wind is likely to suddenly start blowing.

ii) – North wind *(Kashkazi)*

This is the wind blowing from north to south. Generally, it is considered as a good wind for fishing, except when it is very strong. The main indicator for identification of the north wind is the formation of the clouds in the north sky-line. The explanation given in "south wind" on clouds is also valid here. North wind appears also as the response of the south wind. According to the fishermen, as soon as the south wind blows, the north wind is expected to blow afterwards. The North wind, normally, occurs from October to December.

iii) – West wind (*Mmathe***)** and **East wind** (*Madulai*)

The west wind blows from west to east upward and the east wind blows in the opposite direction. According to local knowledge, west and east winds are the most preferable for fishing, mainly, because they are peaceful, especially, when they do not suffer influence from the south wind. When these are influenced by the south wind then they are not usually good for fishing. For their identification and explanation, cloud cover and direction are also used as previously elaborated.

iv) - South East wind (*Phalalazi*) **and South West** (*Olani*)

The South East wind is as a result of the confrontation between South and East winds. According to fishermen, this confrontation always results in very dangerous winds for fishing. The South East wind is therefore considered the worst and is similar to the south wind because of its violent character

especially if it is influenced by south wind. Fishing villagers argue that the South East wind is responsible for many of the sea disasters mainly because it is difficult to identify it in time to escape. Similarly, the South West wind is also as a result of the confrontation between the South and West winds. Contrary to the South East wind though, the South West may offer sometimes, good conditions for fishing, especially when it is less influenced by south wind. Cloud cover and its direction are also used to identify them.

Besides the winds described, there are other types of winds identified like North the West (confrontation between north and west winds) and North East (confrontation between north and east winds). Generally these are considered reasonably good winds. As argued by local fishermen, North West and North East winds are reasonable good winds for fishing mainly because they enjoy the influence of north, west and east winds which are normally peaceful winds. For their identifications, cloud formation is also used.

v) – Human body

The "*Human body*" has also been used as a potential indicator, particularly for the change of weather. At night, if the human body temperature rises or if those people suffering from "*asthma*" face serious problems of breathing or men suffering from "*hernia*" diseases observe abnormal changes in their bodies, these are indicators that, in near future, bad weather will occur. According to artisanal fishermen, for fishing, these human symptoms are indicators for bad wind occurrence.

5.4 – Artisanal fishing zones identification

This section examines how fishermen identify fishing zones where they usually fish using their indigenous knowledge. In this regard, darkness of the sea water, sound of the rocks, tonality of the sea waves, birds signal, visibility and self-experiment are the main characteristics or indicators as well as pre-requisites for identifying artisanal fishing zones.

i) – The "darkness of the sea water"

This is the most common and dependent indicator frequently used in the artisanal fishing zones identification. In the process of looking for better and productivity fishing zones, fishermen, while navigating with their traditional boats (dug canoes and/or wooden boats), they concentrate on

observing sea water characteristics or appearance. When they observe dark sea water in a specific area, they stop and keep fishing. Cumulative results from their experience on such areas, have demonstrated that places characterized by sea water darkness at the surface are potentially good fishing zones. The explanation underlying this indicator is that the sea water darkness at the surface results from the existence of fish on the sea bed. Once the fish is there, in the process of feeding themselves and moving around, they shake physical components lying in the sea bed and, as result, darkness is always observed on the sea water surface.

ii) – The "sound of the rocks"

This is also another potential indicator, especially, for fishing zones identification where the sea bed is characterized by rocks. According to fishermen, when someone goes for fishing, normally one does not, at the first glance, know exactly where the fish are. While searching for fishing zones, fishermen are, carefully, concerned of any situation giving them probability of discovering fish presence. Their experiences have demonstrated that navigating on top where the sea bed is a rock, a special sound is transmitted by the rocks to the fisherman's boat or canoe. As soon as the sound is heard on board the fisherman stops and start fishing there. Fishermen know the species caught on the rock areas. Another aspect confirming they are fishing on top of rocks is that fishing hook used, sometimes, it is stacking on rocks making it impossible to get it back. Sometimes, when is good weather, rocks can, easily, being seen.

iii) – The "tonality of the sea waves"

This is a complementary indicator to rock sea bed fishing zones identification. At the sea water surface where there is a rocky sea bed, the sea wave's formation or performance change their tonality and become more bright/light than those in other places where there is no rock sea bed. As soon as this signal is observed, normally at a distance, fishermen go straight there for fishing. Fishermen argue that their cumulative experiences show that such places yield very good catches.

iv) – The "birds signal"

Fishermen said that certain bird species are extremely good indicators for fishing zone identification. "*Gaivotas*", sea birds known as "*maruerue*" in local language, if observed flying, frequently at certain places on the sea water, are an excellent indicator that there are plenty of fish in that area.

Fishermen said that these birds feed themselves by fishing so that there are no doubt that the places where they frequently fly are abundant with fish. Fishing in those areas, fishermen have had excellent results.

v) – The "visibility"

For fishermen, "visibility" is another indicator on which they base fishing zones identification. In the process of fishing it is possible to see either fish or rocks when sea water is transparent, especially, when there is good weather. Looking into the water, fishermen may observe that this place has a rocky sea bed or they can see the fish exists in water.

vi) – The "self-experiment"

In most of the cases and without any background knowledge on how to identify fishing zones, fishermen simply keep experimenting fishing in various places. The results from the experiments are taken into further consideration for localization of the already discovered fishing zones.

Fishing zones identification is not by itself the end of the process. Identified fishing zones have to be localized for further fishing use. In this regard, for localization of the identified fishing zones, remarkable physical features on the continent are taken as bases. Most of the features taken for fishing zones localization are the highest points situated in the land like mountains, very high and big trees, the beacons, where they exist, dunes and the mouths of the rivers. As soon as the fishing zones are identified in the sea, fishermen carefully look for physical features for localization of the area using natural coordinates on land. The localization of the identified fishing zones is then "very crucial" step because once mistakes are done in this process, the identified fishing zones can be, easily, lost. So, fishing zones identification is, jointly, done with its occupying localization through the physical features situated on land. As shown in plate 5, particular emphasis was given to the indicators used for artisanal fishing zones identification into the open sea or offshore.

“Gaivotas” (maruerue) as indicators for fishing zones identification

Interviewing an old fisherman

Plate 5 – Fishing zones’ indicators and winds identification in fishing villages

5.4.1 – Spatial and non-spatial data collection

Two types of data were gathered in the process: - Spatial data, encompassing coordinates (latitude and longitude); and, - data characterizing the identified fishing zones like code, sea bed, fishing gear, main species and area cover. A Global Positioning System (GPS) was the technical instrument used for spatial data (coordinates) recording. For data characterizing fishing zones, a specific form was used. The spatial data were given by Degrees, Minutes and Seconds (Hddº mm' ss.s"). All the recorded coordinates (latitude and longitude) were kept on the pre-conceived form for further use. Due to the bad weather (south wind) observed at the time coordinates were recorded in the open sea, very few fishing zones (8) were identified. In future, further work in demarcating zones will be done. Details of the data (spatial and non-spatial) gathered in the identified fishing zones are given in table 56 below.

Table 56: - Spatial and non-spatial data in the fishing zones

LATITUDE	LONGITUDE	CODE	FISHING GEAR	SEA BED	AREA	Main species
16-24-453 S	039-59-550 E	IFZ(A)	Hand line	Rocks	Radius (1km)	xaréu, atum, vermelhao
16-20-108 S	040-02-582 E	IFZ(B)	Hand line	Rocks	Radius (1Km)	Sera, atum, xaréu
16-20-230 S	040-04-661 E	IFZ(C)	Hand line	Rocks	Radius (1Km)	Ladrão, salmonete, fuso
16-20-396 S	040-04-590 E	IFZ(D)	Hand line	Rocks	Radius (1Km)	Dourado,garoupa, ladrão
16-24-487 S	039-59-670 E	IFZ(E)	Hand line	Rocks	Radius (1Km)	Pargo, pescada, tubaão
16-28-093 S	039-55-487 E	MFZ(F)	Gillnet	Clay & rocks	Radius (1Km)	Espada,, pescada, garoupa
16-29-861 S	039-53-407 E	MFZ(G)	Gillnet	Sandy	Radius (1Km)	Sardinha, carapau, pescada
16-24-504 S	039-59-508 E	IFZ(H)	Hand line	Rocks	Radius (1Km)	Atum, garoupa, tubarão

5.4.2 – Spatial and non-spatial data processing

Spatial data (latitude and longitude) and data characterizing fishing zones were later organized in a table. Spatial data were first converted into "*milessimus*" to be compatible to the ArcGIS, the software used for spatial and non-spatial data processing and analysis. For converting spatial data, the following formula was applied: **Y (Latitude)** = *Hddº + mm' x 1/60 + ss.s" x (1/60)2*; **X (Longitude)** = Hddº + *mm' x 1/60 + ss.s" x (1/60)2*. The result of the converted spatial data is given in table 57.

Table 57: - Converted spatial data

Y (Latitude)			X (Longitude)				Code	Y (Latitude)	X (Longitude)
16o	24’	33”	39o	59’	10”		IFZ(A)	-16.4091667	39.9861111
16o	20’	48”	40o	2’	42”		IFZ(B)	-16.3466667	40.0450000
16o	20’	50”	40o	4’	1”		IFZ(C)	-16.3472222	40.0669444
16o	20’	36”	40o	4’	50”		IFZ(D)	-16.3433333	40.0805556
16o	24’	7”	39o	59’	10”		IFZ(E)	-16.4019444	39.9861111
16o	28’	33”	39o	55’	7”		MFZ(F)	-16.4758333	39.9186111
16o	29’	21”	39o	53’	47”		MFZ(G)	-16.4891667	39.8963889
16o	24’	24”	39o	59’	28”		IFZ(H)	-16.4066667	39.9911111

Due to the geographical position that Mozambique lies on in the world globe (South East (SE) quadrant), the latitude or the value of Y (Latitude) must be “negative”. The converted spatial data as shown in table 57 were later saved in the DBASE IV compatible and/or readable in the ArcGIS software for further use.

Spatial and non-spatial data were further put together in table 58, later saved in the DBASE IV and/or Accel programme. The ArcGIS was the software used for spatial and non spatial data processing and analysis. As shown in figure 15, the following GIS stapes were then applied for putting data into a map: **-** open ArcMap; **-** open the existing map (Angoche coastal map) in “Layer”; **-** localization of the file (table of spatial and non-spatial data) in C drive; **-** open the menu “Tools” – go to Add XY data; **-** open sub-menu “Choose a table from map and browse it; **-** launch data into map by clicking “OK”.

Table 58: - Processed spatial and non-spatial data for the identified fishing zones

Code	Y (Lat)	X (Long)	Fishin’ gear	Sea bed	Distance	Main species
FZ1	-16.409167	39.986111	Hand line	Rocks	8Km	xaréu, atum, vermelhao
FZ2	-16.346667	40.045000	Hand line	Rocks	12Km	Sera, atum, xaréu
FZ3	-16.347222	40.066944	Hand line	Rocks	14Km	Ladrão, salmonete, fuso
FZ4	-16.343333	40.080556	Hand line	Rocks	15Km	Dourado,garoupa, ladrão
FZ5	-16.401944	39.986111	Hand line	Rocks	8Km	Pargo, pescada, tubaão
FZ6	-16.475833	39.918611	Gillnet	Clay & rock	8Km	Espada,, pescada, garoupa
FZ7	-16.489167	39.896389	Gillnet	Sandy	8Km	Sardinha, carapau, pescada
FZ8	-16.406667	39.991111	Hand line	Rocks	8,5Km	Atum, garoupa, tubarão

Verification and adjustment of the map containing spatial and non-spatial data resulting from the ArcGIS application was, lastly, done in the data application process. A basic map in figure 16 below showing the identified artisanal fishing zones in Angoche coastal zone was, finally, produced.

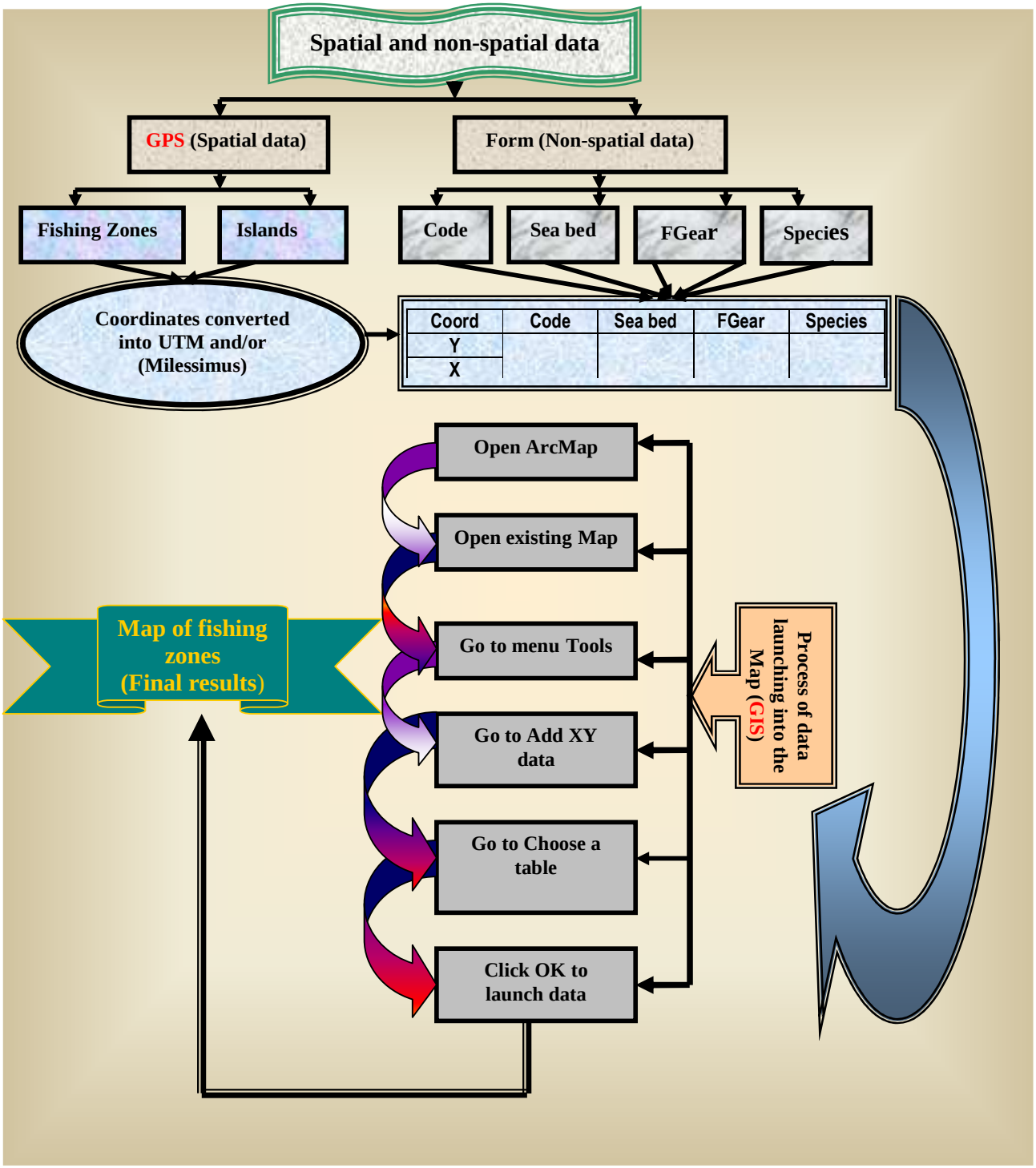

Figure 15 - Flowchart on spatial and non-spatial data

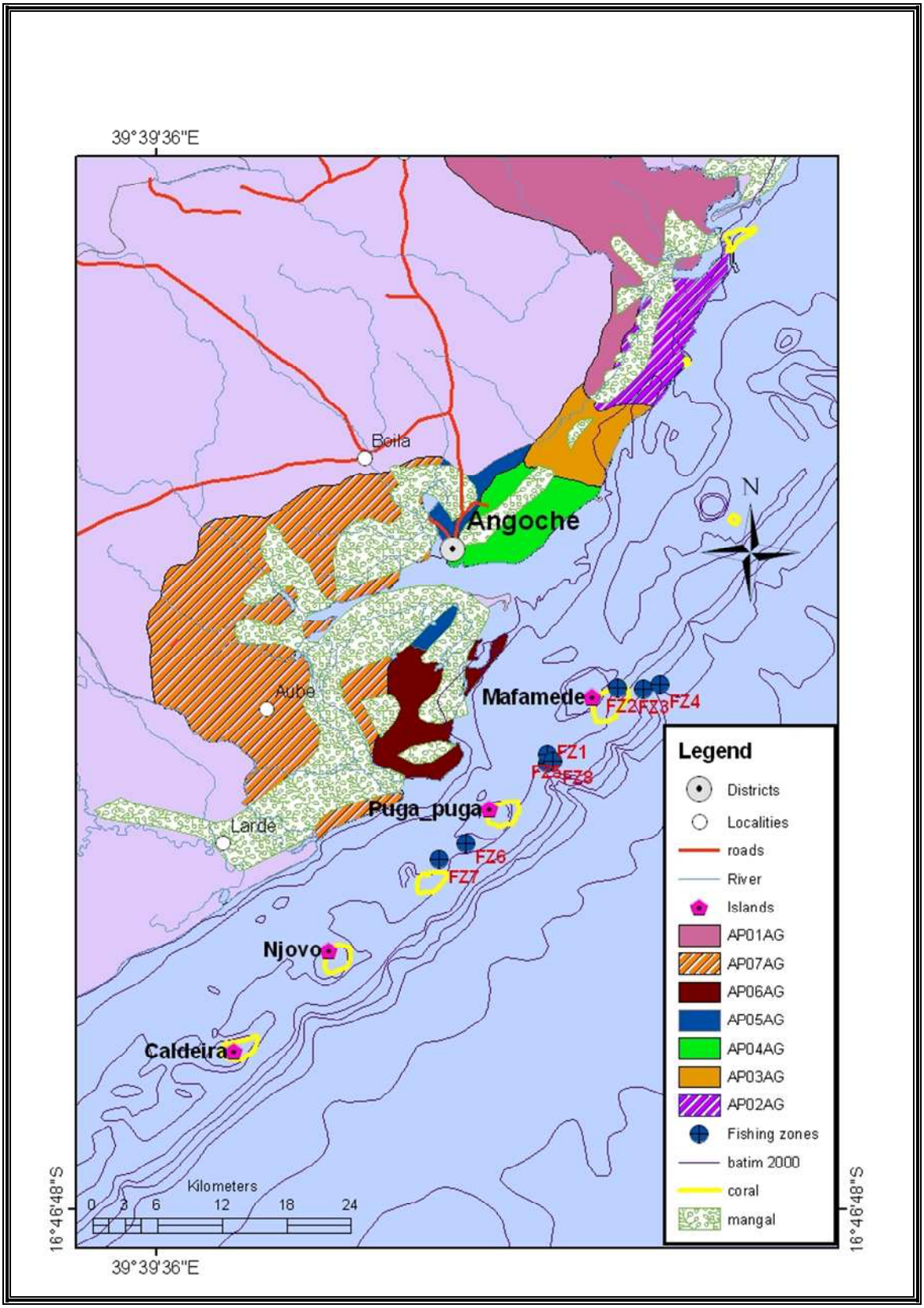

Figure 16 – Map of identified artisanal fishing zones

5.5 – Conclusion

The information analyzed in this chapter shows the potential of the indigenous knowledge used in the fishing communities. Emphasis has been given to atmospheric and oceanic factors and how these influence fishing decisions. Particular emphasis was given to the indicators used for artisanal fishing zones identification in the open sea or offshore;

In the whole seven (7) planning areas cover by the study there is a strong influence of fishing activities. In addition, there are also other economic activities such as agriculture and the informal sector. The fishing activity is, by nature, a seasonal activity. In this regard and taking into account the challenge to fisheries management arrangements, the practice of other economic alternatives is an indicator which can, positively, contribute for the sustainable fisheries management in the study area. For example, fishermen can practice alternative economic activities for their survival while they are observing certain sustainable fisheries management measures;

In almost all seven planning areas, fishing villagers can communicate using Portuguese (official language spoken in the country). In those planning areas, there are strong religious influence and/or beliefs which contribute to tie people to live together in an organized manner. Gender related issues are ongoing in those planning areas. In this regard, language, community organization and gender issues are determinant indicators which can be taken into consideration for government development programmes for the fishing communities;

The fishing villagers in the study area strongly observe and practice traditional and cultural beliefs, particularly for fishing purposes. The knowledge they have regarding fishing like that in atmospheric factors (rainfall, drought, wind and lunar cycle) as well as in oceanic factors (tidal cycle and sea water characteristics) is a result of cumulative knowledge through generations and they have used it for centuries for their survival. This knowledge is embedded in the whole community. Integrating and/or combining this knowledge with scientific knowledge and validating it can, feasibly, contribute for better fisheries management in the fishery sector.

CHAPTER 6

Discussion and conclusion

6.1 – Introduction

This chapter discusses the main findings resulting from the data analysis and draws various conclusions. The role of indigenous knowledge use in Artisanal fishing zones identification is emphasized. Research hypotheses and research questions are the basis for the discussion. In the conclusion, research objectives are taken into consideration. Data on socio-economic, technological and climate characteristics that have been analyzed was meant to give a picture on the administrative organization and the socio-economic characteristic of the fishing communities in the study area. The detailed information on what knowledge fishers use and the process they go through in selecting fishing zones, when to fish what methods to use etc have been identified in order to understanding factors underlying local artisanal fishing zones identification.

6.2 – Discussion

The discussion in this a section is centred on research hypotheses and questions. Based on the analyzed data from the previous chapter 5, the discussion establishes the relationship between the indigenous and scientific knowledge in the process of identifying artisanal fishing zones. Emphasis is given to the hypotheses testing and the response to the research questions. Conclusions are then drawn based on the research objectives.

6.2.1 – Research hypotheses

i) – Effectiveness absence of indigenous knowledge use in identifying Artisanal fishing zones

The analyzed data shows that indigenous knowledge use in artisanal fishing zones identification is based on indicators. Some of these indicators are physical like “darkness”, “rocks sea bed”, “sea birds signals” and visibility. These physical indicators can also be monitored scientifically for their effectiveness and can be incorporated into the scientific (anthropological) research models where possible. In this regard, indigenous knowledge use in identifying artisanal fishing zones would appear to be effective. By so doing, this would disprove “*hypothesis 1*” as being untrue.

Supporting arguments on the above finding have been put forward by a number of authors. NOOA, (2004) for example, argues that traditional ecological knowledge (TEK) is a body of knowledge and

beliefs transmitted through oral tradition and first-hand observation. TEK includes a system of classification, a set of empirical observations about the local environment and a system of self-management that governs resource use. It varies among community members, depending upon gender, age, social status, intellectual capability and profession. It is both cumulative and dynamic, building upon the experience of earlier generations and adapting to the new technological and socioeconomic changes of the present.

ii) – Absence of the relationship between indigenous and scientific knowledge in identifying artisanal fishing zones

The process of identifying artisanal fishing zones, indigenous knowledge is concern the use of physical indicators (darkness, birds, rocks and water transparency) as well as direct observation. Atmospheric factors (rainfall and drought, winds and moon) and oceanic factors (tides, dirtiness and water transparency), are also used. All these are directly or indirectly connected to fishing zone in terms of the way they influence fishing discussions.

Authors supporting the use of indigenous knowledge in artisanal fishing zones identification also argue that traditional ecological knowledge is based on observation of recurrent natural phenomena, which allows fishermen to make decisions about the timing of fishing activities, selection of favourable fishing locations and the use of appropriate techniques for specific species. Without this fine-tuned knowledge, it would be impossible for fishermen to earn a livelihood within an ever-changing and frequently dangerous maritime environment (*Samudra, 2006)*.

Scientifically, very little information has been validated in this regard. The National Institute for Fisheries Resource (IIP) is now starting with an artisanal fisheries mapping programme, but this is still in an embryonic stage. However, the little information that has been collected in this regard indicates that, scientifically, fishing zones identification is based on sea bed physical characteristics (*sub-strata*) and the species caught living in those sub-strata. Logically, factors influencing fishing are, scientifically, also taken into account.

Comparing the basis used either by indigenous or by scientific knowledge in the artisanal fishing zones identification shows the existence of a relationship between these two types of knowledge. The existing relationship between the two knowledge leads one to argue that "*hypothesis 2"* is also untrue.

iii) – No role played in integrating indigenous knowledge for Artisanal fisheries management

The approach on indigenous knowledge use for artisanal fishing zones identification is all about fishing zones into the open sea or offshore. Pushing artisanal fishermen offshore or into the open sea, is a trend for alleviating the use of those fishing zones surrounding beaches, estuaries, bays that have been heavily exploited by artisanal fishermen. In this regard, alleviating fishing activities in inshore areas by pushing fishermen to fish offshore or into the open sea is meant to contribute to the sustainability of artisanal fisheries. It is also meant to enable artisanal fishermen to fish on higher quality and higher economic value fish contributing to enhancement their income in order to uplift their living standards. Furthermore, the main fishing gears used offshore or in the open sea are hand line, gillnet and diving which are considered selective fishing gears compared to those used inshore which are mainly beach seine and quinia which are unselective and destructive fishing gears.

Data and information on indigenous knowledge described in this dissertation shows the potentiality of use of this type of knowledge in fisheries management. For example, indigenous knowledge identifies southerly wind (*Kussi)*, southerly east wind (*Phalalazi)* and rising tides as the worst and dangerous conditions for fishing. Rainy season and dirty water are identified as good conditions for fishing. Scientifically, rainfall and dirtiness are related with providing nutrients for fish breeding. It is also pointed out that from March to September, southerly, southerly east and southerly west winds occur with 85% of intensity which means they are very heavy and dangerous for fishing (MDN, 1986). The information herein shows the potentiality of indigenous knowledge which can be integrated into science for sustainable artisanal fisheries management. Furthermore, indigenous knowledge fishing uses relatively simple technology which limits impact on environment leading to sustainable artisanal fisheries management.

Arguments put forward by some authors substantiate that local knowledge as a system of power can provide a basis for the empowerment of communities to undertake community-based resource management, particularly, in tropical, multi-species fisheries and their environments, for which the scientific knowledge is still relatively poor (Diegues, 2002). As mentioned elsewhere in this dissertation, government interventions based only on scientific knowledge models have been ineffective for sustainable fisheries management. In this regard, it is clear that indigenous knowledge alone plays an important role in artisanal fisheries management. Its integration into scientific knowledge for artisanal fisheries management could play an important role in sustainable artisanal fisheries management. This indicates that "*hypothesis 3*" is also untrue.

6.2.2 - Response to the research questions

i) – Artisanal fishing zones identification using only indigenous knowledge

Artisanal fishermen, using their indigenous knowledge, identify different types of winds and how winds manifest themselves as well as their occurrence to explain the way these influence fishing. They identified tidal and lunar cycles and established the relationship between tides and moon in fishing. Traditional and cultural practices were identified, explained and their relationship to fishing was established. Physical indicators (darkness of the sea water, rocky sea bed, tonality of the sea waves, birds signal, and visibility) as well as their relationship with artisanal fishing zones identification were identified, explained and established. Using Geographical Information Systems, the physical indicators identified by local fishermen using their indigenous knowledge were later processed and a map with output of the information given produced showing the localization and distribution of the artisanal identified fishing zones.

The beliefs such as “cleaning cemeteries”, “Hijabo, Olomba, Lihuco ceremonies” and others, play an important role on fishing activities and in the daily life of the fishermen. The observation of these traditional and cultural beliefs gives to the fishing communities’ confidence and courage in their fishing activities. As argued, indigenous knowledge, as a body of knowledge, is stored in peoples’ memories and activities and is expressed in stories, songs, folklore, proverbs, dances, myths, cultural values, beliefs, rituals, community laws, local language, agricultural practices, plant species, and animal breeds. Indigenous knowledge is shared and communicated orally, by specific example, and through culture. Indigenous forms of communication and organization are then vital to local-level decision-making process and to the preservation, development, and spread of indigenous knowledge (Grenier, 1989). Relying on those traditional and cultural practices, artisanal fishermen, normally, present their gifts to the ancestors before their fishing units are launched from the shore. They do so because they believe that, those who do not praise their ancestors and goddess of the sea will have small catches.

Traditional and cultural practices could not be logically linked to scientific explanation. Time limitation did not allow collecting catch data for empirical analysis, as fishermen do not keep records. Catch data could show the extent to which traditional and cultural practices are related to scientific knowledge, mainly, by comparing catches between to those who observe these practices before going for fishing and those who do not.

ii) – Factors underlying artisanal fishing zones identification

Indigenous knowledge identified atmospheric and oceanic factors as the main factors underlying the identification of artisanal fishing zones. Atmospheric factors include rain, drought, wind and moon and oceanic factors are tides, water dirtiness and water transparency. Other factors such as mangrove cover, river presence, dense forest and undulating terrain, were also identified as useful.

iii) – Relationship amongst physical and climate characteristics and species in fishing zones

Local indigenous knowledge considers that physical coast characteristics consisting of mangrove cover and rivers they have a very strong influence in fishing zones as shown in tables 25 and 26, respectively. Contrary to the previous, dense forest (table 27) as well as undulating terrain (table 28) they do not have fishing influence at all.

Climate characteristics consisting of atmospheric factors such as rain, drought, wind and moon and oceanic factors encompassing tides, water dirtiness and water transparency, have either very strong or bad fishing influence. Relatively to winds, north, west and east winds have very strong influence in fishing as shown in tables 38, 40 and 41, respectively. South and south east winds, tables 39 and 42, have bad fishing influence and south west winds have reasonable fishing influence. Concerning to rainy as shown in table 44 this has very strong influence while dry season, table 45, has bad fishing influence.

In regard to the lunar cycle, new moon, table 46 and first quarter moon, table 48, have a bad influence on fishing; full moon, table 47, has a very good fishing influence and second quarter moon in table 49, has a reasonable influence on fishing. Tidal cycle consisting of rising tides as shown in table 50 has bad influence and falling tides, table 51 has very good influence on fishing. Water dirtiness, in table 52, has very strong influence and water transparency, in table 53, has bad fishing influence, respectively.

Normally, new moon phase (table 46) and full moon phase (table 47) should both have “very strong” influence on fishing, simply, because they coincide with falling tides (table 51) which have “very strong” influence on fishing. In this regard, only full moon phase offers “very good” conditions but new moon phase does not do so. First and second quarters moon phases (tables 48 and 49) should both have “bad” influence in fishing because they also coincide with rising tides (table 50) which

have “bad” influence on fishing. In this case, second quarter moon does not exactly show this relationship. The slight incongruence on lunar and tidal cycles’ relationship, in terms of conditions on fishing, may be due to other complementary factors influencing fishing such as weather conditions.

6.3 – Remarks

For indigenous knowledge, the appropriation of the sea and its resources is expressed in the principle and practice of “knowing-how” marine territory is constructed and ritualized by means of tradition, apprenticeship, experience and intuition. This know-how is only attainable by those with experience and intuitiveness, which comes from understanding what tradition is in specific cultural and work/ production contexts of fishing apprenticeships (*Samudra, s/d*). In this regard, traditional practices that limit overexploitation of resources can be considered to enhance or support biological conservation, in a modern, scientific sense. Under these conditions, those practices mediated by beliefs in mythological beings purposely chosen to avoid over fishing may play an important role in modern fisheries management.

Wilson, et all., (2006) argues that local ecological knowledge (LEK) directly linked to the problems users are facing, and ecological sustainability has better chances of being achieved if allocation issues are being addressed as an integral part of the process. *The backbone of a good adaptive fisheries management system is a good data collecting system that enables multi-disciplinary analysis and provides the assessment to support to management institutions*. To make an effective contribution, however, such information can only be revealed as part of comprehensive studies involving ongoing interactions between fishers, scientists and other stakeholders.

Geographical Information Systems are tools that combine ordinary statistics with geographic location to create meaningful, clear and attractive maps that can be applied to development needs. Due to the spatial nature of Indigenous Knowledge System (IKS), Geographic Information System technologies can facilitate the inclusion of IKS in local decision-making process. However, up until now the possible application of GIS in IK management has been inadequately explored (Tripathi and Bhattarya, 2004).

6.4 – Conclusion

In this section, conclusions are drawn based on overall description and analysis in the preceding six (6) chapters of the dissertation. They are also meant to give response to the objectives of the study as follows.

i) - Understanding how artisanal fishermen identify fishing zones using their indigenous knowledge

Results from this dissertation show that identification of fishing zones offshore or in the open sea can be done simply and based, only, on local indigenous knowledge without scientific knowledge support. Based on the analyzed data, there is a clear understanding that artisanal fishermen have fished for long time and continue to fish in the fishing zones identified by them into the open sea using their own accumulated knowledge.

ii) - The extend to which indigenous knowledge can be scientifically correlated

Water darkness, sea birds, water tonality and rock sea bed, are indicators indigenous knowledge use for fishing zones identification. These indicators can be scientifically correlated and they are neither superstitious nor ineffective. Scientifically, fishing zones identification is based on sea bed, sub-strata and species caught on those environments. The existing relationship between indigenous and scientific knowledge in fishing zones identification does not show any contradiction and the indicators used either in indigenous or in scientific knowledge do match each other. In this regard, indigenous and scientific knowledge can be effectively and significantly correlated.

iii) - Potential for the use of indigenous knowledge in decision-making for artisanal fisheries management by government and other development agencies

Identification of fishing zones offshore or into the open sea is a trend for reducing pressure in inshore areas, those fishing zones surrounding beaches, estuaries, bays that are already heavily exploited. In this context, fishing offshore or into the open sea is supposed to contribute to sustainable artisanal fisheries management. It also enables fishermen catch better quality and higher economic value fish contributing to enhancement of their income and the uplifting of their living standards. The fishing gears used offshore or into the open sea are, mainly, hand line, gillnet and diving which are considered selective, compared to those used inshore like beach seine and quinia which are

considered destructive fishing gears. Thus indigenous fishing practices use relatively simple technology that limits impact on environment leading to sustainable artisanal fishing practices.

Evidence obtained in this study from fishermen in relation to atmospheric and oceanic factors shows the potential of the indigenous knowledge for use in fisheries management, even though at local level this is used to make decision about when it is safe to fish and where fish in order to meet fishing communities' needs for their daily survival. Based on the produced and analyzed knowledge in this dissertation, artisanal fishermen as well as government and other development agencies can take important decisions for effective and efficient artisanal fisheries management. The information herein described and analyzed is conceived, constructed and updated within the fishing communities' indigenous knowledge systems on a daily basis using their experiences on the fishing grounds.

iv) - Potential for use of GPS and GIS in artisanal fisheries management purposes

Global Positioning System (GPS) is a constellation of orbiting satellites maintained for the purpose of defining geographic positions on and above the surface of the earth. Due to its capacity for recording and storing spatial information which can be used for many other purposes, GPS has been used in this study to collect spatial data (latitude and longitude) of the artisanal fishing zones identified by fishermen. Geographical Information Systems (GIS) are tools that combine ordinary statistics with geographic location to create meaningful, clear and attractive maps that can be applied to development needs. GIS was used in this study to process, visualize and produce spatial and non-spatial data given by indigenous knowledge in fishing zones identification. In this regard, GPS and GIS technology facilitated the inclusion of indigenous knowledge into other knowledge which can be used for local decision-making processes.

Summing up, documenting and mapping indigenous knowledge intends to preserve and honor knowledge held by local indigenous people, people whose ancestors have long inhabited a region, or people who are new to a region and bring their own traditions to a new community. Indigenous Knowledge is not in itself capable of addressing all the issues related to sustainable fisheries management. Sustainable fisheries management may well be better served by a system that incorporates both indigenous and scientific knowledge systems. Sustainable fisheries management can only be achieved by developing a science based on the priorities of local people, and creating a technological base that includes both traditional and modern approaches to problem-solving.

Addressing and including indigenous knowledge is, mainly, to bring it into the present as a contemporary means of constructing valid knowledge about local communities. Local communities are not simply the source of raw data for academics, but they must be seen as key players in the construction of knowledge about their societies. As argued by many authors, indigenous knowledge is an enormously valuable resource base but one which is often treated in a far too casual manner by scientists.

6.5 - Recommendation

This research was undertaken for academic purposes in a much reduced time scale, which neither enabled going into deeper aspects nor to cover large coastal areas. Fishing offshore or into the open sea is a challenge government has to overcome to reduce pressure in inshore zones. Results from this research show that identification of fishing zones offshore or into the open sea can be done simply and based on local indigenous knowledge as shown in plate 6. In this regard, it is recommended that Ministry of Fisheries in Mozambique through IDPPE designs a national programme for artisanal fishing zones identification into the open sea using indigenous knowledge covering the more critical coastal zones where inshore resources are depleted and need to be replenished. This can then be combined with scientific knowledge and other techniques such as GIS and GPS in order to produce an integrated knowledge framework for sustainable fisheries management.

Spatial and non-spatial data recording

Artisanal fishermen fishing offshore

Plate 6 – Artisanal fishing zones identification in Angoche coastal zone

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APPENDIX 1

QUESTIONNAIRE FOR INDIVIDUALS

1 - General information

1.1 - Date: / /2007 **1.2** - Form nr: _____

1.3 - Interviewer: _____

2 – Interviewee's details:

2.1 - □ Fisherman
2.2 - □ Fisherwoman

2.3 - Category:

2.3.1 - □ Owner **2.3.3** - □ Crew member
2.3.2 – □ Skipper **2.3.4** - □ other (specify: _____)

2.4 – Fishing gear:

2.4.1 - □ Beach seine **2.4.4 –** □ Cage **2.4.7 –** □ Collectors
2.4.2 – □ Gillnet **2.4.5 –** □ Diving **2.4.8 –** □ Other: ____)
2.4.3 – □ Hand line **2.4.6 –** □ Quinia

2.5 - How old are you? ……years.

2.6 - How long you have been living in this fishing village? ……years.

2.7 - Where did you live before? _____

2.8 - Why did you decide to live in this fishing village? _____

2.9 – What is your **LANGUAGE** and **RELIGIOUS** belief?

Language and religious	**(1st)**	**(2nd)**	**(3rd)**
2.8.1 - Language			
2.8.1.1 - Koti	□	□	□
2.8.1.2 – Macua	□	□	□
2.8.1.3 – Marrovone	□	□	□
2.8.1.4 - Other (specify: _____)	□	□	□
2.8.2 – Religious belief			
2.8.2.1 – Islam	□	□	□
2.8.2.2 – Catholic	□	□	□
2.8.2.3 - Protestant (specify: _____)	□	□	□
2.8.2.4 - Other (specify: _____)	□	□	□

3 - Socio-economic characteristics

3.1 – Demography

3.1.1 - Number of your household: _____; **3.1.2** – Nr of spouses you have: _____;

3.1.3 - Nr of children you have: _____; **(3.1.3.1-Boys**:_____ **3.1.3.2-Girls**: _____**)**

3.1.4 - Who are OTHER PERSONS you live with?

3.1.4.1 - □ Parents: _____; **3.1.4.2** – □ Brothers: _____

3.1.4.3 - □ Sisters: _____; **3.1.4.4** – □ Others (specify:_____)

3.2 – Education

3.2.1 - **Boys studying**: _____; **3.2.2** - **Girls studying**: _____;

3.2.1.1 - At EP1 (**grade**: _____); **3.2.2.1** – At EP1 (**grade**: _____);

3.2.1.2 – At EP2 (**grade**: _____); **3.2.2.2** – At EP2 (**grade:** _____);

3.2.1.3 – At ESG (**grade**: _____); **3.2.2.3** – At ESG (**grade:** _____);

3.2.1.4 – At Other institutions (specify: _____);

3.2.2.4 – Other institutions (specify: _____);

3.2.3 – Interviewee's level of EDUCATION:

3.2.3.1 – □ Primary school (**grade made**: _____);

3.2.3.2 – □ Secondary school (**grade made:** _____);

3.2.3.3 – □ Any professional course made (specify: _____);

3.3 – Economy

3.3.1 - What are the MAIN ACTIVITIES the family is depending on (rank by importance)?

3.3.1.1 – □ Fishing **3.3.1.3** - □ Formal Business (specify: _____;

3.3.1.2 – □ Agriculture **3.3.1.4** - □ Informal business (specify: _____;

3.3.1.5 – □ Others (specify: _____);

3.3.2 - List in the table below the PERIOD OF MORE PRODUCTIVITY for each of the following activities

Activity	*Jan*	*Feb*	*Mar*	*Apr*	*May*	*Jun*	*Jul*	*Aug*	*Sep*	*Oct*	*Nov*	*Dec*
FISHING												
AGRICULTURE												
1 – Rice												
2 – Beans												
3 - Cassava												
4 – Peanut												
BUSINESS												

3.3.3 – Based on your own experience, in which CONDITIONS you think ARTISANAL FISHING IS VERY GOOD?

Main conditions	Very good	Reasonable	Completely bad
3.3.3.1 - North wind (**kashcazi)**?	□	□	□
3.3.3.2 - South wind (**Kussi**)?	□	□	□
3.3.3.3 – East wind (**Madulai**)?	□	□	□
3.3.3.4 – South + east (**Phalalazi**)?	□	□	□
3.3.3.5 – South + west (**Olani**)?	□	□	□
3.3.3.6 - West wind (**Mmathe**)?	□	□	□
3.3.3.7 - Rising tides?	□	□	□
3.3.3.8 - Falling tides?	□	□	□
3.3.3.9 - New moon?	□	□	□
3.3.3.10 - First quarter moon?	□	□	□
3.3.3.11 - Full moon?	□	□	□
3.3.3.12 - Second quarter moon?	□	□	□
3.3.3.13 – Rainy season?	□	□	□
3.3.3.14 – Dry season?	□	□	□
3.3.3.15 - Cloudy?	□	□	□
3.3.3.16 - Stormy?	□	□	□
3.3.3.17 – Water transparence?	□	□	□
3.3.3.18 – Not transparent water?	□	□	□
3.3.3.19 – Churning water	□	□	□
3.3.3.20 – High water salinity?	□	□	□
3.3.3.21 – Cold water?	□	□	□
3.3.3.22 – Warm water?	□	□	□
3.3.3.23 - During the day	□	□	□
3.3.3.24 – During the night	□	□	□
3.3.3.25 – Deepness (Mts: _____)	□	□	□

3.3.4 - If any "*Very good*" answer on above, please give, for each "answer", reasons "WHY"?

_____

_____

(***Please, turn the page for more answer***)

3.4 – Housing

3.4.1 – What is your HOUSE MADE OF?

3.4.1.1 - □ Non-conventional material; **when did you construct it?** _____ ;

3.4.1.1.1 - Nr of divisions: _____; **3.4.1.1.2** – Cover material: _____;

3.4.1.2 - □ Conventional material; **when did you construct it?** _____ ;

3.4.1.2.1 - Nr of divisions: _____; **3.4.1.2.2** – Cover material: _____;

3.4.2 - What KIND OF ASSETS you have?

3.4.2.1 - □ Motorcycle; **when did you buy it?** _____;

3.4.2.2 - □ Bicycle; **when did you buy it?** _____;

3.4.2.3 - □ Radio; **when did you buy it?** _____;

3.4.2.4 - □ Furniture; **when did you buy it?** _____;

3.4.2.5 - □ TV; **when did you buy it?** _____ ;

3.4.2.6 - □ Other (specify: _____);

3.5 – Traditional and cultural practices

3.5.1 – What of the following TRADITIONAL AND CULTURAL PRACTICES you OBSERVE as fisherman?

Cultural aspects	Always	Sometimes	Not at all
3.5.1.1 – Cleaning cemeteries	□	□	□
3.5.1.2 – Hijabo	□	□	□
3.5.1.3 – Olomba	□	□	□
3.5.1.4 – Lihuco	□	□	□
3.5.1.5 – Watalela Phahari	□	□	□
3.5.1.6 - Inkhuto	□	□	□
Others (specify)**:**			
3.5.1.7 -	□	□	□
3.5.1.8 -	□	□	□

3.5.2 - If any "Always" answer on above, please give, for each "answer", reasons "WHY"?

_____

(***Please, turn the page for more answer***)

4 - Coastal characteristics

4.1 – Coastal characteristics have INFLUENCE ON THE SPECIES CAUGHT in the fishing zones when:

Coastal characteristics	Very strong	Strong	No at all
4.1.1 - Coast is covered by mangrove?	☐	☐	☐
4.1.2 – Coast is a river mouth	☐	☐	☐
4.1.3 - Coast is covered by dense forest?	☐	☐	☐
4.1.4 - Coast is covered by wetland?	☐	☐	☐
4.1.5 - Coast is covered by grass	☐	☐	☐
4.1.6 – Coast is undulating terrain?	☐	☐	☐
4.1.7 – Coast is flat terrain?	☐	☐	☐

4.2 – If any "Strong" answer on above, how did you acquire this knowledge? _____

_____

5 – Fishing characteristics

5.1 – WHERE do you use to fish?

Fishing zones	Yes; always	Yes; sometimes	No; not at all
5.1.1 - Inshore			
5.1.1.1 - Beach	☐	☐	☐
5.1.1.2 - Estuarine	☐	☐	☐
5.1.1.3 – Mangrove	☐	☐	☐
5.1.1.4 - Other (specify: _____)	☐	☐	☐
5.1.2 - Offshore			
5.1.2.1 - Close to Islands	☐	☐	☐
5.1.2.2 - Bank of sand.	☐	☐	☐
5.1.2.3 - Rocks	☐	☐	☐
5.1.2.4 - Other (specify: _____)	☐	☐	☐

5.1.3 – If any "YES; ALWAYS" on above, why do you fish in this area?_____

_____

5.1.3.1 - How did you get this KNOWLEDGE? _____

_____

5.1.4 – For each of the above "YES", how far from the cost? _____

_____

(***Please, turn the page for more answer***)

5.2 - What FISHING UNIT do you usually use?

Fishing unit	Yes; always	Yes; sometimes	No; not at all
5.2.1 – Fishing gear			
5.2.1.1 - Beach seine.	☐	☐	☐
5.2.1.2 -Gillnet.	☐	☐	☐
5.2.1.3 - Hand line.	☐	☐	☐
5.2.1.4 –Cage.	☐	☐	☐
5.2.1.5 – Diving	☐	☐	☐
5.2.1.6 – Quinia	☐	☐	☐
5.2.1.6 – Collection	☐	☐	☐
5.2.2 – Kind of boat			
5.2.2.1 - Motorized boat	☐	☐	☐
5.2.2.2 – Non-motorized boat	☐	☐	☐
5.2.2.3 – Without boat	☐	☐	☐

5.3 - From your fishing center, how many HOURS you usually take to reach the

fishing zone you normally use to fish in? _____ hours:

5.4 - List in the table below the MAIN SPECIES you usually fish in the fishing zones characterized by:

Fishing zones characteristics	Main species caught
Seaweed cover	
Rock cover	
Reef cover	
Mangrove cover	
Estuarine	
Bank of sand	

5.4.1 – If ANY ANSWER on above, how did you get this knowledge:_____

_____

6 – Climate characteristics

6.1 - If you have your FISHING UNIT IN GOOD CONDITIONS, do you go fishing when is?

Climate characteristics	Yes; always	Yes; sometimes	No; not at all
6.1.1 - North wind (**kashcazi**)?	☐	☐	☐
6.1.2 - South wind (**Kussi**)?	☐	☐	☐
6.1.3 – East wind (**Madulai**)?	☐	☐	☐
6.1.4 - South + east (**Phalalazi**)?	☐	☐	☐
6.1.5 - South + west (**Olani**)?	☐	☐	☐
6.1.6 - West wind (**Mmathe**)?	☐	☐	☐
6.1.7 - Rising tides?	☐	☐	☐
6.1.8 - Falling tides?	☐	☐	☐
6.1.9 – New moon?	☐	☐	☐
6.1.10 – First quarter moon?	☐	☐	☐
6.1.11 – Full moon?	☐	☐	☐
6.1.12 – Second quarter moon?	☐	☐	☐
6.1.13 - Rainy?	☐	☐	☐
61.14 - Cloudy?	☐	☐	☐
6.1.15 - Stormy?	☐	☐	☐
6.1.16 – During the day?	☐	☐	☐
6.1.17 – At night?	☐	☐	☐
6.1.18 – Transparent water?	☐	☐	☐
6.1.19 – Not transparent water?	☐	☐	☐
6.1.20 – In deep water?	☐	☐	☐
6.1.21 – In churning water?	☐	☐	☐
6.1.22 – In cold water?	☐	☐	☐
6.1.23 – In warm water?	☐	☐	☐

6.2 - If ANY ANSWER on "No; not at all", please give, for each NO, reasons "WHY"? _____

_____

_____

6.3 - How do you usually IDENTIFY FISHING ZONES where you use to fish in? _____

_____

_____

6.3.1 - How did you get this KNOWLEDGE? _____

_____

7 – Management measures

7.1 – List on the table below what MONTHS are: -a) the BEST, and –b) WORST, for fishing?

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Best												
Worst												

7.1.1 - THE BEST months for fishing are so because of:

_____

Climate characteristics	**Yes; always**	**Yes; sometimes**	**No; not at all**
7.1.1 – The best months for fishing			
7.1.1.1 – Rainy season?	☐	☐	☐
7.1.1.2 – Dry season?	☐	☐	☐
7.1.1.3 – Windy season?	☐	☐	☐
7.1.1.4 – Lunar cycle?	☐	☐	☐
7.1.1.5 – Tidal cycle?	☐	☐	☐
7.1.1.6 – Observation of tradition?	☐	☐	☐
7.1.1.7 – Having good fishing unit?	☐	☐	☐
7.1.1.8 – Daily atmospheric conditions?	☐	☐	☐
7.1.1.9 – Other (specify: _____)?	☐	☐	☐

7.2 - What do you do when you see that CATCHES are GOIND DOWN? _____

_____

_____

APPENDIX 2:

QUESTIONNAIRE FOR GROUP INTERVIEW

Interviewed:

1 – □ Village's secretary;
2 – □ Community leader;
3 – □ Elder fisherman;
4 – □ Fishing unit owner
5 – □ Skipper;
6 – □ Experienced crew member;
7 – □ Other (specify: _____ ;)

Date: ____/____/2007

---

1 - General information

1 - Administrative Post: _____; **4** – Fishing village: _____;

2 - Locality: _____; **5** – Fishing centre: _____;

3 - Planning Area: _____; **6** – Fishing zones: _____

_____

7 – Distance (village to fishing centre): ____; **8** - Distance (fishing centre to fishing zones): _____;

1.1 - How do you ACCESS fishing zones?

1 - □ By motorized boat (**specify boat and engine**: _____);

2 - □ Non-motorized boat (**specify type of boat:** _____);

3 - □ walking.

---

2 – Economy

2.1 - What are the MAIN ACTIVITIES in this fishing village?

1 – □ Fishing **3** - □ Formal Business (specify: _____;

2 – □ Agriculture **4** - □ Informal business (specify: _____;

5 – □ Others (specify: _____);

2.2 - List in the table below the PERIOD OF MORE PRODUCTIVITY for each of the following activities

Activity	*Jan*	*Feb*	*Mar*	*Apr*	*May*	*Jun*	*Jul*	*Aug*	*Sep*	*Oct*	*Nov*	*Dec*
FISHING												
AGRICULTURE												
1 – Rice												
2 – Beans												
3 - Cassava												
4 – Peanut												
BUSINESS												

2.3 – In the fishing zones we usually fish in, CATCHES ARE VERY GOOD when is:

Main characteristics	**Very good**	**Reasonable**	**Completely bad**
1 - North wind (**kashcazi)**?	☐	☐	☐
2 - South wind (**Kussi**)?	☐	☐	☐
3 – East wind (**Madulai**)?	☐	☐	☐
4 - South + east (**Phalalazi**)?	☐	☐	☐
5 – South + west (**Olani**)?	☐	☐	☐
6 - West wind (**Mmathe**)?	☐	☐	☐
7 - Rising tides?	☐	☐	☐
8 - Falling tides?	☐	☐	☐
9 – New moon?	☐	☐	☐
10 – First quarter moon?	☐	☐	☐
11 – Full moon?	☐	☐	☐
12 – Second quarter moon?	☐	☐	☐
13 – Rainy season?	☐	☐	☐
14 – Dry season?	☐	☐	☐
15 - Cloudy?	☐	☐	☐
16 - Stormy?	☐	☐	☐
17 – Water transparence?	☐	☐	☐
18 – Not transparence of water?	☐	☐	☐
19 – Churning water?	☐	☐	☐
20 – High water salinity?	☐	☐	☐
21 – Cold water?	☐	☐	☐
22 – Warm water?	☐	☐	☐
23 – During the day?	☐	☐	☐
24 – During the night?	☐	☐	☐
25 – Deepness (Mts: ____)?	☐	☐	☐

2.4 - For each "Completely bad" answer you got above; please give reasons "WHY":

_____

(***Turn page for more answer***)

3 – Traditional and Cultural practices

3.1 – What TRADITIONAL and CULTURAL PRACTICES are linked with fishing activities AND HOW DO THEY WORK? _____

_____

3.2 – HOW these traditional and cultural aspects ARE BEING TRANSMITTED to the youth for its preservation? _____

_____

3.3 – Explain the MEANING and the OBJECTIVES of the following traditional and cultural aspects: (If answer has been done in *point 3.1* do not repeat it)

3.3.1 – HIJABO: _____

_____

3.3.2 – OLOMBA: _____

_____

3.3.3 – INKHUTO: _____

_____

3.3.4 – LIHUCO: _____

_____

3.3.5 – WATALELA PHAHARI: _____

_____

3.3.6 – OTHERS (specify: _____

_____

4 - Climate characteristics

4.1 – List the <u>COMMON WIND's NAMES</u> that normally occur here <u>AND HOW</u>

<u>DO THEY INFLUENCE</u> fishing activity: _____

_____

(T*<u>urn page for more answer</u>*)

4.2 - What of the following CLIMATE CHARACTERISTICS GUIDE FISHERS not going to fish?

Main characteristics	Yes; always	Yes; sometimes	No; not at all
1 - North wind (**kashcazi)**?	☐	☐	☐
2 - South wind (**Kussi**)?	☐	☐	☐
3 – East wind (**Madulai**)?	☐	☐	☐
4 - South + east (**Phalalazi**)?	☐	☐	☐
5 - South + west (**Olani**)?	☐	☐	☐
6 - West wind (**Mmathe**)?	☐	☐	☐
7 - Rising tides?	☐	☐	☐
8 - Falling tides?	☐	☐	☐
9 – New moon?	☐	☐	☐
10 – First quarter moon?	☐	☐	☐
11 – Full moon?	☐	☐	☐
12 – Second quarter moon?	☐	☐	☐
13 – Rainy season?	☐	☐	☐
14 – Dry season?	☐	☐	☐
15 - Cloudy?	☐	☐	☐
16 - Stormy?	☐	☐	☐
17 – Water transparence?	☐	☐	☐
18 – Not transparent water?	☐	☐	☐
19 – Cold weather?	☐	☐	☐
20 – Warm weather?	☐	☐	☐
21 – Churning water?	☐	☐	☐
22 - During the day?	☐	☐	☐
23 – At night?	☐	☐	☐

4.3 - If any "YES" on above, give, for each "YES", reasons "WHY"? _____

_____

4.4 - Explain HOW YOU KNOW that is going to:

4.4.1 – WINDY? _____

_____

4.4.2 – RAINY? _____

_____

4.4.3 – WARM? _____

_____

4.4.4 – CLOUDY? _____

_____

4.4.5 – STORMY? _____

_____

4.4.6 – Have **RISING TIDES?** _____

_____

4.4.7 – Have **FALLING TIDES?** _____

_____

4.5 – How did you get this KNOWLEDGE? _____

_____

4.6 – Please fill in the following tables according to YOUR KNOWLEDGE.

TABLE 1 – Climatic (meteorology) calendar

Legend	*Jan*	*Feb*	*Mar*	*Apr*	*May*	*Jun*	*Jul*	*Aug*	*Sep*	*Oct*	*Nov*	*Dec*
Rainy season												
Dry season												
Windy season												
South wind												
North wind												

TABLE 2 – Lunar and tidal cycles (days)

LUNAR CYCLE																														
New moon																														
First quarter																														
Full moon																														
Secondquarter																														
TIDAL CYCLE																														
Rising tides																														
Falling tides																														

4.7 – List in the table below the MAIN SPECIES CAUGHT by the following fishing gears.

Fishing gear	Main species caught
Beach seine	
Gillnet	
Hand line	
Diving	
Cages	
Collection	
Quinia	

4.8 – How do you usually IDENTIFY FISHING ZONES where you use to fish in?

_____

5 – Management measures

5.1 – What months do you think FISH MUST NOT BE FISHED?

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Why? _____

5.2 – There are THREE TYPES OF FISHERIES. Which of them you know?

Type of fisheries	I know it very well	More or less	No idea at all
5.2.1 – Artisanal fisheries	☐	☐	☐
5.2.2 – Semi-industrial fisheries	☐	☐	☐
5.2.3 – Industrial fisheries	☐	☐	☐

5.3 - If "*ANY TYPE***" known of the above fisheries, please give explanation of HOW YOU CHARACTERIZE IT and GIVE ITS SPECIFIC LIMITS.**

5.3.1 – Artisanal Fisheries: _____

_____

5.3.2 – Semi-industrial Fisheries: _____

_____

5.3.3 – Industrial fisheries: _____

_____

5.3.4 - How did you get this KNOWLEDGE? _____

_____

APPENDIX 3

QUESTIONNAIRE FOR SCIENTISTS

0 – General information

Date: / / 2007; Form nr: ____; Institution: _____; Interviewer: _____

Position of the interviewee: _____ Profession: _____

How long you have been working? ___ years; Name (facultative): _____

1 - How, scientifically, are identified Artisanal fishing zones? _____

_____

2 – In identifying Artisanal fishing zones, scientifically, what are the main indicators taken into account? _____
_____

3 - What are the common characteristics found in Artisanal fishing zones where the following fishing gears are used?

3.1 – Beach seine**:** _____

_____

3.2 – Gillnet: _____

_____

3.3 – Hand line**:** _____

_____

3.4 – Diving: _____

3.5 – Cages: _____

_____

3.6 – Collection**:** _____

4 - What are the common species caught in the Artisanal fishing zones where the following fishing gears are used?

4.1 – Beach seine**:** _____

_____

4.2 – Gillnet: _____

_____

4.3 – Hand line**:** _____

_____

4.4 – Diving**:** _____

4.5 – Cages**:** _____

_____

4.6 – Collection**:** _____

_____

5 – List on the table below what months do you think are: -a) the *best* and –b) the *worst* for Artisanal fishing?

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Best												
Worst												

5.1 - Why do you think so? _____

6 – What months do you think fish must not be fished?

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

6.1 – Why so? _____

7 – Please fill in the following tables (*1 and 2*) according to your own knowledge.

TABLE 1 – Climatic (meteorology) calendar

Legend	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Rainy season												
Dry season												
Windy season												
South wind												
North wind												

7.1 - Do you thing is there any relationship between METEOROLOGICAL CALENDAR and SPECIES CAUGHT in Artisanal fishing zones? If yes, which ones? (Please consider one by one based on the legend): _____

_____

TABLE 2 – Lunar and tidal cycle

LUNAR CYCLE																													
New moon																													
First quarter																													
Full moon																													
Secondquarter																													
TIDAL CYCLE																													
Rising tides																													
Falling tides																													

7.2 - Do you think is there any relationship between LUNAR and TIDAL CYCLES? If yes, which one? _____

_____

7.3 – Do you think is there any relationship between LUNAR CYCLE and the SPECIES CAUGHT in Artisanal fishing zones? If yes, which ones? (Please consider each item of the lunar cycle): _____

_____

7.4 – Do you think is there any relationship between TIDAL CYCLE and SPECIES CAGHT in Artisanal fishing zones? If yes, which ones? (Please consider each item of the tidal cycle)

_____

_____

8 – How indigenous knowledge can be used in identifying artisanal fishing zones?

_____

_____

8.1 – Why? _____

_____

9 – What role (if any) do you think indigenous knowledge can play in Artisanal fisheries management? _____

_____

9.1 - Why do you think so? _____

_____

10 – How Geographical Information System (GIS) technique can be employed for Artisanal fisheries management? _____

_____

11 - How Global Positioning System (GPS) technique can be employed for Artisanal fisheries management? _____

_____

APPENDIX 4

IDENTIFICATION OF FISHING ZONES

Fishing zone:

Fishing center (base): _____

Fishing zone (code): _____

Fishing gear used: _____

Type of sea bed of fishing zone: _____

Main species caught in the fishing zone: _____

_____

Estimated fishing zone area: _____

Distance from the coast to the fishing zone: _____

Main characteristics of the fishing zone: _____

_____

Main signals for fishing zone localization from the coast: _____

_____

Other pertinent information about fishing zone: _____

_____

Observations: _____

GPS:

Latitude: _____

Longitude: _____

Height: _____

Precision: _____

Local time: _____