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Fishing with beach seines

Cover photograph:
Beach seine team hauls in front of Mponha village, Nampula Province, Mozambique (courtesy of James D.K. Wilson).

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Preparation of this document

This document draws on the findings of case studies coordinated and funded by the Food and Agriculture Organization of the United Nations (FAO) Fisheries and Aquaculture Department in the Gambia, India, Kenya, Mozambique, Peru and Sri Lanka, and by the FAO/United Kingdom Department for International Development (DFID) Sustainable Fisheries Livelihoods Programme (SFLP) in Benin, Ghana and Togo. In addition to the findings of the case studies, other studies and publications on beach seines were reviewed and used for the preparation of this document.

Robert Lee, Susana Siar, Hans E. Båge and Thomas Moth-Poulsen of the FAO Fisheries and Aquaculture Department coordinated the country case studies and provided technical and editorial advice.

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The draft of this document was peer reviewed by Dr John Kurien, Centre for Development Studies, Trivandrum, India; Dr Patrick McConney, Centre for Resource Management and Environmental Studies, The University of the West Indies; and Professor Richard Pollnac, Research Professor, Marine Affairs Department, University of Rhode Island.

Abstract

This document provides a global overview of beach seine fisheries and identifies key issues relevant for the responsible use of beach seines and the sustainable livelihoods of beach seine fishers. It also provides guidelines for fisheries managers and other stakeholders on how best to address the issues of management processes and measures, which have the mutually beneficial goals of restoring and conserving the health of fishery resources and their habitats and safeguarding the livelihoods of fishers and their communities.

Chapter 1 provides introductory and background information. It gives a general description of the design and operation of beach seines and highlights that the long-term livelihoods and food security of small-scale fishing communities can only be ensured if responsible and sustainable fishing methods are employed. The challenge is how to balance the short-term food security requirements of coastal fishing communities with responsible and sustainable fishing methods.

Chapter 2 explains the coverage and focus of the country case studies as well as their field survey methodologies. Meanwhile, Chapter 3 contains a comparative analysis of the findings of the country case studies. The findings are complemented by the findings of the literature review. The chapter starts with a global overview of the operational and technical features of beach seining and its environmental impacts. This is followed by a comparison of the social and economic characteristics of beach seine owners and operators and their access to social and health services, education and infrastructure. Economic and financial aspects of beach seine fisheries operations are analysed, as well as post-harvest activities and fishers and beach seine operators' access to credit. An overview of fisheries legislation and management of beach seining and its compliance with fisheries management laws and regulations is also provided. The chapter also discusses the implications of the main findings of the case studies as they relate to the status of fishery resources and habitats and for food security and livelihoods of beach seine fishers. Global trends of beach seining are identified and the assessment of the studies regarding the future of beach seining is summarized.

Chapter 4 presents the recommendations of the authors of the country case studies for achieving well-regulated and well-managed beach seine fisheries.

Finally, Chapter 5 elaborates the topics raised by the case studies that are crucial for the formulation of recommendations and management guidelines. These topics include the approach to co-management and the use of fishers' ecological knowledge in resource management decision-making, the occupational diversification to other income-generating activities and livelihoods, and moving towards more selective and environmentally-friendly fishing methods. Also elaborated are improvements and modifications of beach seine gear and methods; opportunities for value addition and post-harvest improvements; microenterprise development; restoration of aquatic habitat by small-scale fishing communities; microfinance support; and the use of socio-economic indicators for the monitoring of the impact of management measures on the livelihoods of fishing communities.

The chapter concludes with guidelines for fisheries managers and other stakeholders on how to manage beach seine fisheries in a responsible and participatory manner. Key resource, economic and social issues that are addressed by the management guidelines are: (i) the poverty and vulnerability of beach seine fishers due to lack of other income/employment opportunities, low educational levels, and scarce medical and social services; (ii) the negative impact of beach seining on aquatic resources and sometimes

on habitats; (iii) the depletion of fishery resources and the degradation of habitat caused by fisheries other than beach seining and by land-based pollution and human activities; (iv) a lack of compliance with fisheries and environmental regulations; (v) conflict and competition with other users of the common fishery resources; (vi) a generally low value of beach seine catches; (vii) a lack of access to microfinance and insurance services; and (viii) safety-at-sea issues.

The findings of the country case studies are summarized in the annexes of the document for easy reference for readers who are interested in the features of beach seine fisheries in different countries. The annexes also contain designs of selected beach seines used in the India, Mozambique and Peru.

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Abbreviations and acronyms

BMU	beach management unit
BOBP	Bay of Bengal Programme for Fisheries Development
CARDER	Centres for Regional Action for Rural Development
CBFMC	Community-based Fisheries Management Committee
CCG	fisheries co-management committee
CCP	community fisheries council
CMFRI	Central Marine Fisheries Research Institute
CMZ	Coastal Management Zone
CPUE	catch per unit effort
CORDIO	Coastal Oceans Research and Development in the Indian Ocean
CRZ	Coastal Regulation Zone Notification
DFID	United Kingdom Department for International Development
DFMC	District Fisheries Management Committee
EEZ	exclusive economic zone
FRP	fibre reinforced plastic
GHC	Ghanaian cedi
hp	horsepower
ICAT	Institute for Advice and Technical Support
IDPPE	National Institute for the Development of Small-scale Fisheries
IEZ	Inshore Exclusion Zone
IMARPE	Instituto del Mar del Perú/Marine Institute of Peru
INFOPESCA	Centre for Marketing Information and Advisory Services for Fishery Products in Latin America and the Caribbean
INFOPÊCHE	Intergovernmental Organization for Marketing Information and Cooperation Services for Fishery Products in Africa
INFOSA	Marketing Information and Technical Advisory Services for the Fisheries Industry in Southern Africa
INFOFISH	Intergovernmental Organization for Marketing Information and Technical Advisory Services for Fishery Products in the Asia and Pacific Region
INR	Indian rupee
ISO	International Organization for Standardization
IUCN EARO	Eastern Africa Regional Office of the International Union for Conservation of Nature
IUU	illegal, unregulated and unreported
KES	Kenyan shilling
LKR	Sri Lanka rupee
LVFO	Lake Victoria Fisheries Organization
MCS	monitoring, control and surveillance
MDG	Millennium Development Goal
MFRA	Marine Fishing Regulation Act
MZM	Mozambique metical
NCF	net cash flow
NCF/TE	net cash flow to total earnings
NCO	National Centre for Oceanography
NGO	non-governmental organization

NSW	New South Wales
PA	polyamide
PE	polyethylene
ROI	return on investment
SFLP	Sustainable Fisheries Livelihoods Programme
SHG	self-help group
USD	United States dollar
XOF	West African CFA franc

1. Introduction and background

Beach seine nets have been used in fisheries for several thousand years and on every continent (Gabriel *et al*., 2005). The ancient Phoenicians and Romans employed beach seining to catch fish in the Mediterranean.

A typical beach seine has weights attached to the leadline at the bottom of the net and buoys or floats attached to the floatline at the top of the net. The downward force of the weights counteracted by the buoyancy of the floats keeps the net open vertically when it is pulled through the water to entrap fish. A beach seine is often set from shore to encircle a school of fish. Beach seines can also be set at some distance from and parallel to the shore, though still in shallow water, and then hauled onto a boat. This latter method evolved historically into the development of what are now called purse seines, lampara and ring nets.

The general design of the beach seines used and their modes of operation are similar in the countries studied. Typically, two types of beach seines were used: beach seines with codend and those without codend. In the case of beach seines without codend, the central section of the seine consisted of loose netting. The typical beach seine consists of a seine body (or central section) and codend, to which anterior and posterior wings are attached. The gear has a head rope (also referred to as floatline) with floats to keep the upper part of the seine on the surface, and a footrope (also referred to as leadline) with sinkers to keep the gear on or close to the bottom and prevent fish from escaping from the area enclosed by the seine. Hauling ropes or warps are attached to both ends of the wings of the seine. The longer the hauling lines and the wings are, the larger is the fishing area that could be covered with the seine.

In most cases, non-motorized boats are used to set the seine; however, motorized boats are also used. When setting the beach seine, one of the hauling lines is fastened onto the shore, and the shoreward wing, seine body and seaward wing are set out in a wide semi-circular arc. Once the entire net is in the water, the second hauling rope is brought back to the shore. The hauling ropes are then hauled in simultaneously to the beach. The hauling may be done either manually or by means of a tractor, vehicle or winch. The long hauling ropes and the wings of the seine herd fish into the centre part of the seine body. Target species include pelagic as well as demersal species.

In developing countries, beach seines are an important source of income and employment and support the livelihoods of numerous coastal communities. Over the last two decades, however, fishing with beach seines has become controversial. Among other things, critics of beach seines have highlighted negative environmental impacts of beach seines on vulnerable aquatic habitats, such as nursery and breeding grounds, and negative impacts on fish stocks through the catching of juveniles. Many countries have introduced regulations and a few countries have banned fishing with beach seines altogether. The dilemma that policy-makers and fisheries managers are facing is how to balance peoples' livelihoods and food security needs with the need to protect and/or restore a healthy and well-functioning ecosystem that can maintain fisheries productivity for generations to come. However, this dilemma is not unique only to beach seine fisheries as it seems to be more and more common with increased fishing pressure.

The reduction of food insecurity and rural poverty and the promotion of sustainable rural livelihoods and more equitable access to resources are major strategies within FAO's Strategic Framework for 2000–2015. Small-scale fisheries are critical for food

security and poverty reduction as highlighted again by the FAO Committee on Fisheries at its Twenty-fifth Session. A high proportion of small-scale fishers are poor, including those involved in beach seining.

Because beach seining has such important livelihoods implications for many coastal communities, the FAO Fisheries and Aquaculture Department conducted a series of case studies on the technical, socio-economic and environmental features and impacts of beach seining. The case studies were undertaken by consultants in the Gambia, India, Kenya, Mozambique, Peru and Sri Lanka. Previous case studies were also conducted in Benin, Ghana and Togo under the Sustainable Fisheries Livelihoods Programme (SFLP) in West Africa.

In addition, information was gathered from other sources through Internet searches and literature reviews in the FAO Fisheries and Aquaculture Branch Library. The objective of preparing the case studies was to compile and present global information on practices in beach seining so that policy-makers, fisheries managers and other stakeholders can make better decisions on the responsible management and regulation of beach seine fisheries.

2. Methodology

COVERAGE AND FOCUS

In total, nine beach seine country case studies were conducted in four distinct regions of the world. In the Africa region, case studies from West Africa came from Benin, the Gambia, Ghana and Togo, and from Kenya and Mozambique in East Africa. The South Asia region studies came from India and Sri Lanka (desk study); and one case study was conducted in Latin America (Peru).

The case studies contain information on operational and technical features of beach seine fisheries, social characteristics of operators and owners of beach seines, economic and financial aspects of beach seining, environmental impact of beach seines, conflicts with other fishing methods and uses of the shoreline, and legislation and management aspects as well as the perceptions and views of the members of fishing communities on all these aspects of beach seining.

More specifically and, among other things, all case studies generated information on:

Biophysical aspects:

- importance of beach seining as a fishing method, technical dimensions of beach seines, and modes of operation;
- fishing seasons and catch composition;
- fishing boats and propulsion; and
- landing sites and infrastructure.

Socio-economic aspects:

- demographic characteristics;
- livelihoods strategies;
- sources of income and employment;
- labour and kinship relations;
- access to social services and infrastructure;
- vulnerability and food security;
- some aspects of investment and operating costs;
- some aspects of financial and economic returns and benefits;
- sharing of income;
- marketing links; and
- access to formal and informal credit.

Impacts, conflicts and governance aspects:

- impact of beach seines on aquatic habitat;
- impact of beach seines on fishery resources;
- conflicts of beach seining with other fishing methods and uses of the shoreline;
- effectiveness of existing regulations and management measures regarding beach seining; and
- opportunities for co-management and participation of fishers in policy formulation, implementation and monitoring.

While all the case studies covered similar topics and had similar or the same terms of reference, they differ in the depth and extent to which these topics were covered. Differences in their methodologies were also noted.

The first difference relates to the case study on Sri Lanka. While the other case studies collected data and information on beach seining through desk studies and literature reviews as well as field surveys and observations, the case study of Sri Lanka is solely based on the review of literature and reports and supplemented by consultation with the authors of publications and survey reports.

The second difference is that the case studies carried out in Benin, Ghana and Togo in 2000 and 2001 were under the guidance of the FAO/DFID Sustainable Fisheries Livelihoods Programme and the case studies carried out in 2007 and 2008 in the Gambia, India, Kenya, Mozambique and Peru were under the guidance of the FAO Fishing Technology Service.

The former case studies followed a standardized survey methodology agreed to by the three countries at a technical consultation, while the latter five case studies used different survey instruments; all however adopted participatory rural appraisal as the research strategy and analysed their data within the sustainable livelihoods assessment framework.

Another difference between these two groups of case studies is that the respondents of the first group of studies at village level were randomly selected following a frame survey. This was not the case with the second group of studies. The random selection of individual respondents is likely to reduce the sources of bias and increases the reliability and validity of findings mainly with reference to their individual perceptions and opinions. It is not likely to significantly affect other findings of the field surveys that are based on observations, measurements and group discussions rather than on individual interviews, such as findings related to the operational and technical features of beach seining, landing sites and infrastructure, general socio-economic characteristics of beach seine fishers, access to social services and infrastructure, economic and financial aspects, and environmental and resource impacts of beach seining.

For both groups of studies, the sites of the field surveys – the villages and fishing camps where the field surveys were carried out – were chosen purposely and not as randomly selected samples according to specific criteria relevant to the use of beach seines and to the problems and circumstances associated with the practice, which depended on the special situation and conditions prevailing in a particular country.

One more difference between the two groups of studies is that the case studies on Benin and Togo only provide limited or no information on the technical dimension of the fishing gear and craft used in beach seine fisheries and their impact on aquatic habitat. Likewise, they provide little or no information on the financial and economic performance of beach seine fisheries. These deficiencies cannot be attributed to the survey methodologies as the participatory rural appraisals were carried out with a multidisciplinary approach and the survey teams incorporated expertise in the field of fishing gear and fisheries. The focus of these studies was more on the socio-economic aspects and less on production technologies, processes and their economic performance.

As far as the history and regional particularities of beach seining are concerned, these aspects are covered in great depth in the case study on India, which could draw on rich sources of literature on this subject. The above differences in coverage and methods of the country case studies are reflected in the presentation of their key findings in an annex to this document. Studies that contain more specific and original information that might be of interest to fisheries managers, scientists, researchers, as well as fishers and their associations, are more prominently featured than others.

FIELD SURVEY METHODOLOGIES

Benin, Ghana and Togo

The information presented in the three case studies on Benin, Ghana and Togo, conducted under the guidance of the FAO/DFID Sustainable Fisheries Livelihoods Programme, is based on data collected in 2000 and 2001. These three case studies follow a similar survey methodology, which was agreed upon in a technical consultation with the three countries in Ghana from 12 to 16 November 2000.

Following desk research and compilation and analysis of available quantitative data and statistics, the three studies identified primary data needs and sources and designed data collection instruments. Advice was also sought from fisheries researchers as well as fisheries and other public administrators. A combination of qualitative and participatory appraisal methods and socio-economic sample surveys was used to gather primary data.

The field survey was carried out by a multidisciplinary team that incorporated expertise on fisheries science, fishing gear technology and socio-economics and was implemented in two phases. The first phase consisted of a frame survey, which was conducted in all fishing villages selected. When selecting villages and fishing camps for the field survey, the three main criteria were to include coastal regions where beach seining is practised, to include both rural and urban areas, and to take into consideration the spatial concentration/distribution of beach seines. A field guide and a questionnaire were used for the frame survey. Semi-structured focus group discussions were held with groups of adults, youth and children of both sexes. Guided walks and observations in fishing communities were undertaken and maps and diagrams were prepared of physical facilities, natural environment, seasonal activities and other features.

During the frame survey, the various vocational groups and their numbers were identified for each village. These groups were made up of owners and operators of beach seines and fishing craft, fish mongers, fish smokers, fish dryers, carpenters, mechanics and other operators. The data were then used for determining the random sample for the second phase of the survey – the socio-economic survey.

The socio-economic survey was conducted in selected fishing camps according to a sampling plan that took into account the number of days available for investigation, the composition of the team of investigators and the results of the frame survey. Fishers, owners of beach seines and persons involved in processing and marketing of fish caught by beach seines, as well as carpenters and mechanics involved in manufacturing or repair of fishing craft and gear, were randomly selected and interviewed with special questionnaires for each category. The interviews were conducted in the presence of an informal group of two to five persons. This provided an opportunity to clarify and compare the individual responses with other views.

The socio-economic survey took place mainly on the beach, at fish landing sites, or at the workplace in the case of fish smokers, dryers, carpenters and mechanics. In addition to answering the questions of the survey team, the respondents were invited to raise their own questions and views on the topics. The coverage of the field survey differed between the three countries.

In Benin, 10 fishing villages located in the Atlantic and Mono Departments were surveyed. In all, the Atlantic Department had 41 fishing communities and Mono had 17 fishing communities. In Ghana, one fishing community in each of the four coastal regions, i.e. Volta, Greater Accra, Central Region and Western Region, was surveyed, and in Togo, 10 out of the 13 fishing villages were surveyed.

The Gambia

In the Gambia, beach seining has been banned since the 1980s. Despite the ban, however, there are pockets along the Gambian coast where beach seining still takes place. There is recognition among government officials that there is lack of enforcement of the ban. A case study on beach seining was believed to be important in order to shed light on its social and environmental impacts and to provide policy-makers with information that can be used for sound decision-making.

As beach seining is banned in the Gambia, special permission was obtained from the fisheries administration to allow one beach seine unit to resume beach seining for ten days so that data on catch composition and length and weight distribution of fish could be collected. The study was conducted for eight days in the fishing village of Bijilo. Information was collected on the technological and environmental characteristics and impacts, catch composition, and on some economic and social aspects. At the end of the study period, a workshop was held to discuss the findings of the study.

India

In India, the fieldwork undertaken consisted of rapid rural appraisals. Observations, group discussions and interviews of key informants were carried out in 16 villages in five coastal districts of Andhra Pradesh, i.e. East Godavari, Nellore, Prakasam, Srikulam and Visakhapatnam, and in three districts of Orissa, i.e. Balasore, Ganjam and Puri.

The key aspects covered include operational and technological aspects of beach seining, traditional management mechanisms, the modern regulatory framework, the role of women in beach seining, recruitment of beach seine crews and remuneration, composition and use of beach seine catches, and the impact of beach seining on fishery resources.

Kenya

The field survey was conducted at six landing sites. Four of the landing sites are located in Coast Province and two landing sites in Nyanza Province on Lake Victoria. Participatory rural appraisal techniques were used by the study team, including introductory meetings with elders and local authorities, transect familiarization walks at landing sites, observation of beach seine operations and informal interviews. Focus group discussions with groups of beach seine users and non-beach seine users using semi-structured questionnaires, as well as individual interviews with key informants using semi-structured questionnaires, were also used.

Mozambique

In Mozambique, fieldwork was carried out in two villages. Mponha, northeast of the town of Moma in Nampula Province, was chosen because it is located on the Sofala Bank, an area considered very productive and suitable for beach seine fisheries. The area has one of the highest densities of beach seine fisheries in Mozambique and the fisheries have been reported as being dynamic and continually expanding.

The second village, Petane, on the outskirts of Inhassoro in Inhambane Province, was also chosen because the fisheries here were considered fundamentally different from those on the Sofala Bank, both in terms of targeted species and gear design and the fact that beach seines operators used tractor-powered winches.

With regard to the survey methodology, there were essentially five parts: (i) interviews with beach seine owners (group interviews in Petane, individual interviews in Mponha); (ii) group interviews with beach seine crews; (iii) interviews with persons involved with upstream and downstream services, including net makers, traders and boat builders; (iv) measurement of seines and observation of fishing activity; and (v) household benefit surveys.

Questionnaires were used and the following subjects were covered: history of beach seining, employment, catch composition, seasonality, management measures and environmental impact. Interviews with the providers of upstream and downstream services were semi-structured and open-ended except for the case of traders, where prices and markets were systematically investigated.

The household survey attempted to cover around 10 percent of all households in the community. For each household, a household card was completed containing information on the members and composition of the household, asset ownership, occupations of household members, and a quantitative ranking of the benefits derived from these occupations.

Peru

In Peru, field studies were carried out in Lambayeque in the northern region and Lima in the central region. Altogether, 377 fishers were interviewed with the help of standardized questionnaires. Over a period of five months, persons that were part-time and full-time fishers at San José and Lambayeque in the north and in Huacho and Carquín in Lima were interviewed. The methodology also included an in-depth analysis of both mechanized and manual beach seines, and compared them. The interviewees were either head of household and beach seine fisher, or not head of household but practised beach seining. The interviewers were trained in interview skills and in the use of the questionnaires. Information was collected along three main subjects: (i) personal data, including age, education level, responsibility in the family, expenses and income; (ii) housing information, including type, construction material sanitary services, etc.; and (iii) fishing activities, including days fishing, technical and economic and environmental impact information of the fishery. The researchers used the methodology of unsatisfied basic needs to determine the level of poverty, a methodology used by the government statistical department. In addition, literature research was undertaken, including the regulations regarding beach seining and the results of previous studies on the modification of beach seine gear in order to reduce the catch of juvenile fish.

3. Comparative analysis of findings

OVERALL IMPORTANCE, TECHNOLOGICAL AND OPERATIONAL FEATURES OF BEACH SEINE FISHERIES

The country case studies show that beach seining once accounted for the bulk of the catch and employment in the fisheries sectors of all nine countries. Over the last few decades, however, the importance of beach seining has drastically declined in terms of contribution to national fisheries production and employment in fisheries in most of the countries studied.

Table 1 provides a summary and comparison of information provided by the country case studies on the contribution of beach seine fisheries to the total marine catch of the respective countries.

The contribution of beach seining to the fish production of larger fish-producing countries, such as India and Peru, has declined to less than 1 percent of the total catch. In Ghana and Sri Lanka, the contribution of beach seining to the total catch has declined to 15 and 21.5 percent, respectively, while beach seines have been banned in the Gambia and Kenya because of the perceived negative impact on fishery resources and the coastal environment.

However, there are still countries like Benin and Togo in west Africa and Mozambique in east Africa with a less-developed fisheries sector, where beach seines still account for about 70 and 80 percent, respectively, of the total catch and also account for the bulk of employment in the fisheries sector.

TABLE 1
Intercountry comparison of the contribution of beach seine fisheries to marine catch

Country/contribution	Percentage of contribution of beach seining to total marine catch (a) or artisanal marine catch (b)	Catch of beach seines in tonnes (year)
Benin[1]	80 (b)	5 117 (1999)
Gambia		Beach seines banned since 1989
Ghana[2]	15 (a)	31 719 (1997)
India (State of Maharashtra only)[3]	0.7 (a)	2 600 (2000)
Kenya		Beach seines banned since 2001
Mozambique[4]	64 (b)	37 444 (2005)
Peru[5]	0.3 (a)	6 021 (1997–2006)
Sri Lanka[6]	21.5 (a)	54 410 (2004)
Togo[7]	70 (a)	12 000 (2000)

[1] *Source:* Country case study; Annex 1.
[2] *Source:* Country case study; Annex 1.
[3] *Sources:* Country case study; Metar et al. (2003: 52). In the case of India, fishery statistics do not record catches of beach seines separately.
[4] *Source:* Country case study; Annex 1.
[5] *Source:* Country case study; Annex 1.
[6] *Source:* FAO Fishery and Aquaculture Profile, Sri Lanka.
[7] *Source:* Country case study; Annex 1.

When looking at recent trends in beach seining, i.e. production trends from the mid-1990s onwards, a heterogeneous picture emerges. In India and Peru, the significance of beach seining has further declined. In Benin and Togo on the other

TABLE 2
Intercountry comparison of trends in beach seining

Country/trend	Contribution to national fisheries production	Number of beach seine units in operation and fishing effort	Technological changes	Operational constraints
Benin	Production decreased by 18 percent between 1997 and 1999 and so did contribution to overall production	Number of beach seines has remained stable but fishing effort increased over same period by 18 percent and CPUE declined by 31 percent	Smaller mesh sizes are being used	Competition for fishing areas and conflicts with other artisanal fishers operating beach seines and gillnets; eviction from beaches by landowners and tourism development; coastal erosion and fallen trees; accidents because of shifting sandbars
Gambia	Beach seines banned since 1989			
Ghana	Modest increase between 1989 and 1997	Number of beach seine units and fishing effort modestly decreasing between 1989 and 1997	While design of nets remained the same, the size of nets increased and mesh sizes decreased and synthetic fibres are used; size of boats has also increased	Competition from trawlers in inshore waters, coastal erosion
India	Declining	Number of units and fishing effort declining	Traditional nets made of natural fibres have been replaced by larger and more catch-efficient nets made of synthetic fibres with smaller mesh sizes; in some places motorized boats are used for operation of beach seines	Competition with other users of shoreline and from fishing vessels, i.e. trawlers and purse seiners and ring netters targeting same resources and operating illegally in inshore waters
Kenya	Beach seines banned since 2001			
Mozambique	Declining	Increasing	Mechanized hauling of beach seines was discontinued after ban	Conflicts with industrial fisheries are becoming less frequent because of improved surveillance; conflicts with tourism occur in Inhambane Province and are set to increase as tourism develops
Peru	Beach seine catches and contribution to national fish production declined steeply after 1999	Fishing effort declined continuously from 2000–2006 while CPUE remained stable	Introduction of mechanized beach seining and use of smaller mesh sizes, decline of both practices after mechanized beach seining was banned and mesh size regulations were implemented	Conflicts with fishers using other fishing methods on the same fishing ground
Sri Lanka	Modest decline[1]	Number of beach seine units and fishing effort modestly declining	Basic designs of gear remained the same but nets are now made of synthetic rather than natural fibres; size of nets has increased and mesh sizes have decreased; motorized boats are used in some cases	Competition from trawlers and other vessels in inshore waters; coastal erosion
Togo	Production declined between 1996 and 2000	Between 1996 and 2000, the number of beach seine units declined by 18 percent	No significant changes observed in case study	Coastal erosion; coastal pollution through dumping of waste phosphates; social conflicts within fishing communities and conflicts with outsiders

[1] Contribution to national production declined from 27.9 percent in 1995 to 21.5 percent in 2004.
Source: FAO Fishery and Aquaculture Profile, Sri Lanka.

hand, beach seines are still the most important fishing gear. Other countries have seen considerable declines in their beach seine fishery production in recent years, as shown in Table 2.

In Sri Lanka, the contribution of beach seining to national fish production declined only modestly between 1994 and 1995, and, in Ghana, the contribution of beach seining to the total catch even increased between 1989 and 1997, in spite of the fact that the fisheries management plan of 2000 proposed a ban of beach seining.

In India, Peru, Sri Lanka and Togo, the decline in production went hand in hand with a decline in the number of beach seine units. In Benin, though, the number of fishing units remained stable while the catch per unit effort (CPUE) declined, which is an indicator of overfishing, and fishers in Benin have suggested strictly regulating mesh sizes of purse seines, trawl nets and beach seines.

While the basic designs of beach seines did not change much over the years, changes were introduced both in the size of seines, mesh sizes and materials used, as well as in the way beach seines were operated. These changes seem to be similar in the various countries studied.

Traditional nets made of natural fibres were replaced by larger and more catch-efficient nets made from synthetic fibres. To increase catch efficiency further, smaller mesh sizes were used in the codends as well as in the wings. In many places, the hauling of seines was no longer being done manually, but with the help of tractors, cars or winches. In many places, bigger boats and motorized boats were used for operating beach seines.

Efforts to increase the fishing efficiency of beach seines are a reaction to an ever-increasing competition with other fishing vessels, such as ring netters, purse seiners and trawlers, which partly or fully target the same fishery resources and, in many cases, operate illegally close to the shore in spite of regulations designating inshore waters for exclusive use by artisanal fishers.

Other operational constraints of beach seines are competition for fishing areas and conflicts with other artisanal fishers operating beach seines, gillnets and ring nets, eviction from beaches by landowners, tourism development, coastal erosion and fallen trees, accidents because of shifting sandbars, pollution of coastal waters, social conflicts within fishing communities and conflicts with outsiders.

TABLE 3
Intercountry comparison of fishing seasons

Country	Beach seine fishing seasons											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Benin	■									■	■	■
Gambia	Banned but occasionally carried out throughout the year											
Ghana	■	■	■	■	■			■	■	■	■	■
India (Andhra Pradesh)	■	■								■	■	■
Kenya	Banned but carried out from September to April											
Mozambique	■	■	■	■	■	■	■	■	■	■	■	■
Peru	■	■	■	■	■	■	■	■	■	■	■	■
Sri Lanka	■	■	■	■						■	■	■
Togo	■	■	■	■	■				■	■	■	■

As shown in Table 3, fishing seasons of beach seines range from four months to throughout the year depending on weather conditions, resource availability, and also on other occupational activities of beach seine fishers.

Details of the designs of beach seines and crew sizes are summarized in Table 4. The small mesh sizes used in the beach seine codends and central parts highlighted in the country reports in Annex 1 may be noted. Further design details are shown in Annex 2 of this document.

TABLE 4
Intercountry comparison of technical features of beach seines

Country	No. of net panels in each of the wings plus central section/seine body	Typical length of each wing plus central section/ seine body (in m)	Mesh size range in wings (in mm)	Mesh size range in codend/central piece (in mm)	Crew size and people helping to haul the gear
Benin	No information	No information	No information	5–20	Up to 100
Gambia	10	150	40–70	40	25
Ghana	No information	150–300	25–50	10–12	30–50
India (State of Andhra Pradesh), "giant" beach seine – *rampani nets*[1]	24	421.7	10–24	10	40–60
Kenya	2–8	50–200	18–40	1–10	No information
Mozambique	3–4	250–300	50–64	1–38	4–14
Peru	5–12	46–305	45–200	30–64	10–20
Sri Lanka	20	83–144[2]	20–300	6–30	30–40
Togo	No information	115–525	No information	5–24	No information

[1] *Rampani* nets operated on the west coast of India can have a total length of up to 1 000 metres.
[2] According to the case study on Sri Lanka, in addition to the prototype beach seine described in the case study, there are beach seines of the same design being operated in Sri Lanka with a combined length of wings and seine body of up to 600 metres in length.

LITERATURE REVIEWS

In addition to the case studies of the nine countries, carried out with support by FAO and the SFLP, the literature review yielded other studies that complement the information on beach seining and its impact on aquatic resources and habitats. The countries and regions covered by these studies are the Mediterranean, South Africa, Madagascar, the Malabar and Konkan coast of India, and Australia.

The Mediterranean

Beach seines are used by small-scale commercial fishing fleets in the Mediterranean, including Greece, Italy and Spain.

In Greece, beach seines are used by a limited number of boats that are allowed to operate eight months a year at a distance of not more than 70 metres from the beach according to national law. Annual beach seine landings represent as much as 5.8 percent of the total annual fisheries production of Greece. Beach seines are particularly important for picarel (*Spicara smaris*) and calmar (squid, cephalopods) fishing.

In Spain, *sonsera* beach seines are operated on a limited scale (Armeni-Argiovlassiti and Adamidou, 1997). *Sonsera* beach seines are used to catch sand eel in a limited area off the coast of northern Catalonia in the northwestern Mediterranean. Information on fisheries in the southern part of Spain's Mediterranean coastal zone, including a description of a beach seine fishery and its catches, fishing seasons, fishing craft and gear, is provided by Crespo, Garcia and Rey (1981).

The beach seine fishery in Italy is practised as a special seasonal fishery for catching juveniles of European pilchard (*Sardina pilchardus*) and transparent goby (*Aphia minuta*). To evaluate the impact of the beach seine fishery on fishery resources, a survey was carried out in three sample sites, i.e. Schiavonea, Balestrate and Porto Recanti. The qualitative and quantitative composition of the catches showed a negligible impact of the gear on other species in the allowed fishing period (Spedicato *et al.*, 1998).

Another assessment of the impact of beach seines on the fishery resources on the Italian coast comes to the conclusion that the beach seine fishery in Italy is selective and environmentally friendly. It is also highlighted that the beach seine fishery seems to offer good opportunities for aquaculture development, being particularly suited for juveniles and broodstock supply (Cau *et al.*, 2000).

South Africa

Beach seining is commonly practised in South Africa. Studies were conducted on the impact of beach seining on resources and habitats and on the overlap of beach seine catches with catches of other fisheries including recreational fisheries. As in the case of Italy, the findings of these studies suggest that the impact of beach seining on resources and habitats is relatively insignificant and that beach seine catches hardly overlap with catches of other fisheries. Dive surveys found no significant differences in abundance of species composition between sites inside and outside the beach seining areas. The surveys concluded that commercial beach seine netting does not have a significant detrimental effect on the benthic flora and invertebrate fauna of False Bay (Lamberth *et al*., 1995).

Also in False Bay, South Africa, an assessment of the impact of commercial beach seine fishing on juvenile teleost (*Teleostei*) fish populations in the surf zone was carried out. A total of 311 commercial beach seine hauls were monitored in False Bay between January 1991 and December 1992. The hauls yielded 38 930 juvenile teleosts from 31 species and 18 families. It was found that juvenile teleosts constituted 6 percent of the total beach seine catch in the bay. This percentage was considerably smaller than the proportion of juveniles in other South African commercial and recreational fisheries. When compared with published estimates of natural mortality for juvenile teleosts frequenting nearshore sandy beach habitats, potential seine mortality was calculated to be insignificant for most of the species considered (Clark *et al*., 1994a)

Other studies focused on the comparison of the ichthyofauna of estuaries and their adjacent surf zones with an assessment of the effects of beach seining on the nursery function of estuaries for fish. The ichthyofauna of an estuary open intermittently (Zandvlei) and one permanently open (Eerste), and of the surf zones of beaches adjacent to their mouths, Muizenberg and Macassar, respectively, were sampled quarterly by beach seining. Statistical analyses of the density distribution of marine and estuarine fish in the surf zone indicated that although these estuaries were extensively utilized by juveniles of many species, beach seine hauls in the vicinity of estuary mouths were potentially no more harmful to these fish than to those farther away (Clark, Bennett and Lamberth, 1994b).

The beach seine fishery at Durban was investigated from July 1993 to June 1994. During this period, fishers completed 270 hauls on 146 days of operation. In total, 119 species of fish, as well as squid, cuttlefish and crabs, were recorded in the catches. Most of these were shoaling species belonging to the families of ponyfishes (*Leiognathidae*), anchovies (*Engraulidae*) and sardines (*Clupeidae*). Many species were caught at sizes below their reported maturity. Based on this study and data from the National Marine Linefish System, there appeared to be little overlap in the catches of the beach seines and other fishery sectors in the area (Beckley and Fennessy, 1996).

Madagascar

According to Davies, Beanjara and Tregenza (2009), beach seines in Madagascar produce the highest catch per fisher as compared with other gear, but they also catch some of the smallest fish and overlap in selectivity with gillnets. The authors recommend a reduction in the number of beach seines to reduce the catch of small fish and the overlap in selectivity among gears.

The authors acknowledge that artisanal fisheries in Madagascar are nutritionally and economically very important, that poverty is common in Madagascar (which makes sustainable management difficult), and that there are few opportunities for livelihood diversification, making fishers highly dependent on the beach seine fishery for their food security.

Malabar and Konkan coast of India

Nirmale and Metar (2003) describe the *rampani* beach seine, which is operated along the Malabar and Konkan coast of India and is further referred to in the county case study on India. The fishers operating the *rampani* shore seine in Sindhudurg have developed effective ways of resource management that are environmentally sustainable and convenient. The authors describe a rotation system that is strictly adhered to by the different users of the beach, and the ownership of the seine is by a collective of fishers. The natural features of the Malabar and Konkan coast, which has long and sandy beaches, shallow waters, a wide continental shelf and mild currents, are the physical factors that played a role in the development of the resource management systems.

Australia

Studies on discards from beach seining in Australia suggest that survival rates of discarded bycatch of beach seines can be greatly improved by simple modifications to the operations of beach seines and gillnets and by changing post-capture handling procedures.

The problem of discards from beach seining in Australia is highlighted by Gray *et al.* (2001), who analysed observer-based estimates of the quantities and size compositions of discarded and retained catches from the commercial beach seine fishery in Botany Bay, New South Wales, Australia. A total of 71 finfish and 10 invertebrate taxa were identified in catches sampled between February 1998 and February 1999. Thirty-nine taxa were retained by fishers and 77 taxa were discarded. Discards included small individuals of many retained species that are also important in other commercial and recreational fisheries. The estimated monthly ratio of retained to discarded catch ranged from 1:0.26 to 1:2.48. An estimated 44 percent of total individuals and 38 percent of the total weight of catches were discarded. It was estimated that this fishery annually discarded 93 tonnes of fish and invertebrates, which included hundreds of commercially and recreationally important species (Gray *et al.,* 2001).

IMPACT OF BEACH SEINES ON AQUATIC RESOURCES AND HABITATS

Table 5 provides a summary and comparison of information provided by the county case studies on the impact of beach seines on aquatic resources and habitats. In addition to the information provided by the country case studies, the findings of the studies mentioned above have also been incorporated into Table 5 to have a more complete picture of these aspects of beach seining.

With regard to discards, it is interesting to note that with the exception of the case studies carried out in Peru and on the Kenyan coast, discards from beach seine operations in developing countries seem to be negligible and are not a problem as the entire catch is utilized and what is not sold is consumed by the crew and their household members.

A global assessment carried out by FAO also suggests that discards are not a problem in artisanal fisheries. In the absence of information to the contrary, artisanal fisheries, including beach seining, are assumed to have a discard rate of 1 percent or less of the catch, while the global weighted discard rate of all fisheries is assumed to be 8 percent. Beach seine fisheries in developing countries are listed as fisheries with low to negligible discard rates (FAO, 2005a: 17, 19).

The FAO study suggests two principle approaches to addressing the discard problem, i.e. reducing bycatch and increasing the utilization of bycatch. These two harvest strategies may be complementary and, in any given fishery, finding an appropriate balance between bycatch reduction and utilization is required.

TABLE 5
Intercountry comparison of impact of beach seines on fishery resources and habitats

Country/findings of studies/observations and sources	Impact of beach seining on resources	Impact of beach seining on aquatic habitats	Discards
Australia (Gray *et al.* 2001)	Negative impact because of high mortality rates of discards	No information	Empirical study in Botany Bay, New South Wales, Australia, shows that 44 percent of total individuals and 38 percent of total weight of catch is discarded
Benin (case study)	Observations: high shares of juveniles and contribution to overfishing because of small mesh sizes	No information	Negligible
Gambia (case study)	Observations: high shares of juveniles because of small mesh sizes	No information	Negligible
Ghana (case study)	Empirical studies: high shares of juveniles and contribution to overfishing because of the use of small mesh sizes	No information	Negligible
India: Andhra Pradesh and Orissa (case study)	Observations: high ratios of juveniles observed when using small mesh sizes in river mouths, estuaries, nursery ground	No information	Negligible[1]
India: Malabar and Konkan coast (Sathiadhas and Narayanakumar, 2002: 68–69; Nirmale and Metar, 2003)	Empirical study in Kerala: findings indicate that economic losses due to juvenile fishing in the study area are the lowest for beach seines and more than seven times higher for purse seines, more than five times higher for trawl nets and almost four times as high for ring seines Article on Konkan coast describes beach seining as environmentally friendly	No information	Negligible
Italy (Spedicato *et al*., 1998)	Empirical surveys were carried out for estimating the impact of beach seine fishery on the resources in three sample sites, i.e. Schiavonea, Balestrate and Porto Recanti. The qualitative and quantitative composition of the catches showed a negligible impact of the gear on other species in the allowed period	No information	Negligible
Kenya (Mangi and Roberts, 2006)	Empirical study found high shares of juveniles in beach seine catches that contribute to overfishing	Empirical study concluded that fishing gears including beach seines damaged corals	Empirical study found discard rate of 6.5 percent Country case study did not observe any discards, neither on the coast nor on Lake Victoria
Kenya (case study)	High share of juveniles in beach seines, both on the coast and on Lake Victoria	Study on Lake Victoria observed damage of benthic habitats caused by beach seines	Negligible

TABLE 5, cont.

Country/findings of studies/observations and sources	Impact of beach seining on resources	Impact of beach seining on aquatic habitats	Discards
Mozambique (case study)	Observations: high shares of juveniles because of small mesh sizes Recommended: any turtles incidentally caught in beach seines should be carefully handled and released immediately. If this procedure is followed beach seines do not need to have a negative impact on turtle populations	Underwater videos taken of the hauling of mechanized beach seines by the National Institute for the Development of Small-scale Fisheries (IDPPE) in 1998 show that the foot rope of the seine is actually clear of the seabed during hauling, but this may change with hauling force, water depth, net buoyancy and net height Although a large amount of seagrass was landed with each haul during fishing trials, the seagrass was invariably dead, had been floating in the water, and showed no signs of having just been removed from the seabed	Negligible
Peru (case study)	Empirical studies: juveniles constitute up to 50 percent of catch	No information	Observations in Huacho and San José conclude variable discards ratios in manual beach seining. Empirical study on manual beach seining (now prohibited) showed discard ratio of 22 percent of total weight
South Africa (Lamberth *et al*., 1995; Clark *et al.,* 1994a)	Empirical studies carried out in various locations suggest that the impact of beach seining on resources and habitats is insignificant. As for the impact of beach seining on aquatic resources and habitat, dive surveys found no significant differences in abundance of species composition between sites inside and outside the beach seine areas	The surveys concluded that commercial beach seining does not have a significant detrimental effect on the benthic flora and invertebrate fauna of False Bay	Negligible
Sri Lanka (case study)	Observations: high shares of juveniles because of the use of small mesh sizes	No information	Negligible
Togo (case study)	Observations: high shares of juveniles and contribution to overfishing because of small mesh sizes	No information	Negligible

[1] This finding is based on observations. A global study carried out by FAO (2005a: 19) confirms these observations. It lists beach seine fisheries in developing countries as negligible as far as discards are concerned.

All fishing operations should make efforts to avoid unwanted catches and discards that may reduce biodiversity and disrupt ecosystem functions. In the case where catches are unavoidable, efforts must be made to use these catches or return them to the sea, ensure their survival, and keep records of discards for management purposes.

As for the impact on aquatic habitats, most of the country case studies do not provide any information and little information can be found in the literature. The case study carried out in Mozambique highlights that underwater videos taken of the hauling of mechanized beach seines by the National Institute for the Development of Small-scale Fisheries (IDPPE) in 1998 show that the foot rope of the seine is actually clear of the seabed during hauling, but this may change with hauling force, water depth, net buoyancy and net height.

With regard to the catch of seagrasses, the study mentions that although a large amount of seagrass was landed with each haul during fishing trials, the seagrass was

invariably dead, had been floating in the water, and showed no signs of having just been removed from the seabed.

Similarly, the information on habitat impact provided by empirical studies and dive surveys carried out in False Bay, South Africa, concluded that commercial beach seining does not have a significant detrimental effect on the benthic flora and invertebrate fauna of False Bay.

An empirical study carried out in Kenya, on the other hand, concludes that beach seines cause damage to coral reef habitat. A negative impact of beach seining on benthic habitat was also observed in the beach seine fisheries on Lake Victoria.

When assessing the impact of beach seines on benthic habitats, it is probably correct to assume that beach seines can be expected to have less of an impact than heavier gear such as trawl nets and scallop dredges. In this context, it is interesting to note that a study done by FAO (2005b) on the impacts of trawling and scallop dredging on benthic habitats and communities comes to the conclusion that trawling disturbances caused no effects in areas exposed to natural disturbances, e.g. wave actions and fluctuations in salinity conditions which prevail at ocean shores and estuaries where beach seines are operated.

The study highlights the difficulty in conducting impact studies that produce clear conclusions. The reasons given are the complexity and natural variability of benthic communities. It might be reasonable to assume that if bottom trawling does not cause any significant effects in areas with high natural disturbances, beach seines might not cause any significant negative effect on these types of bottom habitats either.

In the case of the observed negative impact of beach seines on benthic habitat on Kenya's coast, it should be taken into consideration that in Kenya the beach seine fishery operates partly in seagrass and patchy coralline habitat of reef lagoons, which are highly sensitive to damage from bottom hauled nets. In other countries, beach seine fisheries operate mostly in soft bottom, sand/silt habitats, which are much less sensitive to the impact of fishing gear.

As far as the impact of beach seining on fishery resources is concerned, all studies observe a high percentage of juveniles in the catches of beach seines. It is interesting to note though that, with the exception of the empirical studies carried out in Kerala, India, and South Africa, none of the other studies compared the amount of juveniles caught by beach seines with the amount of juveniles caught by other types of gear or with the natural mortality of juveniles. Furthermore, none of the studies assessed whether or not the amount of juveniles caught by beach seines is sufficient to have a significant impact on the reproductive capacity of the particular fish species caught. This was outside the scope of the case studies.

The studies on beach seine fisheries in South Africa carried out in various locations, on the other hand, conclude that the impact of beach seining on resources and habitats is relatively insignificant.

Similarly, a study carried out in Kerala on the west coast of India found that economic losses due to juvenile fishing in the study area were the lowest for beach seines and more than seven times higher for purse seines, more than five times higher for trawl nets, and almost four times as high for ring seines, which comes as no surprise as the fishing capacity and efficiency of these types of fishing gear is so much greater than the fishing capacity and efficiency of beach seines.

When considering the impact of beach seining as well as other types of fishing that target or affect the same resources and species, such as ring nets, purse seines and trawl nets operated in inshore waters on the state of fisheries resources, it should be kept in mind that fishery resources are not only affected by the catch of juveniles. For example, the capture of adult fish that aggregate for the purpose of spawning before they are able to spawn can be as harmful or even more harmful than catching some species of juveniles.

The question of whether or not the catch of adult fish or juveniles by beach seines has a significant impact on the ability of a given species to reproduce in comparison with mortality caused by other fishing methods or by natural mortality also depends on the quantity of fish caught.

In order to assess the actual impact of beach seines on fishery resources through the catch of juveniles, the following questions and information need to be answered and collected:

- What is the percentage of juveniles caught in beach seines by species and by season?
- What are the natural mortality rates of juveniles in the areas where the beach seines operate?

TABLE 6
Intercountry comparison of age, gender and educational achievements and kinship ties of beach seine crews[1]

Country	Age composition of crew	Participation of women in beach seining		Educational achievement	Kinship ties among crew, post-harvest workers
		Boat/shore-based participation in setting, hauling, support	Post-harvest participation		
Benin	Average age of crew: 38; of women fish smokers: 39	Sorting of fish	Smoking, drying, marketing	Most crew: fourth grade elementary school; women fish smokers: most illiterate	Kinship ties between women fish mongers and fishers and among beach seine crews
Ghana	No information	Financing and management of beach seining	Processing, storing and marketing of beach seine catches	10 to 40 percent illiteracy among beach seine fishers and women	Kinship ties between some crew members and women involved in post-harvest activities
India (Andhra Pradesh and Orissa)	Strong participation of old people and children in beach seining and hauling of nets	Preparation/provision of food/water for crews for pay, collection of in-kind remuneration (fish) on behalf of husbands, hauling of beach seines	Auctioning beach seine catches, buying and retailing fresh fish, transporting catches to village, fish drying	Majority of crew and household members have not attended or completed primary school	Most crew members have kinship ties, also many kinship ties between post-harvest workers and beach seine crews
Kenya	Majority belong to age group from 30 to 50 years	Hauling of beach seines and sorting of catch	Fish frying and selling in villages	High illiteracy rates prevail in beach seine fishing communities	No information
Mozambique	No information	Hauling of beach seines and sorting of catch	Fish marketing and processing	No information	No information
Peru	In San José: 18–19 years; In Huacho: 30–49 years	No information	No information	33 to 58 percent completed primary education and started secondary education	No information
Sri Lanka	No information	Own shares of beach seines, participate in the hauling of nets	Sorting, drying and marketing of catch	No information	Strong kinship ties among crew and also post-harvest workers
Togo	40 years for male crew members; 58 for beach seine owners; 40 for women	Sorting of fish	Fish smoking, drying and marketing	Two-thirds of beach seine fishers are illiterate	Kinship ties between crew members and women fish mongers and fishers

[1] The case study on the Gambia does not provide information on age, gender and educational achievements and kinship ties of beach seine crews because beach seining was illegal in the Gambia at the time of the study and the study was limited to fishing trials only.

- What are the fishing mortality rates of these species of juveniles caught in beach seines compared with other fishing methods, such as ring seiners, purse seines, gillnets and trawlers operating in inshore waters, including those which operate illegally?

Only when these questions are answered can fishers and other stakeholders understand whether any significant harm is caused by beach seines or whether or not their resource impact is negligible or significant compared with other factors. Answers to these questions are also essential if the problem of resource depletion is to be addressed in a meaningful and comprehensive way, with a view to conserve and restore fisheries resources and the livelihoods of those depending on these resources.

SOCIAL AND DEMOGRAPHIC CHARACTERISTICS AND ACCESS TO SOCIAL SERVICES AND INFRASTRUCTURE

In beach seine fisheries, kinship ties among crew members still play a strong role. Illiteracy is high among beach seine crews and educational achievements are low. Low levels of education and of literacy are one aspect of poverty and vulnerability found among those involved in beach seining and this hampers their occupational and geographic mobility as well as their political participation and empowerment.

In most of the countries studied, beach seine crews belong to the middle-aged group. However, in India and parts of Peru, crew members are either elderly or very young, as most persons of middle age are involved in other types of fishing.

As shown in Table 6, women are involved in many aspects of beach seining and in shore-based activities. These activities range from financing and management of beach seine units, receiving and sorting of catch, preparation and provision of food and water for crews for pay, to the collection of in-kind remuneration, meaning that women fish on behalf of husbands, hauling of beach seines or in post-harvest activities such as the auctioning, processing and marketing of fish.

While the case studies did not provide exact information on the amount of time spent on beach seining as compared with other fishing and non-fishing activities, it is estimated that, with the exception of Peru and Togo, beach seine operators spent between one- and two-thirds of their working time on this type of fishing. In Peru, beach seining is mostly an occasional and sometimes part-time occupation, while in Togo beach seining seems to be a full-time occupation for most beach seine fishers.

The rest of the time not spent on beach seining is spent on a number of other activities, both within and outside fisheries. Other fisheries and fisheries-related occupations of beach seine fishers include fishing with gillnets, longlines, handlines, traps, cast nets, boat seines and purse seines, industrial fisheries and oyster cultivation, as well as fish marketing and processing.

Beach seine fishers are also involved in a number of non-fisheries-related activities such as transportation, construction, carpentry, masonry, services, crop cultivation, coconut cultivation, animal husbandry, repair of engines and vehicles, and other activities (see Table 7).

In addition to their involvement in fisheries, women work in the service sector, transportation, construction, crop cultivation and animal husbandry, as well as making and selling handicrafts, preparing and selling food items, making salt and coconut oil, and similar activities.

The considerable occupational diversity of beach seine fishers is also reflected in their relative dependence on beach seining as the source of household income, shown in Table 8, together with their economic status and the factors that contribute to the vulnerability of their households.

Regarding the sources of income, most of the households earn between one-third and two-thirds of their income from employment in beach seining. The exceptions

TABLE 7
Intercountry comparison of occupational diversity of beach seine crews and households[1]

Country	Full- and part-time involvement in beach seining[2]	Other fisheries/ aquaculture activities of crew members	Non-fisheries occupations of crew members	Non-fisheries occupations of women
Benin	One-third to two-thirds of working time	Gillnetting, traps, cast nets, purse seines, oyster cultivation	Crop and coconut cultivation, cattle-raising, animal husbandry, poultry, carpenters, stone masonry, transportation, mechanics	Crop cultivation, animal husbandry, salt making, peanut and coconut oil making
Ghana	One-third to two-thirds of working time	Gillnetting, hook and lines, boat seines	Crop cultivation, carpentry, masonry, transportation	Crop cultivation, salt making
India (Andhra Pradesh and Orissa)	One-third to two-thirds of working time	Gillnetting, hook and line, cast nets, freshwater aquaculture	Transportation, construction and service sectors, crop cultivation, animal husbandry	Service sector, transport and construction sector, crop cultivation, animal husbandry
Kenya	One-third to two-thirds of working time			
Mozambique	One-third to half of working time	Fish marketing and processing	Crop cultivation, animal husbandry	Crop cultivation, animal husbandry
Peru	One-third or less of working time	Other types of small-scale fishing, industrial fishing	Agriculture, carpentry, construction work, transportation	Agriculture
Sri Lanka	One-third to two-thirds of working time	Gillnetting, boat seining, hook and line, traps, cast nets	Crop and coconut cultivation, animal husbandry	Animal husbandry, crop cultivation, handicrafts, food preparation and sale
Togo	90 percent full-time and 10 percent part-time		Crop cultivation, raising of livestock	Crop cultivation, raising of livestock

[1] The case study on the Gambia does not provide information on occupational diversity of beach seine crews and households because beach seining was illegal in the Gambia at the time of the study and the study was limited to fishing trials only.
[2] Part-time involvement is defined here as involving one-third or more of the total time a crew member spends on earning income in cash or in kind and/or providing a source of a third or more of the total income of the crew member; occasional is defined as less than one-third of the same.

are Mozambique and Togo, where fishing households depend almost fully on beach seining for their income, and Peru, where beach seining accounted for less than one-third of household income.

With regard to the economic status of households, poverty as well as absolute poverty are widespread among households that are involved in beach seining, both in monetary terms as well as in wider terms, which take into consideration standards of housing and sanitation, health, education, access to infrastructure and services, and other factors. Poverty is less common among beach seine fishers in Peru, where 25 percent of all fisher households are considered to be poor while two-thirds are above the poverty line.

In addition to poverty, households involved in beach seining have a high degree of vulnerability. Vulnerability is defined (FAO, 2005c: 6) as a condition arising from the interaction of three factors, i.e. risk exposure or the nature and degree to which a household (or community) is exposed to a certain risk such as natural disasters, conflicts and macroeconomic changes; sensitivity to this risk, measured for instance through the dependence of the household (or community) on fishing activity for food security or income generation; and adaptive capacity of the household (or community) to deal with risk, i.e. its ability to cope with negative impacts.

TABLE 8
Intercountry comparison of economic status, poverty and vulnerability of households involved in/depending on beach seining

Country	Sources of household income other than fishing	Dependency on beach seining for income	Economic status and poverty of crew members and their households	Factors contributing to vulnerability of households and threats to beach seining
Benin	Cultivation of coconuts, crops, cereals, vegetables, raising of cattle and pigs	Major source of income and food	Widespread poverty and absolute poverty	Conflicts with other fishers, exclusion from beaches because of conservation measures, negative impact on beach seines on resources and habitats
Ghana	Crop cultivation, carpentry, masonry, driving, salt making	One-third to two-thirds of income	Widespread poverty and absolute poverty	Competition for fishing areas by housing and industrial developments, coastal erosion, outbreak of diseases, sudden price hikes for fishing inputs, competition for resources and destruction of fishing gear by trawlers
India (Andhra Pradesh and Orissa)	Minor part of income from crop cultivation, animal husbandry, work in construction, transport and service sector	One-third to two-thirds of income	All of crew and most of households below national poverty line[1]	Reduced access to beaches because of urbanization, housing/industrial development, aquaculture, resource depletion by purse seining, growing pollution of coastal waters
Kenya	Agriculture	Major part of income derived from fishing	Widespread poverty and absolute poverty in beach seine fishing communities	Conflicts with other fishers, government ban on beach seining, exclusion from beaches because of conservation measures, negative impact of beach seines on resources and habitats
Mozambique	Agriculture	55–75 percent of fisheries related income	Widespread poverty and absolute poverty in beach seine fishing communities	Low income of beach seine crews, negative impact of beach seining on fisheries resources
Peru	Agriculture, carpentry, transportation, construction work	One-third or less of income	25 percent of beach seine fishers live in poverty	Negative impact on beach seine gear on resources
Sri Lanka	Crop cultivation, animal husbandry, service sector	One-third to two-thirds of income	Widespread poverty among fisherfolk, many vulnerable to absolute poverty	Natural calamities (tsunami), coastal erosion
Togo	Crop cultivation, raising of livestock	90 percent are fully dependent on beach seining	Almost half of beach seine fishers are poor	Coastal erosion and pollution of coastal waters; competition from purse seiners and driftnetters and theft and damage of gear; aids, malaria, cholera and other diseases

[1] According to the Indian Government economic survey of 2007/2008, 22 percent of the population of India lives in poverty. Different poverty ratios prevail in the different states. According to the same survey, as many as 40 to 50 percent of the population of Orissa lives below the poverty line. An estimate of the World Bank, which assumes that a person earning less than USD 1.25 a day lives in poverty, which is the poverty line adopted by the United Nations as far as income is concerned, arrives at a much higher poverty ratio for India for 2005, i.e. 42 percent.

The case studies identified a number of factors that contribute to the vulnerability of households, to beach seining as an important occupation and to sources of income. Most of these factors apply to most of the countries studied. They include reduced access to beaches because of urban sprawl, industrial development, aquaculture development

TABLE 9
Intercountry comparison of contribution of beach seines to food security

Country	Contribution to food security of beach seine operators and households	Contribution to food security of consumers of beach seine catches
Benin	Essential for food security of beach seine crews most of whom live below the poverty line	Beach seine catches are consumed by the rural and urban poor and essential for their food security
Ghana	Essential for food security of beach seine crews, many of whom live below the poverty line. Beach seining is part of the traditional social welfare system and provides free fish to the handicapped, poor and elderly members of the community	Most of the catch is consumed in rural areas by poor villagers
India, (Andhra Pradesh and Orissa)	Essential for food security of beach seine crews, all of whom live below the poverty line, including in absolute poverty, and depend for food security on remuneration in kind (fish) and cash. Also provides fish for other poor villagers who are present when nets are being hauled	Eighty percent of consumers of fresh and dried fish from beach seine catches in villages live below the poverty line
Kenya	Essential for food security of beach seine crews, most of whom live in absolute poverty	Most beach seine catches are consumed by rural poor and important for their food security
Mozambique	Essential for food security of beach seine crews, most of whom live in absolute poverty	A large part of beach seine catches is consumed by the rural poor and essential for their food security
Peru	Contributes to food security of beach seine households	Beach seine catches contribute to food security of poor and low-income consumers in rural areas
Sri Lanka	Essential for food security of beach seine crews, many of whom live below the poverty line. Provides fish for poor villagers	Large parts of beach seine catches are consumed by the rural and urban poor and essential for their food security
Togo	Essential for food security of beach seine crews, many of whom live below the poverty line	Beach seine catches are consumed by the rural and urban poor and important for their food security

and conservation measures; resource depletion by purse seining, trawlers and other fishing activities including beach seining itself; growing pollution of nearshore and coastal waters; natural calamities including tsunamis; coastal erosion; conflicts with other fishers; government bans on beach seining; outbreak of diseases such as cholera, malaria, AIDS; sudden price hikes for fishing inputs; destruction and damage of fishing gear by industrial fishing vessels; and low and irregular incomes, among other factors.

All country case studies emphasize that beach seining makes a very important contribution to food security, as shown in Table 9. First of all, beach seine fisheries contribute to the food security of beach seine fishers and their households, both through remuneration in cash and through remuneration in kind in the form of fish, which is used for their daily consumption. Secondly, beach seine fisheries function as a social safety net for the absolute poor, elderly, disabled, widows, orphans and other destitute villagers as it is customary in most places that anyone who is present at the time of hauling a seine and appears to lend a hand is given some fish in return. Thirdly, the major parts of catches of beach seines are consumed in rural areas with high levels of poverty and thus contribute importantly to the food security protein supply of these areas.

FINANCIAL AND ECONOMIC PERFORMANCE OF BEACH SEINES

Of the country case studies in Annex 1, only the country case study on Mozambique provides information that can be used to assess the economic performance of beach seines in terms of their net cash flow (NCF), the ratio of net cash flow to total earnings (NCF/TE) and the financial performance in terms of the return on investment (ROI). In the case of India, the estimates of the financial and economic performance of beach seines are based on information collected in the 1980s (FAO, 1989: 105–106). As for Ghana, the estimates are based on information collected in 1996 (FAO, 1999: 11). Because the case study in Sri Lanka was done by document review, the financial and

TABLE 10
Intercountry comparison of financial and economic performance of beach seines in Ghana, India and Mozambique

Country	Location/type of beach seine	Rate of return on investment (ROI) (%)	Net cash flow/total earnings (NCF/TE) (%)
Ghana	Coast, motorized beach seining	17	11
	Coastal, non-motorized beach seining	48	25
India	Orissa coast	135	–
Mozambique	Petane, Inhassoro District	94/40[1]	71
	Mponha, Moma District	80	50

[1] ROI is 40 percent with outboard engine.

economic data available were from 1987 and 1997 and with a sparse number of data sets. It was decided that this information was not sufficiently up to date and, therefore, it was not considered in the economic comparisons. The calculations for Sri Lanka, although outdated, are shown in Annex 3.

Table 10 provides examples of the financial and economic performance of beach seines in Ghana, India and Mozambique.

As can be seen from Table 10, beach seines in all three countries showed favourable financial results. The rates of ROIs range from 17 percent for motorized beach seining in Ghana to as much as 135 percent for a beach seine operated on the Orissa coast of India. The ROI of this beach seine, based on older information, seems to fit in well within this range. It was mentioned in some of the country study reports that beach seines operated with motorized boats generally did not perform financially as well as beach seines operated with non-motorized boats. This is because of the added investment cost for the engine and the fact that remuneration of labour in beach seining is relatively low when compared with the investment and operational cost of an engine, which does not actually increase fishing efficiency in this type of fishing but rather replaces labour used for the propulsion of the boat.

As an economic indicator that reflects how well an enterprise is operated in terms of how much gross revenue needs to be generated to produce a certain profit or net surplus, the NCF/TE ranged from 11 percent for the same motorized beach seining in Ghana to 71 percent for a beach seine operated in Petane, Inhassoro District, in Mozambique.

While the country case study on Ghana did not provide sufficient information to calculate ROI and NCF/TE, it did provide information on incomes, expenditures and revenue-to-share ratios of beach seine enterprises in four villages surveyed in the context of the country case study. The information confirms the findings of the global FAO study and shows that beach seine enterprises in Ghana were quite profitable and generated substantial revenue for the crew and company.

Comparing these findings with three global studies carried out by FAO on the economic performance of marine capture fisheries between 1995 and 2003, it is interesting to note that all three studies showed that artisanal fisheries, particularly non-mechanized ones, with few exceptions, have very favourable rates of returns on investment because the initial investments and subsequently the annual depreciations are small.

When relating the positive economic and financial performance of beach seining and other artisanal fishing methods to the issue of widespread poverty in artisanal fishing communities, it should be kept in mind that both phenomena do coexist. Their coexistence is explained by the fact that even though artisanal fishing has in most cases a positive cash flow – otherwise people could not afford to be engaged in this activity in the long-term – the income generated in cash and in kind by artisanal fishing is often small and unevenly distributed over the year owing to the seasonality of fishing.

Such income might not be sufficient to sustain households unless the households also have other sources of income and food. As far as poverty is concerned, it should also be kept in mind that income is only one aspect because poverty also relates to poor housing and sanitary conditions, lack of infrastructure, access to resources, financial and other services, education, political participation and other aspects.

Very often, the beach seine and boat is owned by an individual or by a family. These owners tend to be relatively more well-off economically and socially compared with their crews and to the many persons who assist in hauling the seine with the hope of receiving some fish to eat. The social capital of the owners is quite high in that they provide employment and food to a large percentage of the residents in their community. Ownership of a beach seine by groups of fishers was also observed but is less common.

Finally, economic and financial data need to be collected on a regular basis over periods of time to cover the entire fishing seasons. This would assist policy-makers and operators to better understand the socio-economic impacts of fishing operations and, in particular, beach seines.

REGULATIONS, MANAGEMENT MEASURES AND PARTICIPATORY APPROACHES

Table 11 gives a summary and comparison of information provided by the country case studies on fisheries and beach seine regulations and their effectiveness.

All of the countries where the case studies were carried out have fisheries regulations, which have implications for beach seining, such as regulations on registration and licensing, regulations on vessel safety inspections and insurance, zoning regulations, and regulations concerning fishing seasons and fishing grounds. The case studies reported that in many cases these regulations were not being complied with. Examples include the lack of registration of beach seine boats, lack of enforcement of inshore fishing zones reserved for small-scale fishing activities resulting in encroachment of industrial fishing vessels, and the overexploitation of inshore fisheries resources, which could otherwise be exploited by beach seines.

Many countries have specifically regulated beach seine fisheries in their national waters and regulated mesh sizes, dimensions of fishing gear, fishing craft and gear to be used in beach seining, including limited fishing seasons areas, as well as banning certain operations such as mechanized beach seining. Bans on mechanized beach seining have reduced this activity to some extent in Peru and perhaps in Mozambique and general bans on beach seining have slowed it down on Lake Victoria. There are other cases, such as the case of the Kenyan coast, where such bans have not worked, and the case of Ghana, where beach seining has even increased after a ban was proposed in a fisheries management act.

Concerning the regulations of mesh sizes and dimensions of the gear, the case studies observed that these regulations were not being observed either. In the case of Sri Lanka and perhaps in other cases, there is a need to update existing regulations to account for technical changes that have taken place in the craft and gear that have evolved with time.

In some countries, fisher organizations and traditional fisheries management mechanisms exist, but these are rarely, if at all consulted, when management regulations are formulated. These include beach management units (BMUs) in Africa, fish worker associations and fisheries cooperatives in India and Sri Lanka, as well as traditional village-based fisheries management mechanisms such as the village *panchayats* in Andhra Pradesh and Orissa.

TABLE 11
Intercountry comparison of management regulations for beach seines and their effectiveness

Country	Laws and regulations affecting beach seining	Effectiveness
Benin	Code of Shipping – Ordinance No. 68-38/PR/MTPTPT of 18 June 1968, as amended by Ordinance No. 69-49/PR/MAE of 9 December 1969. Interministerial Decree No. 100/MTPTPT/MDR of 31 July 1968. Ordinance No. 76-49 of 10 September 1976; Decree No. 76-92 of 2 April 1976; Decree No. 78-18 of 9 February 1978.	Regulations do not have specific provisions which affect beach seining.[1] Fishers interviewed during the field study in Benin were aware of the negative resource impact of beach seines and other gears and of the lack of regulation and enforcement. They suggested that the government should prohibit the sale of small mesh netting on the market and regulate the mesh sizes of purse seines, trawl nets and beach seines to make these gears more selective as well as monitor the implementation of such regulations.
Gambia	Beach seining was banned by Act of Parliament in 1989.	Ban of beach seining is not effective as beach seining still continued even though on a much reduced scale.
Ghana	Fisheries Law (PNDC Law 256) of 1991 and Fisheries Act 625 of 2002.	Not effective as beach seining is commonly carried out, mesh size regulations are not followed and prohibited fishing methods are still being used. Law is being revised. New legislation to be proposed to parliament includes strengthening of community-based fisheries management committees, which were created in 1997.
India	Marine Fishing Regulation Act (MFRA), Coastal Regulation Zone Notification.	Not effective in Orissa and Andhra Pradesh, as boats used for beach seining are not registered. In both artisanal and mechanized sector, the mesh size regulations not followed. In the case of zoning of coastal waters, most departments of fisheries have no capacity and infrastructure for implementation of regulations and mechanized boats continue to fish close to the shore negatively affecting catches and operations of beach seine fishers.
Kenya	Fisheries Act Cap 378 of 1989, subsidiary legislation in Kenya Gazette Notice No. 7565 Vol. CIII. No. 69 of 9 November 2001 introduced the ban on beach seining and spear guns.	Ban of beach seining on the coast has not been complied with as most beach seiners lack alternative employment opportunities and would have been left without food and livelihoods had they complied with the ban.
Mozambique	Lei das Pescas (Fisheries Law) 3/1990 and the Regulamento Geral da Pesca Maritima (General Regulation of Marine Fishing) Decree 4/2003.	Very limited compliance with either of the management measures established by the Ministry both as far as closed seasons and minimum mesh size are concerned. Use of mosquito netting in the codend of the beach seine is still common in certain areas on the Sofala Bank and meshes smaller than 38 mm are often found in the codend of nets that do not use mosquito netting.
Peru	General Fisheries Law (Supreme Decree No. 005-89-PE of 1.4.1989) and various ministerial resolutions and regional ordinances regulate fishing areas, seasons and gear specifications. Mechanized beach seine fishing was banned by ministerial in 1998. Minimum mesh size in seine body for manual beach seines is 38 mm. The regional ordinance of Lambayeque (No. 022-2006-GR.LAMB/CR) of 2006 increased the minimum mesh size in the seine body to 63.5 mm.	Ban of mechanized beach seining is not effective as the gear is still being used.
Sri Lanka	Fisheries and Aquatic Resources Act No.2 of 1966; *Madel* (beach seine) Regulations of 1984; Fishing Operations Regulations of 1996; Inland Fisheries Management Regulations of 1996.	Generally effective as far as designation of beach seine areas (*warayas*) is concerned and limiting of entry into the fishery. Regulations have ceased to be effective as far as the regulation of fishing effort and of the types of craft and gears are concerned that can be used for beach seining in the designated beach seine fishing areas as technologies have changed since regulations were promulgated in 1984. Not effective as far as protection of fishing grounds from intrusion of mechanized vessels are concerned. Not effective as far as registration of beach seine craft is concerned as they are exempted from the seaworthiness and insurance provisions of the registration procedures.
Togo	Decree No. 97-108/PR of 23 July 1997.	No specific provisions for beach seining. Beach seine fishers are not familiar with neither fisheries regulations nor administration but keen to learn about both and become involved.

[1] Since the country case study was conducted in Benin, beach seine gear regulations have been introduced to minimize capture of juveniles and damage to the benthic habitat, such as regulations on minimum mesh sizes, minimum length of the codend and maximum total length of beach seines.

Beach seine fishers in the countries studied were often unaware of regulations. In cases where beach seining had been banned, fishers complained that they could not comply with the ban as most beach seine fishers lack sufficient alternative employment opportunities and would be left without food and livelihoods if they obeyed the ban.

As overall, fisheries regulations that directly or indirectly affect beach seine fisheries have not been effective, it might be beneficial to substantially strengthen the already ongoing efforts towards fisheries co-management and the involvement of beach seine fishers and other stakeholders in the process of formulation of policies and regulations as well as their implementation and monitoring.

The overall conclusions and sentiments of the country case studies regarding the future of beach seining are probably most typically expressed by the studies carried out in India and Kenya (Box 1).

BOX 1

The future of beach seining

Venkatesh Salagrama, India

"The importance of beach seining in India today is not so much based on its contribution to economic growth, neither at the national nor at the individual level, as on its contribution to livelihood support and food security in small-scale fishing communities. It is the mainstay of employment for some of the poorest and the most vulnerable groups of people, i.e. older people, who constitute a sizeable proportion of the beach seine crew, women, who depend on beach seine catches for their processing and trade activities and also function as a social safety net.

The future of the beach seining in India does not look promising as a result of both external and internal pressures. The external pressures are manifested in increasing competition from tourism and other shoreline developments where beach seining is carried out and from other fisheries that target the same species. The internal pressures are evident in the widespread notion among younger fishers that beach seining is not a sophisticated technology and that while it can be a source of subsistence, it can never be a source of wealth but an activity for and by the aged people."

Davide Signa, Paul Mboya Tuda and Melita Samoilys, Kenya

"While it is clear that the beach seine gear is very important for the communities in terms of food security, income and employment, it is also clear that as currently practiced, the beach seine compromises sustainability in the exploitation of fisheries resources. Consequently, the dilemma policy-makers and management institutions face is to balance people's needs with the need to ensure a healthy and functioning ecosystem that can maintain fisheries productivity for generations.

The ideal situation, in both Lake Victoria and the coast, is seen as having a small-scale fisheries sector and beach seine fisheries properly controlled and managed in a sustainable way with the full participation of the local communities and with a legal framework developed and enforced in the most participatory manner. The case study concludes that this can be done only if the livelihood challenges and opportunities faced by local fishing communities are properly understood and taken into consideration with an open minded and participatory approach."

4. Recommendations

The country case studies made recommendations on what should be done to bring about changes in resource- and habitat-friendly beach seining and better management practices. The recommendations for all nine countries are presented below.

BENIN

The recommendations for Benin are shown in Box 2.

BOX 2
Key recommendations for Benin

The Fisheries Department should:

- Update rules delineating fishing zones to limit interaction between the beach seine and industrial fleets in collaboration with the fishers.
- Prohibit the importation of fine mesh nets.
- With a view to have fishers accept new mesh size regulations, encourage owners of beach seines to form associations and support these associations in the acquisition of appropriate mesh size materials and fishing equipment.
- Support collection and monitoring of biostatistical data on beach seine fishing for one or two calendar years.
- Promote co-management of beach seine fisheries.

Beach seine owners and fishers should:

- Prepare a proposal for laws regulating beach seine mesh sizes to reduce the catch of juveniles.[1]
- Participate in collection of fisheries statistics and in monitoring and control of fishing effort.
- Control the migration of foreign fishers from other countries to Benin.

[1] Regulations of beach seine fisheries were introduced in Benin following this recommendation.

GHANA

The recommendations for Ghana focus on ending the proposed ban of beach seining and on capacity building and human capital development (Box 3).

BOX 3
Key recommendations for Ghana

Human capital development of fishers and capacity building and awareness-raising:

- Promotion of long-term informal learning methods to remove the weakness of illiteracy, lack of skills in other fishing and livelihoods strategies and on improving fisher and community health status.
- Awareness creation about environmental and public health issues.

Policies, institutions and processes:

- Advocacy to phase out the inefficient ban of beach seining proposed in the fisheries management plan of 2000.
- Advocacy to enforce regulations that prohibit trawlers from fishing in inshore waters and negotiation of concessions for beach seine operators.

BOX 3
Key recommendations for Ghana, cont.

- Promotion and training of other livelihoods strategies, such as salt mining or in other fishing methods.
- Strict enforcement of mesh size regulation and education of beach seine operators to reduce sizes of gear and to operate further away from estuaries.
- Capacity building of the Community-based Fisheries Management Committee (CBFMC) and beach seine owners' associations with regard to group formation and dynamics, leadership skills, advocacy and collaboration.
- Improving fisheries management and implementation of management plans at the grassroots through peer exchange programmes and networking beach seine communities with technical and social-economic institutions.

TOGO

Beach seine fisheries are currently not regulated in Togo. The case study proposes to draft and implement beach seine regulations so that beach seining can be carried out in a sustainable manner, both in terms of aquatic resource sustainability and sustainable livelihoods of beach seine fishers and their communities. The recommendations are shown in Box 4.

BOX 4
Key recommendations for Togo

- Facilitate the participation of all stakeholders in the fisheries sector, including NGOs in policy formulation of laws and regulations.
- The Directorate of Livestock and Fisheries should draft beach seine fisheries regulations taking into account the finding of the stakeholder consultation, studies on length-frequency distributions of fish caught by beach seines, the environmental impact of beach seine fishing and the socio-economic status of households that depend on beach seining.
- The Institute for Advice and Technical Support (ICAT) should incorporate fisheries components in all of its programmes and create awareness about Togo's marine fisheries law and the 1995 FAO Code of Conduct for Responsible Fisheries among all stakeholders.
- The Union of Marine Fisheries Cooperatives (UNICOOPEMA) should formulate projects for training of fishers and women, which can be submitted to donors.
- The quality of coastal waters should be tested and all efforts should be made to reduce coastal pollution.

THE GAMBIA

The recommendations for the Gambia propose to carry out an in-depth study on beach seining with the active participation of all stakeholders and to divert beach seine fishers to other income-earning activities (Box 5).

BOX 5
Key recommendations for the Gambia

- The fisheries authorities should consider conversion of beach seine fishers to other income-generating activities because a complete ban of the use of beach seines has resulted in loss of income for both the fishers and the associated stakeholders.
- An in-depth study on beach seining should be carried out to arrive at definite conclusions and recommendations.
- The proposed in-depth study should determine the mode of operation, mesh sizes, fishing areas and seasons that will reduce landings of juvenile fish and degradation of habitats. The study should map nursery grounds and analyse bathymetric parameters. Depending on the results of the fishery, managed beach seining may be authorized.
- The study should be conducted with the active participation of key stakeholders, i.e. fishers, tourism development authorities, local government authorities and the national environment agency.

INDIA

The recommendations for India for changes to resource- and habitat-friendly beach seining and better management practices are shown in Box 6.

BOX 6
Key recommendations for India

- Study and legitimize traditional use rights and community-based management systems in beach seining fishing communities in order to protect them against development initiatives in the coastal areas.
- Undertake an assessment of the catches of juveniles in the beach seine fishery based on geographical location and seasonality so that appropriate measures such as closure of fishing grounds, seasonal bans and modifications to the gear can be implemented to reduce the capture of juveniles.
- Implement mesh size regulations for trawling, purse seining, ring netting and beach seining to reduce capture of juveniles from these fisheries.
- Undertake community awareness and mobilization programmes (with the assistance of local non-governmental organizations [NGOs] and other extension agencies wherever possible) to enhance community participation in the implementation of fisheries management measures such as mesh size regulations.
- Improve the post-harvest systems in beach seining at the landing, processing and trading levels to increase shelf-life, reduce physical and economic losses and wastage of fishery resources.
- Investigate and promote alternative/supplementary income-generating opportunities for people marginalized by the closure of beach seining operations and ensure access to institutional credit for the beach seine fishers to reduce dependence on the owners for advances and consumption loans.
- Introduce participatory monitoring, control and surveillance and implement the provisions of the Marine Fishing Regulation Act (MFRA) on zoning to prevent encroachment by the mechanized fishing fleets into the nearshore waters.
- Reduce and eliminate, where possible, pollution of the coastal waters by industrial effluents, agricultural runoffs, urban wastes, shipping and other sources in order to increase the health of the ecosystems and improve productivity.
- Develop a reliable database on beach seining in India and assess the aspects of distribution of wealth created in beach seine fisheries in order to draw lessons for improving the focus and implementation of development programmes.

KENYA

The recommendations for Kenya focus on measures to restore fishery resources exploited by beach seines and on strengthening community-based fisheries management mechanisms (Box 7).

BOX 7
Key recommendations for Kenya

Coast-specific

Lifting of the ban on beach seining and imposing management measures to slowly phase out beach seining. The management measures are detailed as follows:

- Introduction of a minimum four-month closed season (October–January) for beach seines, which should be articulated in the by-laws in all beach management units (BMUs).
- Establishment of "no beach seining areas" to protect the most sensitive habitats of the fishing grounds, articulated in BMU by-laws and, where relevant, in concordance with Kenya Wildlife Services legislation.
- In consultation with fishers, undertake tests of beach seine modifications regarding limits on the length, height and mesh sizes.
- Currently operating beach seine users should be given special temporary licences under BMU/district-level management to operate within the above restrictions.
- Co-management mechanisms adopted through BMU by-laws and others to effect these temporary measures.
- Impacts of the proposed management measures should be monitored and evaluated yearly in collaboration with local fishers through BMU structures.

Lake Victoria

In addition to the enforcement of the ban on beach seining on Lake Victoria, complementary actions to the ongoing enforcement activities are recommended.

- Up-scaling of the Lake Victoria gear exchange programme following the pilot experimental comparison of catches from hooks and lines vs beach seines.
- Discourage the marketing of catches of beach seines through strong controls of the minimum allowed fish sizes at buyer level, introduction of fines and legal actions against buyers, sellers and processors of undersized Nile perch, and prosecution of traders and processors and not only of fishers.
- Replenishment of fish stocks, identification and demarcation of the main breeding grounds in consultation with fishers and establishment of spatial closures that can be managed and monitored through the BMU structures.
- Involvement of NGO and BMU leaders in land and water patrols to ensure broader participation and mutual involvement in improved monitoring, control and surveillance (MCS).
- Cost-benefit analysis conducted by the fisheries departments of Kenya, Uganda and the United Republic of Tanzania to estimate cost implications and feasibility of a total and continuous enforcement of the ban on beach seining on Lake Victoria and to share the results with the Lake Victoria Fisheries Organization (LVFO) to identify alternative enforcement options and more economical MCS arrangements.

At the national level, including inland fisheries

- Initiation of poverty reduction, employment generation and livelihood diversification initiatives to minimize the economic incentive to return to beach seining.
- Introduction of co-management structures, such as BMUs, are incorporated in by-laws thereby strengthening compliance with fisheries management measures.
- Coordination between government, United Nations Agencies and NGOs in programmes dealing with training programmes for fishers in sustainable co-management.
- Improvement of collaboration between government and United Nations Agencies and NGOs with respect to credit facilities to purchase legal fishing gear.
- Integrate fishing communities in the formulation of fisheries and resource-use regulations so as to better incorporate their traditional knowledge into co-management measures.

MOZAMBIQUE

The recommendations for Mozambique focus on diversification and resource enhancement, restriction of fishing effort, legal support and on post-harvest and value addition (Box 8).

BOX 8
Key recommendations for Mozambique

Diversification and resource enhancement:
- Promotion of handlining, gillnetting and trammel netting for high-quality fish and shrimp.
- Construction of artificial reefs.
- Promotion of alternative livelihoods synchronized with the local agricultural cycle.

Restriction of fishing effort:
- Restriction of fishing effort through limitation of hauling and head line length to reduce fishing area, effort and conserve stocks. In both the case study areas, i.e. Inhassoro and Moma, the target stock exists beyond the range of manual seines. Restricting their range still further should protect a larger portion of the stock from fishing.
- Establishment of closed seasons, provided alternative employment is available and that the fishers agree.
- Ensure that mesh size restrictions are adhered to on a seasonal basis.
- Limit the number of beach seining licences issued.

Legal support:
- In the context of the transfer of fisheries management authority to local authorities, an updating of the fisheries law is needed to adjust its provisions to the provisions of the Local Authorities Law.

Processing and value addition:
- Promotion of value addition and reduction of post-harvest losses through use of ice, introduction of appropriate salting techniques and improved smoking kilns and methods.
- Enterprise development support to small-scale fish marketing and processing enterprises through

PERU

The recommendations for Peru focus on technological changes in the design of beach seines, supporting training and economic incentive support, recommendations for the reduction of fishing effort, improved collection of biological information and post-harvest practices. The key recommendations are show in Box 9.

BOX 9
Key recommendations for Peru

- Modification of the dimensions of beach seine gear and introducing selectivity/escape devices to reduce the catch of juvenile fish.
  - Wings. Maximum length: 70 m with 90 percent of the netting being a minimum mesh size of 150 mm and the remaining 10 percent being of the material of minimum mesh size of 95 mm.
  - Mouth/opening of body. Maximum width: 7 m. Minimum mesh size: 95 mm.
  - Seine body. Maximum length: 10 m. Maximum width: 6 m. Minimum mesh size: 75 mm.
  - Installation of selectivity/escape devices in manual beach seines, i.e. panels of square mesh netting in the upper part of the seine body.
- Provision of economic incentives and technical training to fishers who modify their gear to be more selective and resource friendly through the National Fund for Fisheries Development (FONDEPES) and the Marine Institute of Peru (IMARPE).

BOX 9
Key recommendations for Peru, cont.

- Reduction of fishing effort by prohibiting new entrants into beach seine fisheries and only permitting the use of beach seines for those fishers who have been traditionally engaged in this activity.
- Reduction of fishing effort by restricting fishing areas and seasons.
- Adoption of voluntary region-specific codes of conduct for responsible fisheries.
- Conduct regular biological studies to identify nursery and spawning grounds, average sizes of fishes at maturity, length frequency data of fish caught and other ecosystem and biological indicators.
- Improve post-harvest practices of beach seine caught fish and explore opportunities for value-added products to improve financial returns and economic benefits of beach seiners.

SRI LANKA

While the principles of co-management are enshrined in the present regulations, the case study recommends, among other things, that the regulations need to be updated to account for the changes in fishing technology that have taken place since they were first passed (Box 10).

BOX 10
Key recommendations for Sri Lanka

- There is a need to update and amend the *Madel* regulations of 1984 to take into consideration the technology changes in beach seines that have taken place since the regulations were promulgated. Otherwise, beach seine fishing effort cannot be properly regulated.
- Safety-at-sea standards for non-motorized beach seine craft should be improved.
- Promote co-management and an adequate awareness of the principles of responsible fisheries at the highest levels and enforcement and administration of the Fisheries Act in a professional manner with competence and understanding of the law including the international obligations.
- Improve post-harvest treatment as well as sanitary standards and quality of beach seine catches and establishment of cold chains to maintain and increase the value that is currently being generated by beach seine fisheries.
- Rehabilitate beach seine fisheries in former conflict areas of northern and eastern Sri Lanka. This would benefit both fishing communities and consumers by providing income and employment and increasing the supply of fish.

5. Conclusions and guidelines

DISCUSSION AND CONCLUSIONS

This chapter draws conclusions and follows on from the findings and recommendations of the country case studies by elaborating on topics raised by the studies that are crucial for the formulation of recommendations and management guidelines for fisheries managers. These topics include:

- co-management and the use of local knowledge;
- use of fishers' ecological knowledge in resource management;
- occupational diversification to other income-generating activities and livelihoods;
- diversification to more selective and environmentally friendly fishing methods, technical improvement of beach seine gear and methods to reduce catches of juvenile fish;
- opportunities for value addition and post-harvest improvements;
- microenterprise development;
- restoration of aquatic habitat by small-scale fishing communities;
- microfinance support; and
- use of socio-economic indicators for the monitoring of the impact of management measures on the livelihoods of fishing communities.

Chapter 4 of this paper summarizes the recommendations made by the country case studies on how to move towards sustainable fisheries and livelihoods for those currently involved in beach seining and on how to manage beach seining in a sustainable manner. Most of the case studies emphasize a need to adopt and strengthen community-based or co-management practices and the use of local knowledge and management practices.

Co-management and the use of local knowledge

Regarding the use of local management practices, McConney and Baldeo (2007) provide an example of a successful co-management initiative in the beach seine fishery for small coastal pelagics at Gouyave, Grenada. The initiative was taken under the Caribbean Coastal Co-management Guidelines Project, which was implemented by the Caribbean Conservation Association. The authors explain how traditional roles for operation of beach seines regarding the staking of claims to fishing areas and sharing the catch were confirmed with captains of beach seine units and thereafter adopted as legal regulations. The fish caught by the beach seine units was mainly used by longliners as bait. In this particular case, fishers did not want to resolve their problems through an informal or formal council but instead preferred to have their traditional rules converted to law. The law was implemented through a tribunal of the department of fisheries, which had a fisher as a member.

While Grenada and some other developing countries such as the Philippines have already introduced decentralized fisheries management and coastal conservation mechanisms (FAO, 2004: 81–97) or involved fishers' organizations in fisheries management and conservation, the consideration of socio-economic issues in coastal and fisheries management and the use of co-management mechanisms in Asia, Africa, Central and South America is rather limited. This is also true, to a large extent, for

the Caribbean, as shown by a study carried out by the Caribbean Regional Fisheries Mechanism in Belize, Dominica, Jamaica, Saint Lucia, Trinidad and Tobago, and the Turks and Caicos Islands (FAO, 2006a).

Berkes *et al*. (2001) observe that most of the world's fishery science effort has been devoted to stock assessment with a focus on biology and to some extent on economics and that such fisheries science had not served the fishery management needs of the South well. They also observe that past science had neither adequately addressed the socio-economic needs of fisherfolk nor the potential benefits of participatory management.

This assessment is certainly true for the countries where the case studies were carried out. The studies show that fisheries statistics, which could be used for the assessments of stocks fished by beach seines or for any science-based fisheries management approaches, are seldom available and/or updated on a regular basis.

The authors identify a number of promising new approaches that are available for fisheries managers to use. These include approaches that emphasize management objectives and processes rather than just stock assessment, and include ways of assessing fishers' knowledge to enrich the information available for management, means to build capacity and institutions, and collaborative approaches to include resource users in the management process.

With regard to the precautionary approach to environment and natural resources management and its application to fisheries, the authors observe that fishery management systems must be able to cope with a great deal of subjectivity and uncertainty at least until there is a good scientific base for management. For small-scale fisheries, providing a scientific basis may not be feasible or affordable. Therefore, management systems that can deal with subjectivity and uncertainty are a basic requirement. These management systems will have to be characterized by clearly specified processes, means of communication among stakeholders that are oriented to reaching agreement on appropriate measures, transparency in the processes and decisions, and clear documentation. Adaptive management is needed that relies on systematic feedback learning, emphasizes "learning by doing" and learning from mistakes.

In information-deficient situations, the use of traditional ecological knowledge is recommended. Traditional ecological knowledge may be defined as a cumulative body of knowledge, practices and beliefs evolving by adaptive processes and handed down through generations by cultural transmissions about the relationship of human beings with one another and with their environment. Local knowledge held by fishers may be about ecology, climate and weather, technology, business, illegal activities and international trade.

Co-management is defined by the authors as the sharing of power between the State and resource user groups in the management of natural resources. It can take many forms and may range from consultation by government with these groups to their having full responsibility for a fishery or managed area. The authors observe further that most co-management literature agrees that the term co-management should be reserved to situations in which there is a sharing of power and responsibility between the users of the resource and the government managers.

Factors facilitating co-management

Brown (1998) identifies the factors that facilitate and support community-based cooperative management. It is interesting to note that these factors apply very much to communities involved in beach seining. According to the author, community-based management is facilitated in cases where the community of eligible users is clearly defined, where there are clear geographic or other boundaries to the resource system over which the users have control and the community of users is able (informally or formally) to exclude outsiders; the communities involved are highly dependent on the

resource and are vulnerable to non-sustainable use; the resource users are relatively immobile – if the resource is overused or the resource system is damaged, the users cannot easily move to another location or another livelihood; users are able to enforce management rules both against each other and against outsiders and where users share a relative homogeneous interest in the resource.

Benefits of co-management

According to Pinkerton (1989: 26), the benefits of successful co-management are that it:

- creates cooperation among individual fishers and local fishing groups in planning the improvement or conservation of local fish stocks;
- creates the commitment among local fishers to share both the costs and benefits of their efforts toward enhancement and conservation;
- creates an appropriate vehicle of conflict resolution among fishers; it increases motivation to negotiate sharing of access which is perceived as equitable;
- enhances the position of fishers so that a more equal negotiating relationship exists between local fishers and other water resource users;
- creates a higher degree of organization and mutual commitment among fishers so that they have a more equal bargaining relationship with fish buyers;
- creates a willingness among both fishers and government to share data about the resource and therefore to reach collectively a more complete understanding of the resource;
- creates a willingness among both fishers and government to explore options for regulation that reduce inefficiencies for fishers;
- creates greater trust between fishers and government and a greater sense of control on the part of fishers so that motivation to invest in competitive gear for first capture is reduced;
- creates a higher degree of trust between fishers and government and improved ability to develop and successfully implement enforcement regimes that fishers perceive as appropriate and legitimate; and
- creates a higher degree of trust between fishers and government and greater willingness on the part of government to allow a range of self-management responsibilities to be assumed by fishers.

In the absence of scientific biological information on the stocks fished by beach seine fishers and other small-scale fishers and given the high cost of collecting and processing such information on a regular basis, all efforts must be made to use local or fishers' knowledge (Charles, 1998).

Use of local knowledge/fishers' ecological knowledge in resource management

Ruddle (1994) observes that, in coastal communities, bodies of local knowledge are empirically based and practically oriented. Most bodies of local knowledge combine empirical information on fish behaviour, marine physical environments and fish habitats and the interactions among the components of ecosystems. Local knowledge includes knowledge of fish behaviour, such as feeding behaviour, reproduction, territoriality, aggregations associated with reproduction during certain months and moon phases, reproductive behaviour related to large-scale weather changes (monsoon) and lunar periodicity. It also includes knowledge of marine physical environments and fish habitats.

The author suggests though that, once local knowledge has been collected, it must be verified and also blended with findings of biological research. With regard to fisheries management, the author identifies a number of advantages of the use of local knowledge in modern fisheries management:

- Because sets of rights and rules that constitute folk-managed fisheries derive directly from local knowledge and concepts of resources on which the fishery is based, bodies of local knowledge are themselves a potentially valuable resource for use in modern fisheries management and especially in co-management.
- Practical, fish-behaviour-oriented local knowledge that focuses on the economically most important species can provide a particularly important information base for managing tropical multispecies and multigear fisheries and their habitats because scientific knowledge of tropical inshore fisheries is relatively poor and data required for conventional management are usually either scanty or non-existent.
- Local knowledge can provide a shortcut to pinpoint applied research needs, especially in localities where a traditional conservation ethic exists.
- Because men and women often possess exclusive and perhaps complementary sets of local knowledge, consultation with both genders is essential if local knowledge is to be useful in comprehensive fisheries management.
- In documenting and analysing local knowledge for application in modern fisheries management, it is imperative to go beyond a mere description of local nomenclature and classification of physical and biological environments and of marine fauna and flora. This is because the myriad details of local knowledge and their application have emerged from, and function only within, specific local contexts.

Gadgil *et al.* (1993) observe that indigenous peoples with a historical continuity of resource-use practices often possess a broad knowledge base of the behaviour of complex ecological systems in their own localities and that this knowledge has accumulated through a long series of observations transmitted from generation to generation.

Johannes, Freeman and Hamilton (2000) highlight that older fishers are often the only source of information on historical changes in local marine stocks and marine environmental conditions. Fishers' ecological knowledge can thus help improve management of target stocks and rebuild marine ecosystems. This information can play important roles in the selection of sites for marine protected areas and in environmental impact assessments.

Johannes (2001) observes that in areas where the same people have been fishing for generations, and this applies to many beach seine fishing communities, this knowledge can be encyclopaedic. Fishers often know the timing and location of important and especially vulnerable life history events such as migratory and spawning aggregations, recruitment and nursery areas, or the locations of rare or endangered species.

Diversification to other income-generating activities and livelihoods as a means to reduce the vulnerability of fishing communities, their dependence on beach seine fisheries and the pressure on fishery resources

Another common recommendation of the country case studies is to promote the diversification of livelihoods and alternative or complementary employment both within and outside fisheries.

Recent studies (Tietze, 2006: 32; Poonnachit-Korsieporn, 2000: 185; FAO, 2000) draw attention to a trend of diversification of livelihoods in fishing communities, which merits support from governments as it reduces poverty and vulnerability of these communities as well as fishing pressure on aquatic resources and habitats. The process of diversification goes hand in hand with a process of polarization within the fisheries sector.

As can be seen from the country case studies, more household members seek employment outside the fisheries sector in service industries, agriculture, transport, and construction and elsewhere and subsequently reduce their involvement in

fisheries. This process of diversification is reflected in a global increase in part-time and occasional fishers when compared with the numbers of full-time fishers between 1970 and 1997 (FAO, 1999a).

Those who remain full-time involved in fishing are using technologically more advanced fishing craft and gear to increase their efficiency and the profitability of their operations. This leads to increased polarization,[1] competition and conflict within the small-scale fisheries sector, as well as between the small-scale fisheries sector and the medium- and large-scale sector. As shown by the case studies, the appearance and increase of ring nets operated by small- to medium-sized fishing craft, which directly compete with beach seines on the one hand and purse seines on the other for the same resources and access to fishing grounds, is an example of this trend of polarization. The use of more efficient netting, smaller mesh sizes, nets of greater dimensions, mechanized hauling devices and motorized boats for the operation of beach seines, as documented by the case studies, are examples of the polarization process within the beach seine fisheries sector.

Pilot projects and discussions at national workshops suggest that occupational and economic diversification and empowerment can be powerful tools and motivation for artisanal fishers to participate in the restoration and conservation of aquatic resources and habitats and their responsible and sustainable use and management.

Diversification of fishing effort away from beach seining to more selective and environmentally sustainable fishing methods

Some of the country case studies document an interest of beach seine fishers to diversify to other fishing methods, such as longlining, ring netting and gillnetting, provided that investment and training support is provided to them. In other cases such as India and Peru, fishers had already moved from beach seining to other small-scale or industrial fishing activities, while on Lake Victoria programmes have been initiated to exchange beach seines for other fishing gear.

Grant and Baldeo (2006: 189–204) provide an example from Gouyave, Grenada, of how occupational diversification of fishing effort has taken place within marine capture fisheries away from beach seining to surface longlining as a more selective and sustainable fishing method. Other countries might be able to learn from this example, which is particularly interesting as the authors also document how traditional knowledge of fishers can be used in occupational diversification and in fisheries management.

The fishing community of Gouyave is located on the west coast of Grenada. As observed by McConney and Baldeo (2007: 81), the beach seine fishery of Gouyave has been traditionally linked to the surface longline fishery of Grenada as the main supplier of bait to this fishery. Moreover, with regard to management, the beach seine fishery of Gouyave is one of the few examples of a co-managed beach seine fishery. In addition to the elements of occupational diversification, co-management and use of traditional knowledge, the case study on Grenada has another ingredient that should be of interest to countries that want to manage their beach seine and small-scale fisheries in a more sustainable way and, that is, how the process of transition has been successfully facilitated by government in close cooperation with technical and financial assistance.

In the 1980s, the Government of Grenada, with assistance from the Government of Cuba, began to promote improved surface longline fishing technology. The main target of the longline fishery was yellowfin tuna (*Thunnus albacares*) and bycatch consisting of sailfish (*Istiophorus platypterus*), common dolphin fish (*Coryphaena hippurus*), blue marlin (*Makaira nigricans*), white marlin (*Tetrapturus albidus*), swordfish (*Xiphias*

[1] The term highlights that one group of fishers becomes more efficiently involved in fishing while another group reduces its involvement to part-time and occasional.

gladius), albacore tuna (*Thunnus alalunga*), wahoo (*Acanthocybium solandri*), shark (*Katsuwonus pelamis*), bigeye tuna (*Thunnus obesus*) and fringe tuna (*Auxis thazard*), listed in order of market preference.

In the history of the Gouyave beach seine and longline fishery, three periods are distinguished, i.e. the pre-longline era from the 1960s to 1978; the popularization of longline fishing from 1979 to 1999; and the present longline fishery from 2000 to date. Prior to the 1970s, Gouyave fishers used different traditional fishing techniques, and beach seines were the most common gear. Other types of gear were handlines for flyingfish, dip nets for ballyhoo (*Hemiramphus brasiliensis*), handlines for bottom, midwater and pelagic fish, handlines for ocean pelagic species, fish pots for demersals, and trammel nets for lobsters and turtles.

In the early 1970s, fishers observed Venezuelan industrial longline vessels fishing and started to copy the technology. Two boats started experimenting with a rather primitive form of longline, using cord, wire and 26 straight hooks. Mainline and droplines were made from braided nylon, and twisted copper wires were attached to the hooks to prevent the teeth of fish from cutting the line.

In 1979, the Grenadian Revolutionary Government with assistance from the Government of Cuba helped to popularize longline fishing. Grenadian fishers were also trained in pole-and-line fishing for skipjack, construction of fish and lobster traps, surface longlining, bottom longline fishing for shark, and gillnet fishing for flyingfish.

Of these fishing methods, longline fishing had the greatest impact on Gouyave fishers. Cuban longline designs were introduced from 1980 to 1983. The Cuban technology caught 80 percent more than the primitive longlines used previously and attracted more fishers and investors to longline fishing.

From 1985 to 1987, fishers continued to use the Cuban technology but with some adaptation. The design kept changing until 2004, when Grant and Baldeo wrote their paper. The length of the mainline increased from 3 to 10 km. Six types of longlines had evolved by 2004:

- a large line baited with live flyingfish; line operated from a hydraulic reel on semi-industrial vessels and seasonal fishing from October to June targeting yellowfin tuna, sailfish and marlin;
- a regular longline baited with medium and large live jacks or flyingfish; line operated from manual reel on all vessel types and fishing year round targeting yellowfin tuna, sailfish and marlin;
- a light line baited with medium and large jacks; line operated from manual reel or box on all vessel types; seasonal fishing targeting yellowfin tuna, sailfish and marlin; and
- three lighter types of longlines.

Small-scale ring nets, also known as ring seining, also provided another opportunity to divert beach seine fishing effort to less harmful fishing methods, particularly suitable in areas where beach seines are used in spawning and nursery grounds. Ring nets exploit the same resources as beach seines but do not affect benthic habitat as the fishing gear does not touch the bottom and is operated further offshore though still in relatively shallow waters.[2]

A ring net[3] is a surrounding net and hybrid between a purse seine, which is used in large-scale and industrial fishing operations, and a lampara net. Like purse seines, ring nets may have rings at the lower edge of the net through which a purse line runs that can be used to close the net under the fish, which is also referred to as pursing. Like a

[2] While ring nets, by the merit of their design and mode of operation, do not cause impacts to benthic habitat, they can certainly have a negative impact on fishery resources if too small mesh sizes are used that result in catch of juveniles, as shown by Sathiadhas and Narayanakumar (2002: 68–69).

[3] See www.fao.org/fishery/geartype/250/en

lampara net, the ring net has a central seine body with smaller mesh sizes than the rest of the net, in which the catch is concentrated as the two wings of the net are hauled together. The fish is removed from the net by means of a scoop net. Another similarity to lampara nets is that the leadline of the ring net is shorter than the floatline, which gives the net the shape of a spoon.

Ring nets are suitable for small-scale fishing operations as they may require little equipment, such as a small capstan and a derrick, and can be operated from vessels of a similar size to vessels used for the operation for large beach seines, i.e. vessels with a minimum length of 12 metres.

As far as the operation of ring nets is concerned, on many occasions two boats work together, as is also sometimes the case with the operation of large beach seines. When a suitable shoal of fish is located and both vessels are ready, the first vessel will set its marker buoy and sail around one side of the shoal paying out bridles and net. After the shoal of fish has been surrounded, the purse line is hauled in to close the bottom of the net. The two wings of the net are hauled on board at the same time and the fish is concentrated in the central part of the net. The catch is removed from the net, which is kept in the water next to the boat with the help of a scoop net.

Beach seine fishing effort can also be diversified to gillnet and trammel net fishing and possibly other fishing methods.

Improvement of beach seine gear and methods

Apart from diversification to more selective and resource-friendly fishing methods, there are also possibilities to modify beach seine gear to make it more selective. Broadhurst, Wooden and Millar (2007) investigated the selection mechanisms of beach seines during two separate experiments in New South Wales (NSW), Australia, to determine the effects on catches associated with changing mesh size in the posterior wings and the seine body.

The main findings of the investigations were that, owing to the orientation of meshes in the posterior wings, size selection for many species was considerably more defined than in the seine body. However, because most fish were eventually directed into the seine body and codend, this area demonstrated a greater potential for improving selection. The investigations concluded that increasing the smallest minimum mesh size (30 mm) used in NSW's beach seines by almost 100 percent to correlate with the maximum girth of one of the smallest legal-sized species would be an appropriate first step for reducing unwanted fishing mortality, but that further work was required to investigate the utility of other more novel modifications throughout the gear and especially in the seine body and codend.

Broadhurst *et al.* (2008) highlight that mortality of discards from beach seining can be greatly reduced and survival rates improved by simple modifications to the operations of beach seines and gillnets and/or post-capture handling procedures. Based on experiments in an Australian estuary to quantify the mortalities and contributing factors for key species discarded during eight and nine deployments of commercial beach seines and gillnets, respectively, the authors suggest that close regulation of size selectivity of the target species, careful removal of fish from meshes and abstention from setting beach seines during high abundances of jellyfish will maximize the survival of discarded bycatch.

The case study on Peru also made suggestions on how to modify the seine body of beach seines to make the gear more selective (Box 9). It was suggested to modify the dimensions of beach seine gear and incorporate selectivity/escape devices to reduce the catch of juvenile fish.

Opportunities for value addition and post-harvest activities

Studies carried out by the Centre for Marketing Information and Advisory Services for Fishery Products in Latin America and the Caribbean (INFOPESCA), the Intergovernmental Organization for Marketing Information and Cooperation Services for Fishery Products in Africa (INFOPÊCHE), the Marketing Information and Technical Advisory Services for the Fisheries Industry in Southern Africa (INFOSA) and the Intergovernmental Organization for Marketing Information and Technical Advisory Services for Fishery Products in the Asia and Pacific Region (INFOFISH) (FAO, 2008a) confirm that products from small-scale fisheries can generate greater economic benefits through value addition, improvement of product quality and access to new markets.

However, a number of constraints need to be overcome before this can be achieved. These constraints also include the ones identified by the nine country case studies. Post-harvest losses due to poor infrastructure and lack of storage and transportation facilities need to be reduced and knowledge of proper fish handling methods needs to be improved.

The studies carried out by the intergovernmental organizations suggest that efforts should be aimed at the establishment of hygienic fish-landing sites, increasing storage facilities and the supply of ice, as well as improving roads that connect fishing communities to markets. Equally important are the improvement of technical support and extension services to enable fishing communities to access appropriate technologies and information and training on quality improvement, proper fish handling procedures and storage, product diversification, value addition, as well as on packaging. In the case of beach seine fisheries, dried products made from small pelagics might be worth considering as a priority in the case of regional markets.

Small-scale fishers and processors can obtain better prices for their products by shortening the fish supply chain and increasing their bargaining and lobbying power. In this regard, the formation of marketing cooperatives is encouraged, and it is suggested that existing associations of small-scale fishers and processors should be strengthened by providing support for institution building.

Microenterprise development

There is also a need to raise awareness among microfinance institutions regarding the needs of the small-scale fisheries sector for credit and savings services. All of these recommendations also apply to beach seine fisheries.

As suggested by some of the country case studies, to take advantage of opportunities to improve post-harvest activities and to further develop income-generating activities outside the fisheries sector, beach seine fishing communities need support for the development of microenterprises. Examples for such type of support are documented in the report of the National Workshop on Micro-enterprise Development in Coastal Communities in the Philippines: Sharing of Experiences and Lessons Learned, held in March 2006 (FAO, 2007a), and in *Livelihood and Micro-enterprise Development Opportunities for Women in Coastal Fishing Communities in India: Case Studies of Orissa and Maharashtra* (FAO, 2007b).

Key elements of sustainable microenterprise development as identified by the workshop in the Philippines include capacity building of fisherfolk organizations, such as cooperatives and associations to implement livelihood projects, the preparation of feasibility studies and business plans, technical skills development, sound financial management practices, development of innovative and high-quality products, access to new markets, including urban and regional markets, and the full participation of fisherfolk in the identification of livelihood activities and microenterprises.

A pilot project in support of the development of microenterprises in Banate Bay, Iloilo and Southern Iloilo was implemented by the University of the Philippines in the

Visayas in cooperation with the Banate Bay Resource Management Council, Inc. and the Southern Iloilo Coastal Resource Management Council with support from FAO. A number of microenterprises were introduced and supported in the municipalities of Banate Bay and Southern Iloilo, including fish ball production, shrimp paste production, oyster and mussel culture, salt production and iodization, fish marketing and fish sauce production. Training programmes were conducted for fisherfolk on product development and marketing of their products. Good coordination with local government units, active participation of all stakeholders and conduct of appropriate training programmes are considered essential for the sustainability of the microenterprises.

The involvement of fisherfolk in livelihood activities and microenterprises is strengthening their participation in the fisheries and aquatic resources management councils of Banate Bay and Southern Iloilo. The experiences of the pilot project also suggest that in order to make various income-generating livelihood initiatives sustainable and stand on their own feet, many of these need to develop further into full-fledged microenterprises.

Considerable scope lies in farming of aquatic organisms such as seaweed, shellfish and various fish species, as well as in fisheries-related value-adding activities such as fish processing and marketing. As far as the relationship between the conservation of aquatic resources and the generation of income is concerned, the health of the aquatic environment and the economic success of mariculture microenterprises and activities are directly related. This should create a strong motivation for fisherfolk entrepreneurs involved in such type of enterprises to be strong advocates and stewards of a healthy coastal ecology. In the long term, fisherfolk will benefit from the development of various microenterprise initiatives. It is clearly in their interest.

In the case of India and with a focus on women as a target group for occupational diversification, the findings of the studies carried out in the States of Maharashtra and Orissa suggest that through actively promoting self-help groups (SHGs) and cooperatives among women in coastal fishing communities and through linking these associations with financial institutions, investment and working capital needs of their members can be met.

To make the best use of capital inputs, SHGs and their federations need vocational and enterprise development training from NGOs and from fisheries training and research institutions as well as assistance for establishing links to new market outlets for their products, both domestically and for export.

The report on India (FAO, 2007b: 58–66) elaborates on the features and standard economics of microenterprise opportunities for women in coastal fishing communities in Maharashtra and Orissa. The enterprises include composite fish farming in existing tanks/ponds; fish seed rearing in seasonal tanks/ponds; small-scale breeding unit for ornamental fish; integrated fish and poultry farming; composite fish and freshwater prawn farming in newly excavated tanks/ponds; freshwater prawn farming in existing tanks/ponds; brackishwater prawn farming; mussel raft culture; artemia culture; mud crab culture; and a small-scale fish drying plant. In addition, two horticulture activities were found suitable to be undertaken by women in coastal villages of the Konkan belt, i.e. the cultivation of coconut trees and the cultivation of cashew nut trees on one acre (equivalent to 0.405 hectares) each.

Restoration of aquatic habitat by small-scale fishing communities

Apart from occupational and livelihoods diversification, another opportunity for beach seine fishing communities to improve their livelihoods and natural resource base is to participate in the restoration of aquatic and marine riparian habitats. Planting

mangroves and restoring eelgrass beds expand the geographic scope and quality of habitat for spawning and nursery grounds. In addition, planting of trees along shorelines helps to prevent erosion and improves water quality that is essential for fish and other species.

Kurien (2003) draws attention to the Indian State of Kerala, where small-scale, community-based fisherfolk initiated collective action to invest in rejuvenating the natural assets of the sea that had been destroyed by the incessant fishing operations of large-scale bottom trawlers in the region. The fisherfolk placed artificial reefs on the sea bottom in coastal waters to create anthropogenic marine environments.

The author explains that reefs act as fish refuge and become sources of food for them as the structures are soon covered with bottom-dwelling biomass. Artificial reefs placed in strategic positions in the coastal waters can in time increase the overall biomass and the fish stock in the local ecosystem. An unintended side-effect of sufficiently large artificial reefs is that they act as barriers to the operation of bottom trawl nets, effectively performing the role of a sea bottom fence against incursions of trawlers into coastal waters.

Microfinance support

The diversification of livelihoods, improvement of post-harvest practices, development of microenterprises, restoration of resources and habitats, modification of beach seines and acquisition of more selective and environmentally friendly gear is greatly facilitated by the availability of microfinance.

Microfinance support is an important part of poverty alleviation, occupational diversification and microenterprise development. The United Nations General Assembly Resolution A/RES/52/194 of 18 December 1997 acknowledged the important contribution that microfinance programmes have made to poverty eradication and empowerment of the poor. It called upon the organizations of the United Nations system to include a microfinance approach in their programmes.

Microfinance is defined as the provision of a broad range of services, including savings, loans and insurance. FAO (2003a) has published guidelines, which provide general principles and basic considerations for those involved in providing microfinance services to fisheries and aquaculture and for those who intend to include fishing and fish farming communities as part of the client base of their operation.

The guidelines further elaborate on lending models, methodologies and policies that have applicability to fisheries and address concerns that are particular to the sector while adhering to best practices in the microfinance field. The guidelines conclude with two examples of successful FAO-executed projects that incorporated microfinance programmes in fishing community development in the Philippines and in small-scale aquaculture development in Viet Nam, with a special focus on gender and poverty alleviation. The case studies provide practical examples of how microcredit can contribute to the empowerment of women in fishing and fish farming communities, help alleviate poverty and contribute to the socio-economic well-being and food security of fishers and fish farmers.

Use of socio-economic indicators for the monitoring of the impact of management measures on the livelihoods of fishing communities

Important elements of a framework for improved governance and management are not only the introduction of management mechanisms that allow the involvement of all stakeholders in the management process, but also the use of clear and transparent systems for monitoring and evaluation and for measuring the impact and success of management regimes, including the impact on the socio-economic well-being of fishing and coastal communities (Tietze, 2006: 29).

The monitoring of the actual impact of fisheries management measures on the livelihoods and well-being of coastal communities requires the use of socio-economic and demographic indicators. FAO, in cooperation with fisheries administrations and research institutions of member states, has prepared and field-tested guidelines which can be used for the collection of demographic and socio-economic information on fishing communities for use in coastal and aquatic resources management (FAO, 2004).

The guidelines specify key indicators for the identification of demographic issues in coastal and aquatic resources management and for monitoring the impact of fisheries management measures on the well-being of coastal communities. They also identify data sources and methods for the collection of data. As far as possible and to avoid the duplication of efforts and reduce cost, data sources are identified as censuses and surveys which are routinely carried out. These include population and housing censuses, national demographic surveys, maternal and child mortality surveys, labour force surveys, functional literacy, educational and mass media surveys, family income and expenditure surveys, family planning and similar surveys. For other information needs, primary data collection is necessary.

GUIDELINES FOR THE RESPONSIBLE MANAGEMENT OF BEACH SEINE FISHERIES AND THE CONSERVATION OF FISHERY RESOURCES AND HABITATS

Guiding principles and approach

The FAO publication *Fisheries Management* (FAO, 1997: 82) defined fisheries management as "the integrated process of information gathering, analysis, planning, consultation, decision-making, allocation of resources and formulation and implementation, with enforcement as necessary, of regulations or rules which govern fisheries activities in order to ensure the continued productivity of the resources and accomplishment of other fisheries objectives."

The ecosystem approach to fisheries (EAF) recognizes the need for fisheries management to consider the impact of the ecosystem and other users of the ecosystem on fisheries as well as the broader impact of fisheries on the ecosystem as a whole (FAO, 2003b). Following this approach, it is clear that beach seine fisheries cannot be managed in isolation from other factors that have an impact on the fishery resources harvested by beach seines.

These above fisheries-related factors include both small-scale and industrial fishing activities. The country case studies identified many cases where overfishing of coastal resources by industrial fishing fleets had negative impacts on the resources exploited by beach seines. In addition to fisheries related impacts on fishery resources, there are a number of other sea- and land-based impacts that also need to be addressed by fisheries management.

The FAO publication *Integration of Fisheries in Coastal Area Management* (FAO, 1996: 5) identifies key impacts on fisheries as pollution from land-based sources, e.g. industrial or agricultural waste dumped into rivers and carried to the coastal area, pesticide and fertilizer runoff into rivers, sewage, as well as sea-based impacts, e.g. oil spills and ocean dumping of sewage and toxic waste.

The guidelines highlight further that, while the fishery sector may also contribute to coastal pollution, generally the sector suffers more from rather than causes pollution. Direct habitat degradation occurs as a result of mangrove clearance, coral mining or indirectly by sedimentation of marine flora beds and reefs due to soil runoff associated with poor land use practices and sedimentation. Spatial conflict may occur where coastal fisheries have insecure property and use rights and are gradually squeezed from their traditional areas by coastal developments such as urban sprawl and tourism development.

All these negative impacts are relevant to beach seine fisheries, and it is the responsibility of fisheries management authorities, in cooperation with other government agencies and stakeholders, to reduce and prevent these impacts and protect the interest of coastal fisheries *vis-à-vis* the interests of other users of the coastline.

The FAO publication *Fisheries Management* (FAO, 1997: 59) further states that the utilization of living aquatic resources and the management of this utilization should be seen as partnerships between the management authority and the interest groups. The objectives should reflect the reasonable desires of the interest groups, within the constraints imposed by the biological and ecological limitations of the resources and the overriding objectives of national planning.

As far as the overriding objectives of national planning are concerned, and this is particularly true for developing countries, the fight for eradication of poverty and hunger and the achievement of the Millennium Development Goals (MDGs) figure prominently among the objectives of national planning and should have a central place among the management objectives of fisheries administrations.

Poverty is a complex concept and process characterized by low incomes, poor health, low literacy levels, undernutrition, and inadequate housing and living conditions. Governments have committed themselves to eradicate poverty. At the United Nations Millennium Summit held in September 2000, all the then 189 Member States of the United Nations General Assembly adopted the Millennium Declaration directed at reducing extreme poverty and related problems that affect human well-being and are sources of global instability.[4]

The commitment to achieve MDG 1 and eradicate poverty and hunger was reiterated in the Declaration of the World Summit on Food Security at the World Summit on Food Security, held at FAO, Rome, 16–18 November 2009. In adopting the declaration, countries agreed to undertake all necessary actions required at the national, regional and global levels to halt immediately the increase in – and to reduce significantly – the number of people suffering from hunger, malnutrition and food insecurity. Countries pledged to reinforce the efforts to meet the 2015 targets of Millennium Development Goals and the World Food Summits (FAO, 2009).

Considering the above commitments, governments are obliged to avoid inflicting more poverty through imposing management measures and changes in fishing practices that reduce the income-generating capacity of already poor people. Mitigation measures must be taken that ensure that poverty at least does not increase or spread as a result of the implementation of new regulations. When closing areas for fishing, poor fishers who have been fishing there traditionally should be allowed to continue unless other occupations have been found for them or they have been compensated otherwise.

In addition, FAO advocates a rights-based approach to fisheries. FAO (2007c, p. 6) recommends to practitioners in small-scale fisheries management that "A rights-based approach, in defining and allocating rights to fish, would also address the broader human rights of fishers to an adequate livelihood and would therefore include poverty-reduction criteria as a key component of decisions over equitable allocation of rights, including in decisions over inclusion and exclusion, and the protection of small-scale fishworkers' access to resources and markets."

Article 6.18 of the *Code of Conduct for Responsible Fisheries* (FAO, 1995) states that: "Recognizing the important contributions of artisanal and small-scale fisheries to employment, income and food security, States should appropriately protect the rights of fishers and fishworkers, particularly those engaged in subsistence, small-scale and

[4] See www.un.org/millennium/summit.htm

artisanal fisheries, to a secure and just livelihood, as well as preferential access, where appropriate, to traditional fishing grounds and resources in the waters under their national jurisdiction."

Therefore, taking into consideration the above, any approach to the management of beach seine fisheries must also ensure that other users also do their share to restore and conserve fishery resources. This includes the need for efforts to efficiently regulate industrial fishing fleets, as well as efforts to end illegal, unregulated and unreported (IUU) fishing in inshore and offshore waters of East and West Africa, India and Sri Lanka, the reduction and prevention of water pollution and coastal erosion caused by housing and industrial development, and the proper management of other factors that have an impact on fisheries resources and aquatic habitat. In addition, fisheries managers and administrations should adopt a rights-based approach that links fishery rights and human rights.

Management objectives and key issues

The overall global management objectives for beach seine fisheries advocated in this document is to restore and conserve fishery resources and habitats in areas fished by beach seines and to ensure and promote sustainable fishing practices and livelihoods of communities involved in beach seining.

As can be concluded from the country case studies and other sources reviewed in this document, the key issues to be addressed in order to achieve the overall management objectives are:

Key resource-use issues:

1. Negative impact of beach seining on aquatic resources and habitats.
2. Depletion of fishery resources and degradation of habitat because of fishing practices other than beach seining and because of land-based sources.
3. Lack of compliance with fisheries and environmental regulations.
4. Conflict and competition with other users of fishery resources and riparian lands.

Key economic issues:

5. Low value of beach seine catches.
6. Lack of access to microfinance and insurance services.

Key social and occupational issues:

7. Poverty and vulnerability of beach seine fishers because of lack of other income/ employment opportunities.
8. Poverty and vulnerability of beach seine fishers because of lack of education, medical and social services and their exposure to natural disasters and climate change.
9. Lack of safety of fishing craft and gear.

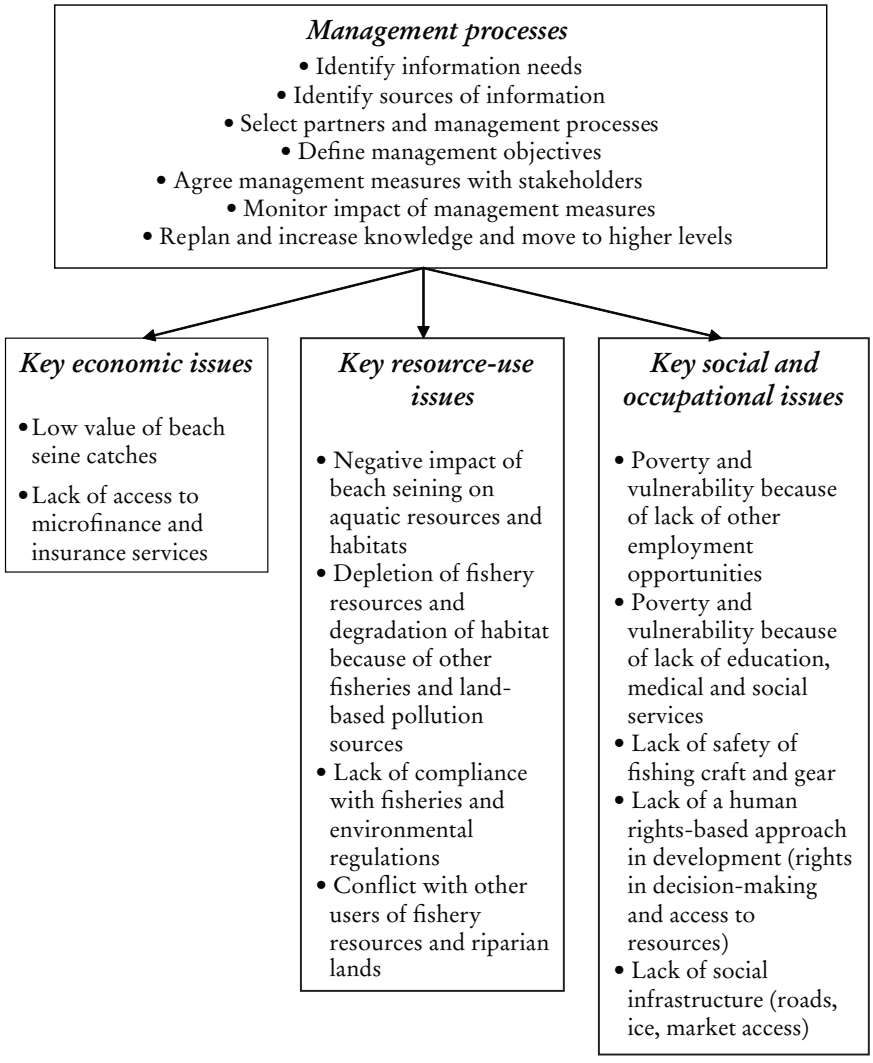
To address these issues, it is necessary to:

- identify key information needs;
- identify the sources from where the information can be obtained;
- select co-management partners and define management processes, i.e. how to communicate with stakeholders and interact so that management objectives and measures can be agreed upon, implemented and monitored;
- define management objectives;

- reach agreement among key stakeholders on management measures to be taken to achieve the management objectives agreed upon; and
- monitor the impact of the measures taken on the status of fishery resources, habitats and livelihoods of fishing communities.

Figure 1 provides an overview of management processes and key issues.

FIGURE 1
Management processes and issues



Drawing on the findings of the country case studies and on the conclusions, Tables 12 to 20 contain for each of the nine key issues guidelines on management processes, objectives and measures for addressing these issues. Though comprehensive, the guidelines should not be followed rigidly but rather they are meant to be creatively adapted to the local conditions, situations and circumstances. In this way, they will contribute to the ultimate objective of helping to achieve a more sustainable use of fishery resources, improved livelihoods and food security for those who use these resources.

TABLE 12
Guidelines for addressing key issue 1: Negative impact of beach seining on aquatic resources and habitats

Key issue 1: Negative impact of beach seining on aquatic resources and habitats	
Key information needs	• Baseline information on benthic, riparian habitats of areas used for beach seining. • Biological information on spawning, nursery grounds, seasons and average size at maturity of important species. • Operational information on numbers of beach seines in operation, fishing seasons, total catch, and catch composition by species and length frequency, technical dimensions and specifications of fishing gear and craft and operational aspects.
Information sources	• Interviews with experienced fishers and regular consultation with representatives of beach seine fishing communities. • Periodical biological sampling of beach seine catches in cooperation with fishers. • Periodical census and registration/inspection of beach seine fishing gear and craft.
Management processes and partners	• Identification of co-management partners such as fisher associations, traditional village councils and fisheries management authorities, academic and fisheries research institutions, NGOs. • Disaggregate fisheries statistics at the national level so that beach seine catches can be accounted for separately. • Surveys of fishing grounds and catches in cooperation with fishers and their representative organizations and mapping of benthic, aquatic, riparian habitats of areas where beach seines are being used. • Registration of beach seine fishing gear and craft and disaggregate fisheries statistics at the national level so that beach seine catches can be accounted for separately. • Drafting, implementation of regulations in close consultation and cooperation with fishers and their organizations and regular monitoring of the impact of the regulations on fishery resources, habitats and livelihoods of fishers. • Monitoring of impact of management measures on resources and habitats in close cooperation with fishers, their organizations and other relevant stakeholders. • Partners: individual fishers, their communities and organizations, local governments, fisheries administrations, government authorities responsible for environment/ecology.
Management objective	• To restore and conserve fishery resources and riparian habitat and to make fishing practices and livelihoods of communities involved in beach seining more sustainable.
Options for management measures	• Conduct awareness and educational programmes for beach seine fishers on sustainable and responsible fisheries and co-management and empower fishers to participate in the formulation of fisheries and resource use regulations which incorporate their knowledge. • Diversification of fishing effort to other regulated and managed fishing methods such as gill netting, longlining, handlining, trammel netting, ring netting. Promotion of diversification through government sponsored gear exchange programmes. • Diversification of fishing effort to aquaculture, post-harvest activities or non-fishing occupations (see key issue 7). • Restriction of fishing effort and areas fished through: – regulations that limit length of hauling ropes, length of wings and seine bodies to restrict the area covered by the net, thereby reducing capacity; – regulations that set minimum mesh sizes based on the girth size of the mature targeted species in wings, seine bodies and codends to reduce catches of juveniles; – install selectivity/escape devices to reduce the catch of juvenile fish (see Box 9, Peruvian case study); – make sure and facilitate that netting and other gear components which meet regulations are locally available for sale and prohibit the manufacture or importation of nets that have illegal mesh sizes; – make purchase and wholesaling/retailing of juvenile fish illegal; – introduction of regulations on closed seasons and areas to protect spawning and nursery grounds and sensitive benthic habitats such as seagrass beds, coralline and mangrove areas; – identification and demarcation of major fish spawning and nursery areas in consultation with fishers and establishment of spatial closures that are managed and monitored through co-management mechanisms; – furnishing traditional beach seine fishers after closure of areas for beach seining with special temporary licences that regulate the activity in terms of species, quantity, length and number of sets; – restricting number of new beach seine licences and preventing new entrants into beach seine fisheries. • Promote and support resource enhancement and habitat restoration through mangrove reforestation, planting/transplanting of seagrasses, reforestation of shorelines, construction of artificial reefs, etc. • Providing economic incentives and technical training to fishers who modify their gear in response to more resource-friendly regulations; diversify fishing effort to more selective and/or resource-friendly fishing methods or participate in resource enhancement and habitat restoration efforts. • Encouragement of beach seine owners/crews to form associations and to acquire beach seine fishing gear that complies with existing regulations.

TABLE 13
Guidelines for addressing key issue 2: Depletion of fishery resources and degradation of habitat due to fishing practices other than beach seining and from land-based sources

Key issue 2: Depletion of fishery resources and degradation of habitat due to fishing practices other than beach seining and from land-based sources	
Key information needs	• Catch and effort data from industrial and small-scale fishing fleets exploiting inshore waters where beach seining is carried out. • Information on illegal fishing practices in inshore waters. • Information on water quality, shoreline erosion, sedimentation and health of riparian habitats i.e. mangrove areas, seagrass beds, coral reefs, etc. • Information on sources of land-based pollution and degradation of riparian habitat.
Information sources	• Observations of coastal fishers and residents. • Interviews of skippers of industrial and small-scale fishing vessels. • Fisheries statistics, staff of fisheries department. • Reports of and meetings with departments of health, environment, ecology. • Reports of and meetings with coast guard, police and MCS authorities. • Reports of and meetings with local governments. • Reports of and meetings with chambers of commerce. • Reports and meetings with the ministries responsible for the environment and coastal zone management. • Reports and meetings with NGOs specialized in environmental matters.
Management objective	• To restore and conserve fishery resources and riparian habitat by reducing negative impacts from land-based sources and fisheries other than beach seining.
Management processes and partners	• Assessment of level of exploitation of coastal fishery resources and share of different fishing fleets and fishing gears in exploitation. • Identification of illegal, unregulated and unreported (IUU) fishing practices in coastal waters and their effect on fisheries resources. • Assessment of health of aquatic and riparian environment and identification of causes and effects, trends and problems and their effect on fishery resources. • Identification of sources of land-based pollution and other factors that contribute to the degradation of riparian habitat. • Identification and implementation of regulations and measures to limit fishing effort and end IUU fishing in coastal waters. • Identification and implementation of regulations and measures to reduce or end pollution of coastal waters and riparian habitat degradation from land-based sources. • Monitoring of impact of management measures on resources and habitats in close cooperation with stakeholders. • Partners: fisheries departments, fishing communities and their organizations, fishery industry associations, departments of health, environment, ecology, coast guard, police, local governments, chambers of commerce.
Options for management measures	• Protection of landing sites and areas of operation of beach seine fishers and other small-scale fisheries from housing, industrial, tourism and other urban development. • Advocacy for drafting and implementing zoning regulations/ordinances in coastal areas that establish buffer zones along shorelines to protect them from development that will degrade the ecosystem. Independent Environmental Impact Assessments for all development must be undertaken. • Regular testing of coastal waters to identify types, sources and impact of pollution on the ecosystem. • Reduce pollution of coastal waters by determining and closing down or reducing sources of industrial effluents, agricultural runoffs, urban waste, shipping and other sources of pollution to make coastal waters and fishery resources and the ecosystems in which humans live more productive and valuable. • Advocacy to stop the fishing of trawlers and industrial fleets in inshore waters and strict enforcement of zoning regulations that protect small-scale fisheries. Participatory surveillance between coast guard and fishing communities should be instituted. • Issue and implement mesh size regulations for trawling and purse seining and limit number of licences in accordance with a sustainable level of fishing effort. Enforcement of the regulations in place and increase fines and sanctions.

TABLE 14
Guidelines for addressing key issue 3: Lack of compliance with fisheries and environmental regulations

Key issue 3: Lack of compliance with fisheries and environmental regulations	
Key information needs	• Information on compliance with fisheries and environmental regulations in different geographic areas and by different groups of beach seines and other fishers and users of shoreline. • Information on which part of the regulations are not complied with and on reasons for non-compliance.
Information sources	• Interviews with beach seine fishers, associations, village councils. • Interviews with non-beach seine fishers and other shoreline users. • Meetings with local government authorities. • Meetings with fisheries and other law enforcement agencies.
Management processes and partners	• Dialogue with beach seine fisheries, local government and law enforcement agencies to identify reasons for non-compliance with existing regulations. • Identification of informal mechanisms for the management of beach seine fisheries including use rights of beaches and fishing grounds and conditions under which these will be governed. • Identification of opportunities to improve compliance with existing regulations and conditions through awareness building and educational efforts. • Revision/amendment of existing regulations in close consultation with beach seine fishers and other stakeholders such as fishers using other fishing methods, local governments and law enforcement agencies. • Preparation of educational materials and awareness building for beach seine fishers and other stakeholders. • Regular monitoring of compliance with regulations together with all concerned stakeholders. • Monitoring of impact of measures on compliance with regulations in close cooperation with stakeholders. • Partners: fisheries departments, beach seine fishers and other fishers and their associations, local governments, law enforcement agencies, chambers of commerce.
Management objective	• To put in place, in close consultation with all stakeholders, regulations for beach seine fisheries and other activities affecting fishery resources, which are complied with and ensure a sustainable use of fishery resources and the aquatic environment.
Options for management measures	• Regularly update fisheries legislation and regulations to account for changes that have taken place. • Capacity building for community-based fisheries management organizations and beach seine owner/crew associations on leadership skills, advocacy and collaboration. • Phasing out ineffective bans on beach seine fishing and replacing these with pragmatic regulations in negotiated consultation with beach seine users. • Promotion of fisheries co-management mechanisms and groups and their effective participation in local government and governance. • Conduct cost-benefit analysis of fisheries management arrangements to determine the economic impact and trends of the management measures on livelihoods and poverty alleviation. • Study and legitimize traditional use rights and community-based management systems of fishing communities involved in beach seining – particularly in situations where the benefits for socio-economic and resource sustainability will be increased.

TABLE 15
Guidelines for addressing key issue 4: Conflict and competition with other users of fishery resources and riparian lands

Key issue 4: Conflict and competition with other users of fishery resources and riparian lands	
Key information needs	• Conflicts with users of other fishing gears. • Conflicts with other users of riparian lands.
Information sources	• Beach seine and other fishers and their associations. • Local government authorities. • Law enforcement authorities. • Fisheries department.
Management objective	• To reduce and settle conflicts with other users of fishery resources and riparian lands and defend interests of beach seine fishers against other interests.
Management processes and partners	• Compilation of information on conflicts of beach seine fishers with other fishers and land-based users of riparian lands. • Advocacy for justified interests of beach seine fishers. • In cooperation with all stakeholders, identification of possibilities to settle or reduce conflicts. • Monitoring of impact of management measures on frequency of occurrence and resolution of conflicts in close cooperation with stakeholders. • Conduct independent Environmental Impact Assessments of coastal zone development on the fisheries ecosystem and aquatic resources. • Partners: beach seine fishers and their associations, land-based users, fisheries administrations, industrial and other fisheries associations, local governments, chambers of commerce, law enforcement agencies, coast guard.
Options for management measures	• Update delineation of fishing zones in close consultation with fishers to reduce conflicts between beach seine fishers, other small-scale fishing operations and industrial fisheries. • Take steps, in cooperation with coast guard and law enforcement agencies, to end IUU fishing in coastal and other waters. • In cooperation with beach seine fishers, local governments and law enforcement agencies, prevent unauthorized encroachment and use of public shores used for beach seining for other purposes, such as housing and industrial development, tourism and aquaculture. • Fisheries authorities should advocate interests of beach seine fishers in cases of changes of land use regulations vis-à-vis other local and federal government agencies and other interest groups and lobbies. • Control of in-migration of foreign beach seine fishers where this causes problems.

TABLE 16
Guidelines for addressing key issue 5: Low value of beach seine catches

Key issue 5: Low value of beach seine catches	
Key information needs	• Understanding of marketing channels and final consumers of beach seine catches, physical flows and financial margins at different stages. • Final destinations, consumers and uses of beach seine catches. • Type and quality of processing and products where catches of beach seines are used. • Needs assessments of infrastructure for landing, storage, transportation, preservation and processing of catches. • Number and profile of people involved in processing and marketing.
Information sources	• Beach seine fishers, small-scale processors and traders and household members. • Fish buyers, wholesalers and retailers. • Government authorities regulating food and fish markets. • Government authorities responsible for food safety. • Consumers and users of beach seine catches.
Management objective	• To improve the income of beach seine fishers, processors and traders and their communities by adding value through post-harvest operations and provide safer and better quality fish products for consumers.
Management processes and partners	• Compilation of information on marketing of beach seine catches. • Identification of opportunities for value addition and improved or new products. • Providing infrastructure support. • Improving quality and safety of products through quality inspection. • Monitoring of impact of these measures on the value of beach seine catches and income of beach seine fishers and post-harvest workers in close cooperation with stakeholders. • Partners: beach seine fishers and their household members, fish traders and retailers, government agencies responsible for food safety, local governments.
Options for management measures	• Conduct marketing studies to explore opportunities for value-added products and better financial returns and economic benefits. • Reduction of post-harvest losses through provision of ice and associated infrastructure for the hygienic handling, landing, sorting, storage and transportation of catches. Improved designated landing site management. • Promotion campaigns for the use of ice for preservation of catches. • Promotion of the use of salt in drying of fish and improved fish drying techniques. • Promotion of the use of improved fuel-efficient smoking kilns and methods for beach seine catches to reduce post-harvest losses and increase value of catch. • Provide microenterprise development support to small-scale fish marketing and processing enterprises through supplier contacts, assistance with licensing, inspection and registration processes. • Provision of technical support and extension services to enable fishing communities to access appropriate technologies and information and training on quality improvement, proper fish handling procedures and storage, product diversification, value addition as well as on packaging. • Assistance to beach seine fishers in assessing their fishery resources and identifying those that have potential for trade in the domestic, regional and international markets. • Encouragement of the formation of marketing cooperatives/associations so that small-scale fishers and processors can get better prices for their products by shortening the fish supply chain and increasing their bargaining and lobbying power. • Set up systems for market information accessibility which include information on species, prices, quantities, locations, and timing coupled with the use of technology such as text messaging on mobile phones.

TABLE 17
Guidelines for addressing key issue 6: Lack of access to insurance and microfinance services

Key issue 6: Lack of access to insurance and microfinance services	
Key information needs	• Sources of finance for purchase of beach seines and fishing boats and operating expenses. • Forms and use of savings by beach seine fishers and their households. • Sources and terms of credit for productive and consumption purposes and other microfinance services and level of indebtedness. • Frequency and types of accidents related to beach seining and post-harvest operations. • Insurance and other mutual support arrangements in case of accidents related to fishing and post-harvest operations. • Institutional sources of rural credit. • Insurance arrangements for small-scale fishing craft and gear. • Traditional and informal credit systems (tontines, savings clubs and middlemen).
Information sources	• Interviews with beach seine fishers and fish processors. • Lending regulations and programmes of rural financial institutions, NGOs, government agencies, including new and upcoming development policies on microfinance and Central Bank initiatives. • Insurance regulations and programmes for fisheries sector. • Interviews with money lenders and other informal lenders.
Management objective	• To improve the income of beach seine fishers, processors and traders and their communities by adding value through post-harvest operations and provide safer and better quality fish products for consumers.
Management processes and partners	• Compilation of information on the importance and use of financial and microfinance services by beach seine fishers. • Compilation of information on mutual support and insurance arrangement in the case of accidents during beach seine and post-harvest operations. • Identification of credit, microfinance and insurance needs of beach seine fishers in close consultation with all stakeholders and consultation on providing credit, microfinance and insurance service to beach seine fishers and their households. • Monitoring of impact of measures on access of beach seine fishers to and use of credit and insurance facilities and services in close cooperation with stakeholders. • Partners: fisheries departments, NGOs, rural banks, insurance companies, beach fishers and small-scale fishers associations.
Options for management measures	• Conduct enquiry on use of credit and other microfinance services by beach seine fishers. • Conduct enquiry on type and frequency of accidents during beach seine and post-harvest operations. • Identification of credit, savings, microfinance and insurance needs of beach seine fishers in close consultation with all stakeholders. • Awareness raising among credit, microfinance institutions and insurance agencies regarding the needs of the small-scale fisheries sector for credit, savings and insurance services with a special focus on credit for the acquisition of responsible beach seine gear, of fish preservation and processing equipment and savings facilities. • Implementation of special credit programmes for beach seine fishers in cooperation with government, donors and NGOs to enable beach seine fishers to acquire legal fishing gear and to operate these in strict adherence to the negotiated regulations. • Promotion of self-help groups and associations among women in beach seine fishing communities and linking these associations with financial institutions to meet investment and working capital needs of their members. • Training and support for the capacity development of fisher and women's groups to acquire and manage the credits including minor bookkeeping and business planning skills.

TABLE 18
Guidelines for addressing key issue 7: Poverty and vulnerability of beach seine fishers due to lack of other income/employment opportunities

Key issue 7: Poverty and vulnerability of beach seine fishers due to lack of other income/employment opportunities	
Key information needs	• Levels and types of poverty of beach seine fishers and their households. • Sources of income and food of beach seine fisher households throughout the year and periods of seasonal closures, poor weather and low resource presence due to migration or other natural cycles. • Education and vocational skills of beach seine fishers. • Local employment opportunities outside the fisheries sector and in fishing other than beach seining.
Information sources	• Interviews and surveys with beach seine fishers and household members. • Local chambers of commerce and employers. Demographic and household income and expenditure statistics. • Government agencies and NGOs involved in the promotion of agriculture, animal husbandry, forestry, promotion of micro- and small-scale enterprises and poverty alleviation.
Management processes and partners	• Compilation of information on levels and sources of poverty and occupational diversity of beach seine fishers and their communities. • Identification of complementary and alternative sources of employment and income. • Promotion of occupational diversification through training, other support and incentives. • Monitoring of impact of management measures on poverty and vulnerability levels in close cooperation with stakeholders. • Partners: fisheries administration, local governments, beach seine fishers and households, government agencies and NGOs involved in the promotion of agriculture, animal husbandry, forestry, promotion of micro- and small-scale enterprises and poverty alleviation.
Management objective	• To reduce/alleviate poverty and vulnerability of beach fishers and their communities by promotion of occupational diversification.
Options for management measures	• Conduct study on levels and sources of poverty, sources of income and food, education and vocational skills of beach seine fishers and their household members. • Explore possibilities for conversion of fishers to other gears, once this does not produce conflicts with other users, or for converting full time beach seine fishers to part time fishing in order to reduce pressure on the fish stocks. • Promotion of alternative livelihoods synchronized with local agricultural cycle. • Include beach seine communities in national poverty alleviation programmes and efforts of employment generation. • Capacity building of fisherfolk organizations to implement livelihood projects, prepare feasibility studies and business plans, acquire vocational and financial management skills. • Promotion of post-harvest complementary income-generating activities and microenterprises such as fish ball production, shrimp paste production, fish marketing, fish sauce production, operation of small-scale fish drying plants, improved fish drying and smoking. • Promotion of farming of aquatic organisms such as seaweed, oysters and mussels, composite fish farming in ponds, fish seed rearing in seasonal ponds, operation of small-scale breeding units for ornamental fish, integrated fish and poultry farming, composite fish and freshwater prawn farming in ponds, freshwater and brackishwater prawn farming in ponds, mussel raft culture, artemia culture and mud crab culture. • Promotion of horticulture activities such as cultivation of coconut trees, cashew and other trees and crops. • Promotion of cattle raising and small animal husbandry. • Promotion of salt production and iodization. • Promotion of food production such as making coconut oil and preparing snacks and meals for local sale. • Provide microenterprise development support to develop income-generating activities into full-fledged microenterprises.

TABLE 19
Guidelines for addressing key issue 8: Poverty and vulnerability of beach seine fishers due to lack of education, medical and social services and exposure to natural disasters and climate change

Key issue 8: Poverty and vulnerability of beach seine fishers due to lack of education, medical and social services and exposure to natural disasters and climate change	
Key information needs	• Educational and health status of beach seine fishers and households. • Availability of solid waste disposal facilities, sources of safe drinking water, sanitation and hygiene, housing, medical services, schools, transportation. • Vulnerability analysis to climate change and natural disasters.
Information sources	• Observations and surveys in beach seine fishing communities. • Departments of public health and education and other concerned departments such as the department of transportation. • Local governments and disaster risk management plans and procedures.
Management objective	• To reduce/alleviate poverty and vulnerability of beach seine fishers and their communities by improving medical and social services, literacy levels of beach seine fishers and the level of preparedness for climate change adaptation of their communities.
Management processes and partners	• Compilation of information and social infrastructure and conditions of operations. • Identification of key problems related to health, education and social services. • Liaison with departments of public health, education, other concerned departments and NGOs and advocate the provision of better medical and social services for beach seine fishers and communities. • Monitoring of impact of management measures on poverty and vulnerability levels in close cooperation with stakeholders. • Partners: beach seine fishers and communities, fisheries administrations, national and local disaster risk management institutions, departments of public health and education, local governments and NGOs working in the field of public health, water and sanitation and education.
Options for management measures	• Organization of awareness creation campaigns on environmental and public health issues. • In cooperation with NGOs and departments of education, initiate literacy programmes in beach seine fishing communities. • In cooperation with local governments and departments of public health, implement all national health programmes in villages where beach seine fishers reside and establish basic medical facilities. • In cooperation with local governments, NGOs, department of public health, provide sanitation and hygiene facilities such as toilets/latrines, safe drinking water at or close to fish landing sites as well as the management of such facilities. • In cooperation with department of transportation, improve road access to landing sites and villages where beach seine fishers reside. • Development of community plans to reduce vulnerability to natural disasters and awareness raising of the needs and implications for climate change adaptation.

TABLE 20
Guidelines for addressing key issue 9: Lack of safety of fishing craft and gear

Key issue 9: Lack of safety of fishing craft and gear	
Key information needs	• Safety status of beach seine fishing craft, equipment and gear. • The extent of preparedness and education of beach seine crews in safety-at-sea matters.
Information sources	• Fishing craft registration records. • Observation of beach seine craft and gear. • Interviews with beach seine crews and skippers.
Management objective	• To reduce the number of accidents, injuries and deaths of crew members and damage of beach seine craft and gear through improving safety-at-sea and preparedness standards.
Management processes and partners	• Collection of information on safety status of beach seine fishing craft and preparedness and education of crews in safety-at-sea matters. • Identification of safety problems in close cooperation with beach seine owners and crews. • Design and implementation of measures to improve safety of beach seine crafts and preparedness of crews and implementation of measures. • Monitoring of impact of management measures on safety of fishing craft and gear and occurrence of accidents in close cooperation with stakeholders. • Partners: beach seine fishers and associations, boat builders, fisheries administrations and fisheries training schools, coast guard, local governments.
Options for management measures	• Make certification of seaworthiness and insurance cover a requirement for the registration of beach seine craft and other small-scale fishing vessels. • Where registration of beach seine fishing craft and gear is not yet compulsory, amend legislation to make registration of beach seine craft a legal requirement as well as insurance cover and certification of seaworthiness. • Subsidize registration and insurance fees in case of poverty of crew members. • Develop safety-at-sea education learning and teaching materials. • Hold on-the-job training courses for beach seine crews on safety-at-sea and swimming. • Promote the use of life vests, floatation devices and other safety equipment. • Promote the use of radios in beach seine fishing villages for monitoring marine weather forecasts. • Promote the use of water resistant mobile phones and/or waterproof carrying pouches.

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Annex 1
Summary of findings of country case studies

Rather than in alphabetical order, the country summaries in this annex are listed in a regional geographical order, i.e. South Asia, West Africa, East Africa and South America. This is to allow the reader to understand the studies within their geographical context. In addition, countries with more comprehensive country reports appear first in order to enable the reader to gain a better and easier understanding of beach seining in a particular geographical region.

SUMMARY OF FINDINGS: INDIA

This summary is based on the report prepared by Venkatesh Salagrama in 2007: The social, economic, technological and environmental aspects of beach seining in India.

1. Technological and operational features of beach seine fisheries and their impact on fishery resources and habitats

History and regional distribution of beach seining

Beach seines have been widely used along both the Indian east and west coasts. While their importance has declined over the last couple of decades due to the introduction and shift to other fishing methods and other factors, they can still be commonly found along the shores of the Arabian Sea and the Bay of Bengal.

The beach seines operated along the east and west coasts of India can be broadly categorized into two main types. The first type consists of a seine body, codend and two wings. Examples are the *Periya valai* or *Mada valai* in Tamil language, the *Pedda vala* in Telugu language, and the *Bada Jalo* or *ber jal* in Oriya language. All names have the same meaning, i.e. big net. The *alivi or ayila vala*, also common in the state of Andhra Pradesh, is a beach seine without codend (Table A1.1).

The second type – *rampani* nets – do not have a codend and consist of a net that is narrow at the ends and broad at the centre. These nets are mainly used for catching mackerel and sardine. The *rampani* nets on the west coast are thought to have been first introduced by a Portuguese missionary about 100 years ago. Panikkar and Sathiadhas (1993) note that: "Before the mid-seventies, the marine fishery of Karnataka was dominated by traditional fishing methods particularly using *rampani*". These seine nets were operated by large outrigger boats and the *rampani* crews involved from 60 to 80 fishers per unit. However, just after the mid-seventies, as a result of the introduction of mechanized craft and gear which started dominating the fisheries, the *rampanis* – which used to contribute more than 60 percent of the total catches – almost disappeared.

TABLE A1.1
Local names of seines by coastal area – India

Coastal area	Local name of seine
West Bengal (Digha and Chandripur)	*Sarini*
North Orissa	*Sarini Jalo, Khia Badia Jalo, Gheri Jalo*
South Orissa (Puri and Ganjam Districts)	*Bada Jalo*
Coromandel Coast	*Periya valai, Thallu Valai*
Palk Bay	*Karaimadi valai, Thallu valai, Karai Vallai, Illuppu valai*
Gulf of Mannamar	*Karaimadi valai, Thallu valai, Marukku valai*
Andhra Pradesh	*Alivi* or *ayila vala*

In the 1960s and 1970s, beach seines were important fishing gear, often with spectacular catches, and with sometimes up to half of the entire village participating in the activity.

Government policies to modernize Indian fisheries did not take sufficient consideration of the traditional fishing craft and the methods and gear such as beach seines. Instead, motorization and mechanization of fishing craft and promotion of active fishing methods targeting species such as shrimp, which could be exported, were the main focus.

Fishing gear materials such as cotton, jute, hemp and coir were replaced by nylon. Fabrication of these traditional materials and gears were labour-intensive and provided work for women and older people. Cotton nets were smaller and their mesh sizes larger than nylon nets, and it can be assumed that the overall catches were smaller too but with higher numbers of juveniles escaping. The traditional nets needed to be repaired more often, required regular tanning for preservation, and were used less because of the maintenance.

Introduction of nylon nets took place during the 1960s and 1970s along the east coast of India and went hand in hand with mechanization and motorization programmes. As Seshagiri Rao (1987: 17) notes, the nylon made fishing nets catch more fish. They are lighter and offer less resistance in the water, facilitating operation and handling. The use of transparent twine made it invisible to the fish and improved catch rates. The comparative strength of nylon enabled larger nets to be used, greater catches per haul and fewer days lost for net repairs. As with gillnets, ready-made sections of netting of various mesh sizes and twine thickness can be bought and easily joined together by a crew.

Almost all traditional nets made the shift to nylon rapidly, with the exception of the beach seines[1] and to a lesser extent boat seines. Beach seines disappeared from several areas due to a decline of interest among fishers, who could earn more with a small *kattumaram*[2] and gillnet than as a beach seine crew.

However, the eventual modernization of beach seining led to its commercialization as a result of increased catches and a growing demand for small pelagic catches to be used as animal feed. On the west coast, this gave rise to the setting up of several fishmeal and fish oil production plants. However, on the east coast, the catches were never quite big enough to justify industrial-scale production of fishmeal. There was no scope for fish oil production either because oil sardines were not a major part of the catch on the east coast.

While beach seines eventually benefited from the introduction of synthetic fibres for net fabrication, the fisheries modernization processes in India had, overall, a negative impact on beach seine fishing.

Present status of beach seining in India

The current status of beach seining in India shows marked differences from state to state and even from region to region within a state. On the Coromandel Coast, in Tamil Nadu, and in Andhra Pradesh, the importance of beach seines has declined. In North Orissa, the number of beach seines has dwindled in the last two decades

[1] Monofilament or partly transparent twine (if used at all in seines) can be an advantage in gillnets but will be a disadvantage in seines, where it is important that the fish sees the net.

[2] A *kattumaram* (in the Tamil language) is a traditional Indian fishing boat that consists of several logs that are pegged together. The boat is used from open surf beaten beaches and this form of construction has the important advantage that, firstly, the hull is not damaged when landing on the beach in heavy surf, and secondly, the boat can be disassembled after use and carried to the village for safekeeping. Traditionally, *kattumarams* were powered by oars and sails and had a maximum length of 5.5 metres. During the last few decades, larger *kattumarams* have been used, many of which are motorized as they fish farther offshore. In design and fabrication, *kattumarams* have nothing in common with catamarans (even though the name sounds similar), which are typically dugout canoes with outriggers. In the Telugu language, *kattumarams* are called *teppas*.

because of increasing non-viability of operations (FAO, 2006b: 26). Decline of inshore fish catches, pollution and other anthropomorphic effects, competition from fishing boats, and cost of operations (mainly for repairing nets) have been cited as reasons for the non-viability. This decline has had the effect of increased unemployment in some villages.

In both Andhra Pradesh and southern Orissa, a reason for the continued survival of the beach seines has been their seasonal nature as the fishers operate them only for a few months in a year, which coincide with the lean season for other gears used farther offshore. Thus, beach seining has become a secondary occupation and coping strategy for fishers.

In 2005, the Central Marine Fisheries Research Institute (CMFRI) (CMFRI, 2006) recorded that the total number of beach seines in India was 46 621; the statewide breakdown of the numbers are shown in Table A1.2.

TABLE A1.2
Number of beach seines in India, by state, 2005

State	WB	OR	AP	TN	PC	KL	KR	GD	MH	GJ	Total
Number of beach seines	69	12 690	5 099	5 690	19	3 302	869	251	4 423	14 209	**46 621**

Note: WB: West Bengal; OR: Orissa; AP: Andhra Pradesh; TN: Tamil Nadu; PC: Pondicherry (including Karaikal, Mahe and Yanam); KL: Kerala; KR: Karnataka; GD: Goa, Daman and Diu; MH: Maharashtra; GJ: Gujarat.
Source: CMFRI, 2006.

Gear specifications, fishing practices and catch composition

The size and dimensions of beach seines in India vary from place to place and have changed over time. In recent years, the previously largest of the traditional beach seines operated in Andhra Pradesh has been surpassed by a locally called "giant" beach seine, i.e. *alivi vala*, which has no codend but a central section instead. The total length of the net can be close to 900 metres, central section and wings combined, which is much longer than the old "big net". While the new "giant" beach seine is much bigger than the old "big net", its mesh sizes in the wings are much smaller than the mesh sizes in the wings of the old "big net".

Boats used for beach seining

Along the east coast and also in Kerala, *masula* boats, also referred to as *podhua or padava* boats, have been used for beach seining for centuries as well as for carrying goods and passengers from arriving ships to surf beaten beaches (Thurston, 1909). The boats are typically made from Mango planks (*Mangifera indica*), from 7 to 8.8 metres in length and powered by oars and sails. The boats have no rigid frames and the planks are stitched together with coir and made leak proof by caulking the gaps between planks with various materials. Not having a rigid frame, the boats can withstand the impact of the heavy surf as well as bottom contact during their voyages along the surf beaten open beaches from where they are operated. Traditional boats called *Akada hodi* on the Konkan and *Padava* on the Malabar coast are also used for beach seining. These boats range from 5 to 6 metres in length.

As beach seines became larger and heavier, *masula* boats were replaced by bigger wooden, plank-built *nava* boats in central Andhra Pradesh, where beach seines could be operated from sheltered bays and coves. The *nava* is from 9 to 12 metres long and is a crescent-shaped, plank-built boat with frames. Oars, sails and also motor power are used. Along the beaches of southern Andhra Pradesh, large *kattumarams,* also referred to as *teppas,* are used for beach seining.

FIGURE A1.1
Hauling of beach seine in Andhra Pradesh, India

Operation of beach seines

The principal method of operation of beach seines is the same all over India. One rope connected to the shoreward wing of the net remains on the shore while the rest of the net is carried out to sea in a boat, paid out in a semi-circular path, and the hauling rope connected to the seaward wing of the net is then brought back to the shore. In some cases, two boats carry different sections of the net and join them together once a shoal of fish has been encircled. The two ends of the net are then slowly dragged by two parties of men and women to the shore (Figure A1.1).

The *rampani* net is generally operated near the shore at about 7 to 8 metres of depth. At the start of the operation, a fisher is sent out in a small boat to look for and signal the arrival of a shoal of fish. He locates the shoal based on the colour of the water. The seine is then set around the shoal.

On the west coast, which is more affected by the southwest monsoon, the *rampani* fishing season is reported to last about six months from August/September to January (Nirmale and Metar, 2003: 8). As in other regions and states that are strongly affected by the southwest monsoon, rains and strong winds can prevail from June to August and September and force beach seine operations to cease during this period.

The seasons and months when beach seines are operated also depend on whether the operators of beach seines are also involved in other kinds of fishing.

Seasonal migrations of beach seine units in the same state or between Andhra Pradesh and Orissa have also been observed. During the peak fishing season, beach seines are set and hauled twice a day. In locations with strong tidal influence, the net is set preferably during high tides to encircle shoals of fish that have come in with the tide. Care is taken to haul the net before sunset.

Catch composition

A beach seine, particularly when operated with small mesh sizes in the codend, seine body and wings, is an active, non-selective fishing gear that catches almost everything that happens to be encircled by the net even though most beach seines in India are primarily targeting pelagic species.

The catch of beach seines in southern Tamil Nadu includes, but is not limited to, sardines (*Clupeoidae*); anchovies (*Engraulidae*); silverbellies (*Leiognathus*); seerfish (*Scombridae*); ponyfishes (*Leiognathidae)*; Thrissocles (*Clupeoidei*); Indian anchovies (*Stolephorus* spp.); shads (*Hilsa toil);* and pompanos and jacks (*Carangidae)* in addition to small quantities of other fish species, shrimps and crabs. The miscellaneous groups of

small fishes constitute 33 percent of the total catch and include garfish (*Belone);* ribbon halfbeak (*Hemirhamphus)*; croakers (*Sciaenidae*); and ponyfishes (*Leiognathidae*) (Marine Fisheries Information Survey, 1989: 7).

Further north along the Coromandel Coast, the most commonly caught species in beach seines are shoaling species such as anchovy (*Engraulidae*); sardine (*Clupeoidae*); catfish (*Amblycipitidae*); mackerel (*Scombridae*); pomfrets (*Bramidae*); caranx and jacks (*Carangidae*) (Bharathi, 1999: 51). In West Bengal, the Marine Fisheries Information Survey (1985: 7) reports that the important species caught by beach seines included mainly croakers (*Sciaenidae*); Thrissocles (*Clupeoidei*); anchovies (*Engraulidae*); juvenile pomfrets (*Bramidae*); ponyfishes (*Leiognathidae*); threadfins (*Polynemidae*); and catfishes (*Amblycipitidae*).

In northern Andhra Pradesh, Rajeswari and Prakash (2007: 239) identify the main catches of beach seines as goldstripe sardinella (*Sardinella gibbosa);* fringescale sardinella (*Sardinella fimbriata);* rainbow sardine (*Dussumieria acuta);* yellowstriped goatfish (*Upeneus vittatus); Sulphur Goatfish (Upeneus sulphurous);* Indian mackerel (*Rastrelliger kanagurta);* Commerson's anchovy (*Stolephorus commersonii);* Indian anchovy (*Stolephorus indicus);* tiger prawn (*Penaeus monodon);* Indo-Pacific king mackerel (*Scomberomorus guttatus);* short-tailed hairtail (*Trichiurus russelli);* kawakawa (*Euthynnus affinis);* splendid ponyfish (*Leiognathus splendens);* giant trevally (*Caranx ignobilis);* Indian shad (*Opisthopterus tardoore);* flathead grey mullet (*Mugil cephalus);* fourfinger threadfin (*Eleutheronema tetradactylum);* false trevally (*Lactarius lactarius);* purple jewfish (*Johnius carutta);* black pomfret (*Parastromateus niger);* and largescale tonguesole (*Cynoglossus macrolepidotus).*

Impact of beach seines on fishery resources and aquatic habitat

The main sources of concern regarding the environmental and resource impacts of beach seining in India are identified by the country case study as the use of very small mesh sizes in the central part and codend of beach seines and the operation of beach seines close to river mouths and estuaries, which are breeding and nursery grounds for many fish species. These fears are particularly justified in areas where beach seine landings are seasonally dominated by large volumes of juveniles of commercial species.

However, not all beach seine catches contain high percentages of juvenile fishes. Unfortunately, reliable and detailed information on the catch composition of beach seine catches in different areas, including seasonal variations, is not available. Geographical and seasonal variations about the prevalence of juveniles in beach seine catches have been observed though. For instance, beach seine landings in Srikakulam and Visakhapatnam Districts of Andhra Pradesh contain a far smaller proportion of juveniles than those in East Godavari District of Andhra Pradesh. In East Godavari District, catches of juveniles occur mainly in the three post-monsoon months because spawning usually occurs during the southwest monsoon month, which brings heavy rainfalls in many parts of India. During the rest of the year, adult fishes dominate the beach seine catches in East Godavari District.

The study observes that there is a need to establish the geographical and seasonal abundance of juveniles in beach seine landings so that appropriate policy measures such as closure of sensitive areas and seasonal bans on beach seining can be implemented.

In order to evaluate the impact of beach seines on fishery resources and the mortality of juveniles, it is also necessary to compare the impact of beach seines with other sources of mortality and particularly mortality caused by other fishing methods. Sathiadhas and Narayanakumar (2002: 68–69) estimated the percentage share of juveniles of several species in the overall catches of selected fishing gears in Kerala during 2001–2002 (Table A1.3).

TABLE A1.3
Share of juveniles (in percentage of weight) in the catches of selected fishing gears in Kerala, India, 2001–2002

Species	Mini trawl	Ring net	Mechanized trawl net	Purse seine	Beach seine
Anchovies *(Engraulidae)*	30	40	–	–	40
Mackerels *(Scombridae)*	–	15	–	20	15
Croakers *(Sciaenidae)*	–	15	–	15	–
Oil sardine *(sardinella longiceps)*	–	30	–	25	20
Cuttlefish *(Sepiidae)*	–	–	20	–	–
Sea breams, snappers *(Sparidae, Bramidae)*	–	–	25	–	–
Lizardfish *(Synodontidae)*	–	–	20	–	–
Bullseye snakehead *(Channa marulius)*	–	–	10	–	–
Flatfish *(Pleuronectiformes)*	50	–	–	–	–
Prawns *(Penaeus* spp.*)*	30	–	–	–	–
Other prawns	20	–	30	–	–

Source: Sathiadhas and Narayanakumar (2002: 68–69).

Their findings show that the percentage of juveniles in the catch of beach seines is equally high as for other gears in the case of anchovies and even lower in case of oil sardines and mackerels. The same study (Sathiadhas and Narayanakumar, 2002, 69–70) estimates economic losses due to juvenile fishing by various gears in Kerala during 2001–2002 (Table A1.4).

TABLE A1.4
Economic losses (in Indian rupee [INR]) due to juvenile fishing by various gears in Kerala, India, 2001–2002

Species	Mini trawl	Ring net	Mechanized trawl	Purse seine	Beach seine
Anchovies (*Engraulidae*)	67 872	584 832	–	–	110 208
Mackerels (*Scombridae*)	–	207 909	–	3 514 797	327 366
Croakers (*Sciaenidae*)	–	100 452	–	–	–
Oil sardine (*Sardinella longiceps*)	19 527	1 015 956	–	443 187	64 377
Cuttlefish (*Sepiidae*)	–	–	1 462 300	–	–
Sea breams, snappers (*Sparidae, Bramidae*)	–	–	1 012 370	–	–
Lizardfish (*Synodontidae*)	–	–	49 187	–	–
Bullseye snakehead (*Channa marulius*)	–	–	–	–	–
Flatfish (*Pleuronectiformes*)	96 220	–	–	–	–
Prawns (*Penaeus* spp.)	475 720	–	–	–	–
Other prawns	29 187	–	302 634	–	–
Total	**688 526**	**1 909 149**	**2 826 791**	**3 857 984**	**501 951**

Source: Sathiadhas and Narayanakumar (2002: 69–70).

The authors' findings indicate that the economic losses due to juvenile fishing in the study area were the lowest for beach seines and more than seven times higher for purse seines, more than five times higher for trawl nets, and almost four times higher for ring nets. The reason for this picture is related to the higher catch efficiency of the other types of gear, which use similarly small mesh sizes, cover a much wider area, and because of the larger numbers which exert a much higher fishing effort than beach seines.

As far as discards are concerned, the study in India found that very few fish are discarded in beach seine fisheries. Just about everything caught is kept, only some poisonous or non-edible species are discarded on the beach.

2. Social, demographic and occupational characteristics of fishers and their access to social services and infrastructure

Ownership, sharing of income, demographic characteristics

Historically, the ownership of beach seines and boats in many parts of India is based on family, kinship or clan lineage. Schoembucher (1988: 219–224) also found that beach seining in northern Andhra Pradesh was organized in accordance with the principles of lineage systems, where the lineage acts as a corporate group with economic, political and ritual functions.

Lineage elders were responsible for maintenance of craft and gear, for the organization of the fishing enterprise and for the distribution of the yield. Ownership of a beach seine unit also gave the owners a special status and showed their ability to provide employment for their kinsfolk (Bharathi, 1999: 85). During the field study in Andhra Pradesh, family-based operations are still prevalent in important beach seining areas, such as Pudimadaka.

However, over the years, kinship-based ownership has been replaced in many places by individual ownership. Individual ownership prevails in major beach seining areas like Uppada and Mulapeta. With reference to southern Tamil Nadu, Hopewell (2004: 43) suggests that because beach seines are expensive to buy and maintain and require a sizeable boat to operate, they are often owned by rural elites who employ labourers to operate them. This typically leads to a patron-client relationship between the owners and the crew.

Hopewell (2004: 69) also observes partnerships of two to five net owners and/or fishers, which might involve combining pieces of beach seine fishing gear, craft and crew, splitting the operating costs and sharing losses or profits.

Nirmale and Metar (2003: 8) noted that there has been an increase in communal ownership of beach seines in states like Andhra Pradesh in response to the increasing cost of nets and their operations and to the seasonal nature of beach seining in these areas. However, there have been problems with the day-to-day management and maintenance of these beach seines under these types of ownership systems.

As far as the remuneration of ownership of fishing gear, craft and labour is concerned, the field study found that, in the case of individual ownership in Andhra Pradesh and Orissa, the share system was such that after the immediate expenses of the fishing operation had been covered, between one-third and one-half of the proceeds from fishing went to the owner/s of beach seine and boat and the rest was divided among the crew members and those who helped hauling the net according to the type and amount of labour contributed to the beach seining effort. A similar system applies in case of communal and family ownership, with the difference that the shares accruing to the owner/s of the net and boat are used by family and community to maintain and replace fishing craft and gear and for other family and community purposes.

With regard to the age of beach seine crews and of those crew members who assist in hauling the seines onto the shore, there is a strong participation of older people and children in hauling of nets, and they are given fish in return. For many senior villagers, who cannot fish anymore and have no other source of income or employment, beach seining provides a social security net and a source of food. In parts of southern India, women also participate in the hauling of nets.

Otherwise, women play a very important role in beach seining. They provide essential shore support to beach seine crews by preparing and supplying food and water, sometimes carrying it over long distances from their villages to wherever the beach seine operation is taking place. In most cases, they are paid in cash for their services. Women also select and collect and transport the fish from the catch, which is part of their husbands' share or remuneration in kind. The fish is usually sold or auctioned.

The more visible and well-known contribution of women to beach seining in India is their involvement in auctioning catches, buying and retailing fresh fish, fish drying and curing.

The case study on India does not provide any information on the level of literacy and educational achievements of beach seine crews and their families and households. However, in India, there are great differences between different states according to the general level of development of these states.

Occupational diversity of beach seine crews and households

Regarding occupational diversity of beach seine crews and households, the case study on India suggests that most beach seine crew members are also involved in other types of fishing, either as crew/labourer or as part or full owner and operator of fishing craft and gear, such as fishing with drift or bottom set gillnets, hook or lines, traps and other fishing gear.

Fishing is a full-time or major-time activity for most artisanal fishers. During the lean season, fishers and women from fishing communities also work as labourers in the agricultural and construction sector. However, artisanal fishers including beach seine fishers spend most of their time on fishing, where the major share of household income is derived.

Housing, infrastructure and social services

Housing, infrastructure, social and health services in fishing villages of Andhra Pradesh and Orissa still leave much to be desired. Many fishing villages and houses still lack safe drinking-water, electricity, solid waste disposal infrastructure and sanitary toilet facilities. Basic medical and educational facilities are available as well as various means of public transport. More recently, the Orissa State Fisherman's Cooperative Federation has conducted social/economic/analytical studies on socio-economic conditions of fishers in selected areas to suggest measures for their economic development and undertakes housing schemes for the benefit of the members and sell them on a hire-purchase basis or otherwise. In Andhra Pradesh, representatives from the fishing industry are strongly lobbying the government for improvements in housing and better socio-economic benefits.

Economic status, poverty, food security and vulnerability

According to the case study on India, all beach seine crew members in Andhra Pradesh and Orissa and their household and family members fall below the national poverty line and depend for their food security on remuneration in kind (fish) and cash.

With regard to the food security of consumers of beach seine catches, the case study carried out in India estimates that 80 percent of consumers of fresh and dried fish from beach seines in villages fall under the national poverty line. Among the consumers of dried fish caught by beach seines are many members of tribes who live in the interior of Orissa and Andhra Pradesh, all of whom fall under the national poverty line. Older people in fishing villages who assist in the hauling of beach seine nets are traditionally rewarded with fish, which forms an essential part of their diet.

The case study on India identifies a number of factors that contribute and that will continue to contribute to the vulnerability of households involved in beach seining and threaten this fishing method in the years to come. Among them is the growing limitation and prohibition of access of fishers to beaches from where they traditionally fished because of urbanization, housing and industrial development, aquaculture, establishment of marine parks and conservation areas and other uses. Another threat to livelihoods and beach seining is posed by the growing pollution of inshore waters, which is caused by some of the same above-mentioned developments.

Another important threat to beach seining and the livelihoods of those who make a living from it is the depletion of fisheries resources by more powerful and industrialized fishing methods such as purse seining and trawling, which are in many cases carried out close to the shore in defiance of existing fisheries regulations and which overharvest and eventually destroy aquatic resources and habitat on which beach seining depends.

3. Marketing and processing arrangements, access to credit and costs and earnings of beach seining

Marketing, processing and utilization of the catches of beach seines and access to credit

The case study on India concludes that it is not possible to ascertain the quantities of fish going into different supply chains because of the lack of a regular monitoring system of fish marketing in India. This is particularly true for the catches of beach seines, which are typically not landed at fishing harbours or at established landing sites but at scattered locations along the coastline. The study further suggests that, due to the informal nature of the marketing process, it is even more difficult to obtain information on the economics of the value chain.

During the fieldwork phase for the country case study, carried out during the lean beach seine fishing season, estimates were made regarding percentages of fish going into different supply chains in selected locations of the states of Andhra Pradesh and Orissa. They are summarized in Table A1.5.

TABLE A1.5
Estimated percentage of fish from beach seines from selected landing sites going to different market chains in Andhra Pradesh and Orissa, India

Marketing outlet	Percentage of beach seine landings
Domestic urban markets	5
Export markets	< 5
Local fresh fish markets	10–15
Dried fish markets for human consumption	35–45
Dried fish for animal feed	30–40

About two-thirds of the catch or more was dried and used for human consumption or for animal feed. The species involved were small pelagics. Insignificant parts of beach seine catches made their way to domestic urban or export markets and only a small part of the beach seine catch was sold in local fresh fish markets. These figures should be treated with caution, however, as the percentages might be different during the peak season when more buyers are attracted to beach seine landing sites and to the different species that are landed.

Buyers of fresh fish are usually petty traders, such as women from the same fishing village as the beach seine crew who buy the fish on credit, and bicycle fish vendors, typically men from neighbouring villages who usually pay cash. The women carry the fish on their heads and walk or take public transport to neighbouring villages up to 40 km away and sell it in markets or door to door. Some of the women have a few regular customers who buy on credit.

The bicycle fish vendors carry the fish back to their villages travelling up to 60 km, occasionally taking a ride on trucks along with their bicycles, and sell the fish at their local markets.

Both the women and the bicycle vendors use small quantities of ice to preserve the fish from spoiling. Whatever fish remains unsold at the end of the day is generally salted and dried.

The sale of fish to large traders is frequently on credit although some advance is collected at the time of sale to pay for the crew's expenses. While the sale price of fish is fixed when it is sold to outside traders, it becomes negotiable when sold to local women on credit based on how much the women have managed to sell it for.

In addition to fresh fish, women traders sell smaller quantities of dried fish in neighbouring villages. Larger quantities of dried fish are transported to weekly markets. There are several dried fish markets along the coast of Andhra Pradesh and Orissa, where a large number of sellers and buyers congregate from different states.

Because more than half of the catch of beach seines in Andhra Pradesh and Orissa goes into dried fish trade, the structure and functioning of dried fish markets has major implications for the earnings of beach seine crews, owners and processors who dry the fish. The existence of a number of intermediaries, who frequently add little value to the transactions, makes it difficult for fish processors to realize good prices for their products.

This is further aggravated by a lack of infrastructure at dried fish markets, which does not allow for storing dried fish until it can be sold for a good price and which also negatively affects the quality of dried fish whenever it rains. Traders frequently depend on quick returns from the sale of the dried fish to obtain the working capital necessary for the next operation. This weakens their bargaining position.

The wholesale traders supplying dried fish for poultry feed employ their own agents to collect fish from larger fishing villages and landing sites with sizeable beach seine landings. In smaller and more remote villages with smaller and irregular landings, the fishers themselves dry the fish to fishmeal grade and transport them by truck to the wholesalers in centralized locations, such as the town of Kakinada in Andhra Pradesh, from where the poultry or aquaculture feed manufacturers are supplied.

In the 1990s, it was common for the poultry feed suppliers to advance sizeable sums of money to beach seine owners or, more frequently, to the bigger dried fish processors in fishing villages in return for an assured supply of dried fish. This practice has become less common even though it still continues and amounts up to INR 100 000 are advanced to beach seine owners. These traders then have the right to purchase all fish, both fresh and for drying.

Despite many programmes and projects between 1960 and 1980, which demonstrated that artisanal fishers can be viable clients of rural banks without subsidies and follow-up efforts of NGOs, artisanal fishers today have very limited, if any, access to institutional finance and, to a large extent, rely on moneylenders who charge high interest rates and provide only short-term credit. More information on access to credit in the sector in India is provided by DFID's Post-harvest Fisheries Project (2006).

Economic and financial performance

Few of the country case studies provide information on the annual earnings of beach seines, operating costs, investment costs and depreciation, which can be used to assess the economic performance of beach seines in terms of their net cash flow (NCF) and the ratio of net cash flow to total earnings (NCF/TE) and the financial performance in terms of the return on investment (ROI). Reliable data over appropriate time intervals are simply not available.

4. Regulation and management of beach seining, conflicts with other users of fishery resources and shorelines, and recommendations of country case studies

National legislation and regulation of beach seining and compliance with regulations

Marine Fishing Regulation Act

In India, laws relating to conservation, management and development that apply to various aspects of fisheries have implications for beach seining. In the Federal Constitution of India, it is the responsibility of each state government to implement all laws relating to fisheries and the legal frameworks.

The general framework for fisheries legislation is provided by the Marine Fishing Regulation Act (MFRA). The Government of India circulated a model bill to all states with a recommendation to enact similar legislation.

The key features of the MFRA in Andhra Pradesh are:

- registration for all fishing vessels including artisanal ones; annual licensing for all vessels with an annual fee;
- zoning of fishing grounds with waters up to 8 km offshore reserved for non-mechanized traditional fishing craft, mechanized fishing vessels under 15 metres in length to operate beyond 8 kilometres, and vessels above 15 metres in length to operate beyond 23 kilometres; and
- mesh sizes smaller than 12.7 mm are prohibited and sanctioned with fines.

Two additions to the MFRA in the last decade are a seasonal fishing ban lasting six weeks, from 15 April to 30 May every year, which was extended to two months in 2008, and a ban on shrimp seed collection.

As far as compliance with the MFRA is concerned, no evidence was found during the field study in Andhra Pradesh and Orissa that boats used for beach seining, i.e. *masula* and *nava* boats, had been registered with the Department of Fisheries.

Both in the artisanal and in the mechanized sector, the mesh size regulations of the act are often not followed, and trawlers, purse/ring net and beach seiners all use mesh sizes smaller than 12.7 mm in their codends and seine bodies.

In the case of zoning provisions of coastal waters for mechanized and non-mechanized fishing fleets, most state departments of fisheries have no capacity and infrastructure for implementation of the zoning provision and mechanized boats continue to fish close to the shore, negatively affecting catches and in conflict with operations of beach seine fishers where there is overlap.

Coastal Regulation Zone Notification (CRZ Notification)

In 1991, the Ministry of Environment and Forests issued a Coastal Regulation Zone Notification to protect the coastal zone. The coastal regulation zone (CRZ), as defined in the notification, consists of the area within 500 metres from the high tide line. The coastal zone also includes riparian lands by the side of rivers, creeks and backwaters up to the point where the tidal effect is felt.

The CRZ was subdivided into CRZ-I, CRZ-II, CRZ-III and CRZ-IV.

CRZ-I included areas of great ecological sensitivity, such as mangroves, historical importance or great natural beauty, which were to be protected from development.

CRZ-II included already developed and urban areas, which fall under existing urban land development rules.

CRZ-III included the bulk of rural areas, where development was to be strictly regulated. Absolutely no development was allowed within 200 metres of the high tide line, while the 200- to 500-metre zone was to be carefully regulated. Certain activities were prohibited in the CRZ-III, while certain others were permitted but subject to rules.

Since the notification was issued, a number of amendments have been made to the notification. In 2008, the Ministry of Environment and Forests came out with the draft of a new notification entitled the Coastal Management Zone (CMZ) Notification 2008, which would – when enacted – replace the earlier CRZ Act. A number of fishworker organizations in India are opposing the new draft notification because it is felt that the notification facilitates the transfer of ownership and access to beach fronts from fishing communities to non-coastal agencies and groups with commercial interests (Sridhar *et al.*, 2008: 13). It can be assumed that the CMZ Notification, when implemented, could further weaken, particularly the beach seine fishers' claim, their traditional fishing *padu*s (beach seine fishing spots).

Informal and traditional management mechanisms

In coastal villages in Andhra Pradesh and Orissa, fishing, like other economic activities, is regulated by traditional village and caste councils, which are locally referred to as *panchayats*. These *panchayats* (Bay of Bengal Programme, 1984: 8) govern both social and economic aspects of village life. Caste *panchayats* are traditional associations in which membership is hereditary. The caste *panchayat* also adjudicates on the division of property, collects money for festivals, settles disputes between net owners and labourers, and has the right to ban fishing on particular occasions. Senior members of both caste and village *panchayats* are often also members of the elected formal local government structures and modern institutions such as *gram panchayats* and cooperatives.

Traditional village councils establish territorial use rights of the village over its fishing grounds and attempt to ensure equal access by all beach seine fishers in the village.

The study in India identified five different access arrangements to beach seine fishing spots, or *padus.*

1. Permanent use rights. In this system, the rights of first access to a *padu* are confined to a particular family, lineage or net group and are inherited. No other group can operate its net in the *padu* unless the group holding the rights to the *padu* has taken its turn first. Only in cases where the rights holders do not operate their net on a given day can the other groups have the first use of the *padu*.
2. Rotational access to fishing spots. When the number of beach seines in a village exceeds the number of fishing spots, the rotation system allows people to operate their nets in a sequential manner, reducing scope for conflicts.
3. First-come first-served basis. This system is applicable in villages where the number of *padu*s is higher than the number of beach seines. The fishers have the choice to go to any *padu* and operate their net on any given day. There is no guarantee though that they will be able to fish the same *padu* the next day as another crew may arrive there earlier.
4. Open access. This is a system where no restrictions are placed on fishers, whether local or not, to operate their nets according to wherever there is opportunity. This happens in places where no claims have been made for fishing rights by any village, or where the village is too small to enforce its claims to the *padu*s, or where the village does not have any beach seines even though it has access to *padu*s, or where the village is transitory in nature and cannot impose its claims strongly enough.

   In Orissa, on the uninhabited islands and sandbars located on the seaward side of Lake Chilka, fishers seasonally migrate using the open access principle. On Hope Island in Andhra Pradesh, the local villagers are few and their entry into beach seining itself is a relatively recent phenomenon and many beach seine net groups from the mainland seasonally fish on the seaward side of the island.
5. Restricted access. Under many circumstances, the *padu* system has to operate within the confines of restrictions placed upon it by formal regulations. In such cases, the traditional rule systems are no longer being followed.

Linkages between formal and informal management systems

Attempts to implement fisheries management and development programmes in India have largely sought the help of the informal community-based systems. These institutions have radically transformed themselves in modern times and their role has changed from being the key decision-maker in the village to being an intermediary in the fishers' dealings with the outer world, especially the government. The key function of the government in the fisheries modernization phase of the sector has been one of

providing support to fishers and to their traditional institutions. These institutions have played an important role in forging close links with the fisheries administrations and in gaining support for their villages.

The case study concludes that there are strengths in both the formal and informal systems of fisheries management and development in India and that both systems can complement each other. Building on each other's strength for more efficient and participatory policy formulation and implementation in fisheries management and development is crucial.

Competition with other users of beaches and fishing grounds and views of beach seine fishers

Beach seining operations in India have been restricted by other uses of coastal lands, such as for industrial development, including for special export processing zones, shipping and port development, aquaculture, military and naval installations, conservation, tourism and other activities. For example, in Orissa, the southern part of the Puri beach is being developed for tourism purposes and the fishers who have long operated their beach seines along the beach find themselves being held accountable by the local administration for their day-to-day activities.

Beach seining also faces increased competition from within the fisheries sector both for fishing grounds and for the specific varieties of fish caught by the beach seines. The increasing number of boats of all kinds, motorized, non-motorized and mechanized, and their focus on fishing in the nearshore waters is in direct competition with beach seine operations. Besides reducing the space for fishing, some of these boats and their gear damage beach seines. Other types of fishing gear such as ring nets and purse seines do not compete with beach seines for fishing grounds but catch the same fish that beach seines do. For many fishers, ring seines also operated within the small-scale sector are the most significant threat to their fishery.

Most of the young fishers encountered during the field study in Andhra Pradesh and Orissa consider beach seining an old-fashioned activity that cannot transcend its subsistence orientation, i.e. it can help people to survive but not necessarily make them better-off or well-to-do. Moreover, there is a feeling among younger fishers that beach seining lacks the sophistication of a modern fishing technique.

The fact that it is the older people who are considered the most reliable source of human resources to operate beach seines suggests that it is certainly not considered a gear for the future. The case study on India concludes that modernization and development in rural India provide more opportunities for people to move out of subsistence-based activities and that choices of livelihood activities by younger fishers are more and more determined by the lure of higher social status or prestige attached to salaried employment. Thus, new commercial and industrial initiatives in coastal areas, while placing additional pressures on beach seining, also provide new opportunities for young people, including fishers and women to move into new types of employment.

SUMMARY OF FINDINGS: SRI LANKA

This summary is based on the report prepared by Aloy W. Fernando in 2008: Beach seining in Sri Lanka.

1. Technological and operational features of beach seine fisheries and their impact on fishery resources and habitats

History and regional distribution of beach seining

The beach seine fishery is one of the oldest fisheries in Sri Lanka. It accounted for over 40 percent of the total fish landings until the 1950s (Fernando and Suraweera, 1995). It is believed that the local name for beach seine, i.e. *madela,* was derived from the Sinhalese words *maha dela,* which means, literally translated, a huge net (Alexander, 1995). The term *madela* is still used today in most legal documents.

The type of beach seine that was the most important fishing gear in Sri Lanka until the 1950s is described by Canagaratnam and Medcof (1956). As in India, beach seines had been traditionally made from natural fibres, i.e. cotton, hemp and coconut fibres. These natural fibres were later replaced by synthetic fibres.

Beach seine fishing in Sri Lanka is confined to coastal waters up to 3 kilometres offshore. Operations are usually conducted before and after the southwest monsoon season. However, in certain areas, such as the Island of Mannar, the islands off Kalpitiya, Kalpitiya mainland in the northwestern province and in Mawella in the southern province, fishing takes place all year round and whenever the weather permits.

Traditionally, fishers from villages located on the west coast of Sri Lanka and exposed to the southwest monsoon, such as Negombo, Wennappuwa, Marawila and Udappuwa, migrated to the northern and eastern shores of the country at the onset of the southwest monsoon and set up temporary fishing camps. Because of the civil war and unrest in these parts of the country, the seasonal migration stopped in the late 1980s.

The continental shelf of the island is wide in the north and the northwest of the country, and the coastline from Puttalam to Colombo is devoid of rocks, has sandy or muddy bottoms and is also used for trawling. In these areas, the *padus*[3] are demarcated almost adjacent to one another. The continental shelf narrows from Colombo all the way south to Hambantota and Batticaloa and is characterized by rocky sea bottoms and shorelines. In these areas, fewer *padus* are designated.

In certain *warayas*,[4] such as Kallarawa in Trincomalee District, where beach seining takes place in rocky areas, divers are used to guide the net and the foot rope over rocks without damaging the net. Many of the lucrative *warayas*, in which the catches are consistently good, are situated in vicinities of river mouths. Because of the high nutrient content, there is an abundance of plankton resulting in large concentrations of plankton feeders and in turn the shoaling of small pelagics and those fishes that feed on them.

Table A1.6 shows the geographic distribution of *padus* in Sri Lanka.

[3] Areas designated by law for beach seines, usually between 100 and 500 metres long.
[4] Beach seine harbours.

TABLE A1.6
Designated beach seine areas (*padus*) in Sri Lanka, by District Fisheries Extension Office (DFEO) Division

DFEO Division	Number of *padus*
Puttalam	145
Chilaw	28
Negombo	15
Kalutara	24
Galle	30
Matara	10
Hambantota	14
Trincomalee	90
Mullaitivu	87
Jaffna	144
Batticaloa	109
Mannar	115
Kalmunai	76
Colombo	11
Total	**898**

Table A1.7 shows the geographic distribution of fishing crafts used for beach seining in Sri Lanka.

TABLE A1.7
Beach seine craft by fisheries districts in Sri Lanka, 2006

District	Number of beach seine craft
Colombo	29
Negombo	34
Kalutara	27
Galle	52
Matara	10
Tangalle	70
Mannar	6
Kalmunai	113
Batticaloa	113
Trincomalee	117
Puttalam	227
Chilaw	20
Subtotal	**818**
Estimated number of boats	
Mullaithivu	20
Jaffna	140
Kilinochchi	30
Total	**1 008**

Source: Ministry of Fisheries Statistics Unit, 2006/2007 census.

Gear specifications, fishing practices and catch composition

Beach seines in Sri Lanka principally consist of a seine body, codend, wings, foot ropes, head ropes and hauling ropes, weights and floats

As in the case of India, the seine body of a typical Sri Lankan beach seine consists of two sections: the mouth and the codend section. The mesh size in the codend varies from about 6 to 18 mm, if small fish species are targeted, with a ply of about 27 (27 times Denier 210) to provide sufficient strength to withstand pressure from large catches in the range of 2 to 3 tonnes.

If shoals of larger fish are targeted, mesh sizes from 30 to 50 mm are used in the seine body. In most beach seines, the codend can be detached from the wings. Many beach

seines have several codends with different mesh sizes so that fish species of different sizes can be more effectively targeted throughout the year. Beach seines targeting sardines (*Clupeidae*), locally called *kuni dela,* have a mesh size of 6 mm in the codend; beach seines for targeting Indian mackerel (*Rastrelliger kanagurta*), locally called *sala dela,* have a mesh size from 23 to 30 mm; and beach seines targeting shark *(Squaliformes),* locally called *mora dela,* have mesh sizes of 94 mm and more (Fernando, 2001).

The main body of a beach seine is cone shaped and is made of nylon netting of 18 ply and the length of the body ranges from 10 to 15 metres. The width at the opening to which the seine body is attached is about 12 metres, while the width at the codend of the net is about 2 metres. A head rope is buoyed with wooden floats and the foot rope is weighted down with pierced stones, cement blocks or lead pieces. The cone-shaped body of the seine is made up of ten cylindrical netting sections. The mesh size of the main body increases from 20 mm at the cod end to 60 mm at the mouth (Fernando and Suraweera, 1995).

In the southwestern region of Sri Lanka, the body of the net is attached to the wings by means of two sections of netting, locally called *siringu* and *lanu thiringu.* A *siringu* has a length of 10 to 15 metres, a mesh size of 20 to 25 mm and is made of polyamide nylon twine of 9 ply. It is attached to the body of the beach seine. The *lanu thiringu* connects *siringu* to the wings. It is made out of coir netting 1 to 3 metres long and has a mesh size of 100 mm. The two wings of the beach seine consist of about seven sections, the lengths of which can vary from 8 to 15 metres each. The number of meshes in each section decreases as the mesh sizes increases up to a maximum of 300 mm. The weighted foot ropes and buoyed head ropes, which keep the wings in a vertical position with floats and sinkers, extend from the body along the wings up to the hauling ropes. The hauling ropes have diameters from 20 to 25 mm and a length from 400 to 3 500 metres depending on the area to be encircled and on the type of operation. For ease of handling, the ropes are made into coils of about 75 metres each.

In addition, other modified designs are used in the country, which have been adapted to local conditions, traditions, availability of investment capital, material and labour, and other circumstances. Many of these are smaller than the one described above and include a mini beach seine, locally called *siri dela,* with a combined length of body and wings of less than 110 metres. This net is operated without boats. The operation of a beach seine in Sri Lanka is very similar to that described in the case study on India.

In Sri Lanka, a variety of fishing boats are used to operate beach seines, as well as other small-scale fishing gear. Table A1.8 shows the most common types of boats together with their technical specifications and investment costs. For the operation of larger beach seines, *parus* and *vallams* are commonly used as other boats do not have sufficient carrying capacity.

The wooden *vallam* is a sturdy dugout canoe made from a large tree trunk. It is mainly used for beach seining (Pietersz, 1981) but also for other types of fishing. It is most widely used on the east coast, but also common along the northern, northwestern and southwestern coasts. Owing to the scarcity of large trees, according to Fernando (2001), 65 percent of all *vallams* in the northwest of the country are now made of fibre-reinforced plastic (FRP).

One of the oldest and most traditional fishing boats in Sri Lanka is the *oruwa,* a wooden dugout canoe with an outrigger. It is mostly used for gillnetting and other types of fishing but sometimes also for the operation of smaller beach seines. This type of boat and other boats are also frequently made in FRP today by the country's flourishing FRP boat building industry. In the case of beach seining and fishing with other nets, a platform is rigged on to the outrigger beams for storing fishing gear. The boat is narrower and lighter than a *vallam*.

TABLE A1.8
Specifications of beach seine crafts operating in northwestern and southern Sri Lanka, 1992–1997

Type of craft	Material	Length (m)	Beam	Propulsion	Crew	Cost (LKR)	Place of operation
Wooden *vallam* dugout	Wood	9.5–11	1.25	Oars, sails	7–10	100 000	Udappu
FRP *vallam*	FRP	9.25–9.5	1.5	Oars, sails, outboard motor	7–10	125 000–150 000	Northwest, west
Oruwa dugout with outriggers	Wood	8.5–10	0.5	Oars, sails	3–4	25 000	South
Paruwa	Wood	10–14	1.5–2	Oars, sails	10–15	100 000	Northwest, west
Outrigger *paruwa*	Wood	9–12	1.25	Oars, sails	5–8	90 000	Induruwa
Paruwa with dugout	Wood	10–14	1.5–2	Oars, sails	7–10	110 000	Weligama, Galle
FRP *paruwa*	FRP	10–14	1.5–2	Oars, sails	7–10	135 000–165 000	Balapitiya, Ambalangoda
Catamaran	FRP	6.5	0.5	Oars, sails	3	30 000	Pandura
Teppam	Wood	3.5–4.5	1–1.25	Oars, sails	2	12 000	Northwest, west
Kattumaram	Wood	3	1–1.25	Oars, sails, outboard motor	2	15 000	Northwest

Note: FRP = fibre-reinforced plastic; LKR = Sri Lanka rupee.
Source: Fernando, 2001.

The *paruwa* boats of Sri Lanka are similar to *masula* boats in India and have similar characteristics, which make them very suitable to operate beach seines from surf beaten beaches. The boats have no rigid frames and their planks are stitched together with coir ropes and caulked. They are widely used in all parts of Sri Lanka. Some *paruwas* have dugouts attached to each side or outriggers for added stability.

Teppas and *kattumarams* are log rafts, similar to the ones described for India, that are used for beach seining in the northern and northwestern regions of Sri Lanka.

Beach seine catches

In a study on the beach seine fishery in the northwestern and the southern regions of Sri Lanka, 47 finfish species belonging to 25 families and 5 crustacean species belonging to two families were identified in catches of the northwestern region, while a total of 38 finfish species were recorded in catches from the southern region (Fernando, 2001).

Of the identified species, 14 belong to the herring family (*Clupeidae*), 11 to the horse mackerel family (*Carangidae*) and 9 species to the silver belly family (*Leiognathidae*). In the study conducted by Fernando (2001), species of sardines (*Sardinella*), ponyfish (*Leiognathidae*), mackerel (*Rastrelliger*), anchovies (*Stolephorous*), caranx (*Carangidae*) and spotted sardinella (*Amblygaster sirm*) were the most common varieties in the beach seine catches in the northwestern province; in the southern region, the most common varieties in the catches were anchovies (*Stolephorous*), silver bellies (*Leiognathidae*), sardinella (*Sardinella*), hairtail (*Trichiurus*) and barracuda (*Sphyreana*).

Table A1.9 provides an overview of catch rates and percentage contributions of dominant species of beach seine catches in the northwestern and southern region of Sri Lanka, 1992–1997.

Impact of beach seines on fishery resources and aquatic habitat

Beach seines are often regarded as having a negative impact on the environment. With small mesh sizes in the seine body and codend, the method is considered non-selective and negatively affects the aquatic fauna encircled by the seine, including larval forms, fry, juveniles and ova, while virtually scraping the seabed.

The catch of undersized fingerlings is a noticeable feature of the beach seine fishery in Sri Lanka. In addition to target species, these may contain fingerlings and juveniles of commercially valuable large fish such as tuna, species of large sized caranx (*Carangidae*), prawns (*Scomberomorus*), Spanish mackerel (*Scomberomorus commerson*), etc.

TABLE A1.9
Catch rates and percentage contributions of dominant species of beach seine catches in the northwestern and southern region of Sri Lanka, 1992–1997

Species	Northwestern region (1992–1994)			Southern region (1995–1997)		
	Catch rate (kg/haul)	%	Ranking	Catch rate (kg/haul)	%	Ranking
Goldstripe sardinella (*Sardinella gibbosa*)	74.56	27.5	1	0.62	0.4	11
White sardinella (*Sardinella Albella*)	37.42	13.8	2	7.0	4.5	6
Spotted sardinella (*Amblygaster sirm*)	35.54	13.1	3	8.70	5.5	5
Ponyfish (*Leiognathidae*)	21.05	7.7	4	18.22	11.5	2
Pompano (*Carangidae*)	19.65	7.2	5	15.13	9.5	3
Indian mackerel (*Rastrelliger kanagurta*)	19.49	7.2	6	4.61	2.9	7
Anchovies (*Stoloephorous*)	13.09	4.8	7	49.27	31.7	1
Barracudas (*Sphyreana*)	2.77	1.0	8	4.14	2.6	8
Sardines (*Chirocentrus*)	2.51	0.9	9	1.47	0.9	10
Rainbow sardine (*Dussumeria accuta*)	2.12	0.7	10	0.56	0.4	12
Longfin herring (*Pellona*)	1.33	0.4	11	2.74	17	9
Hairtail (*Trichiurus*)	1.11	0.4	12	13.46	8.5	4

Source: Fernando, 2001.

In Sri Lanka, no empirical studies have been carried out that confirm and quantify these impacts and compare these with the impacts of other fishing methods or natural mortality of juvenile fishes.

As in the case of India, and unlike the beach seine catches in developed countries, there is hardly any of what is considered bycatch in the landings of beach seines in Sri Lanka as low-value fish and undersized fish are consumed by the crew and their households.

Discards are also negligible, except for poisonous fish such as puffer fishes and sea snakes, and sponges, anemones, echinoderms, sea urchins, starfishes, tunicates, etc., found in the catch at times and usually in small quantities.

2. Social, demographic and occupational characteristics of fishers and their access to social services and infrastructure

Ownership, sharing of income, demographic characteristics

As with India, beach seines were traditionally owned by family lineages and inherited from generation to generation. Today, however, beach seines are most commonly owned by individuals on the west coast and also by several individuals as well as cooperative societies that own shares of the gear.

The remuneration of capital and labour varies among the beach seine fishers in different areas in the country. Most commonly, one-half of the income after meeting operating expenses accrues to the owners and the other half is distributed among the workers. This ratio was found to prevail in beach seining in Sinnapadu and Mampuri in Puttalam District, as well as at Mawella in the south of the island, where beach seine operations are carried out throughout the year. In Udappuwa in Puttalam District, only one-third of the proceeds go to the owners of the net and boat and two-thirds are divided among the crew members. In other places, such as the village of Welipatanwila,

40 percent is retained by the owners of the net and gear. Another 40 percent is paid to the permanent workers, while the remaining 20 percent is used to pay all other workers.

With regard to the number of villagers involved in and remunerated for the hauling of beach seines, Alexander (1995: 117) notes that in Sri Lanka (and this may also be true in India as well as other countries) "many observers noting the large numbers (of people) who often participate in hauling a beach seine have suggested that the labour requirement of beach seining is larger than is the case. While it is probably true that the larger nets require bigger crews than the nine men customary in Gahavalla, reports of 50 to 100 men crews reflect the poverty of these villages not the demands of the beach seining technique."

In Sri Lanka, women participate in the operation of beach seines in several ways. In many fishing villages, women are eligible to register and own shares of beach seines. In some areas, women participate in the hauling of beach seine nets. Women are commonly engaged in post-harvest activities such as sorting, drying, and marketing the catch of beach seines.

Economic status, poverty, food security and vulnerability[5]

According to the Canadian International Development Agency (CIDA),[6] while 7 percent of Sri Lanka's population lives in absolute poverty, close to half of the population, i.e. 45.4 percent, is highly vulnerable as far as absolute poverty is concerned and lives on an income below USD 2 a day. Coastal fishers are particularly affected. The December 2004 tsunami killed 31 000 people, displaced 500 000, devastated Sri Lanka's coastal infrastructure and livelihoods, and resulted in an additional 250 000 Sri Lankans being pushed below the poverty line.

Studies, carried out with support from the Centre on Integrated Rural Development for Asia and the Pacific (CIRDAP), confirm the relative poverty level of small-scale fishers not only by comparison with the national average level of income, but also more significantly in relation to incomes and amenities of similar socio-economic groups such as farmers, other rural dwellers and urban workers. Most of the fishing communities live at the subsistence level.[7]

After the tsunami, because of the damage caused and coupled with the vulnerability of coastal communities, the Government decided to implement by-laws regulating the proximity of edifices to the high water mark. These laws, not strictly enforced before, restricted the re-establishment of some fishing communities along the coast and, of course, their ability to fish. In addition, some hotels and the tourist industry started lobbying to use this law to occupy the spaces where the fishing villages had been but were not permitted to re-establish. After debate, the setback has since been reduced and this has somewhat alleviated the situation of the communities by permitting them to re-establish albeit not as close to the high water mark and to continue to carry out their operations.

3. Marketing and processing arrangements, access to credit, and costs and earnings of beach seining

Improved transport facilities and a better network of roads now link most landing sites with the main road network. Vendors and consumers and wholesale dealers and retailers now access beach seine landing sites and communities with insulated/refrigerated trucks, vans and cars, and motorcycles and bicycles.

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[5] The case study on Sri Lanka does not provide any information on occupational diversity of beach seine crews and households.

[6] See www.acdi-cida.gc.ca/srilanka-e

[7] See www.faoorg/docrep/x0264e/x0264e01.htm

Fish from beach seines is not normally weighed prior to retail sale. The bulk is retained in the net during the bidding. The selling units are boxes, which contain about 35 kg, or shallow cane baskets containing about half of that amount. Large fishes are sold individually. In some places, the catch is taken to an auction shed where the catch is auctioned.

Over the years, artisanal fisheries in Sri Lanka have had access to a number of credit schemes which had elements of capital and interest subsidies and supported the introduction of motorized fishing boats. It is not known to what extent beach seine fisheries have benefited from these schemes.

When assessing the performance of beach seines in Sri Lanka against the performance of other artisanal fisheries in Asia, it might be interesting to look at the three global studies carried out by FAO on the economic performance of marine capture fisheries between 1995 and 2003 and their findings with regard to the performance of artisanal fisheries (FAO, 1999b; FAO, 2001; FAO, 2005d). All three studies showed that artisanal fisheries, particularly non-mechanized ones as in the case of beach seining in Sri Lanka, with few exceptions, have favourable rates of return on investment because the initial investments and subsequently the annual depreciations are small and in some cases insignificant when compared with earnings and when compared with semi-industrial and industrial fisheries.

When relating the positive economic and financial performance of beach seining and other artisanal fishing methods to the issue of widespread poverty in artisanal fishing communities, it should be kept in mind that both phenomena do coexist. Their coexistence is explained by the fact that even though artisanal fishing has in most cases a positive cash flow – otherwise people could not afford to be engaged in this activity in the long term – the income generated in cash and in kind by artisanal fishing is often small and unevenly distributed over the year and also within different seasons of the year.

Such income might not be sufficient to sustain households unless the households also have other sources of income and food. As far as poverty is concerned, it should also be kept in mind that income is only one aspect of poverty. According to the common definition of poverty, when a person finds it difficult to meet the minimum requirement of acceptable living standards, he or she is considered poor. Thus, poverty also relates to poor housing and sanitary conditions, lack of infrastructure, services, education, political participation and other similar aspects.

4. Regulation and management of beach seining, conflicts with other users of fishery resources and shorelines

National legislation and regulations of beach seining

In the late 1800s and early 1900s when beach seining was a dominant fishing method in Sri Lanka, many regulations were made for the control, administration, development and management of the beach seine fisheries. In the absence of a fisheries law, these regulations were made under different ordinances and well administered and enforced in respect to marine, brackish-water and freshwater fisheries.

The more important ordinances were, in chronological order:

- Local Boards Ordinance, No. 13 of 1887;
- Village Communities Ordinance, No. 24 of 1889;
- Small Towns Sanitary Ordinance, No. 18 of 1892;
- Game Protection Ordinance, No. 1 of 1909;
- Local Government Ordinance, No. 11 of 1920;
- Village Communities Ordinance, No. 9 of 1924; and
- Fisheries Ordinance, Law No. 24 of 1940.

Except for the Fisheries Ordinance of 1940, the other ordinances were not exclusively for beach seine fisheries but for regulated fisheries, including beach seine fisheries, as far as the following aspects are concerned:

- registration of fishing craft and gear and conditions of their operation;
- prohibition of fishing in certain areas and during closed seasons;
- regulating retail marketing of fish and fishing gear;
- regulating the preservation of fish; and
- prohibition of the use of poisonous substances and the use of explosives for harvesting fish.

A common feature of most of these regulations was the prominence given to the concept of community-based management in the wording of the ordinances, which in many cases approved and legalized the rules made by the inhabitants of the concerned areas where the rules would apply. Local ordinances were finally replaced by national legislation such as the Fisheries and Aquatic Resources Act No. 2 of 1966; the *Madel* (beach seine) Regulations of 1984; the Fishing Operations Regulations of 1996; and the Inland Fisheries Management Regulations of 1996.

Unlike the earlier regulations, the *Madel* (beach seine) fishing regulations of 1984 by the minister under the provisions of Section 33 of the Fisheries Ordinance and approved by parliament were applicable to the beach seine fishery in the entire island.[8]

The key features of these regulations are the designation and protection of special areas where beach seining can be carried out and the limitation of entry into beach seine fisheries. These features are in line with the principles of community-based fisheries management and incorporate the traditional management practices of this fishery in the past. Some of the more important provisions are summarized below:

- All beach seine fishing operations are to be carried out exclusively from 311 designated beach seine *warayas* (bays or harbours) identified in the regulations by name and an assigned number and only by beach seine owners who are registered and issued with permits for such operations at those *warayas* which are reserved for their use. Many *warayas* have more than one *padu* (the reserved portion of the beach for a registered beach seine owner). The regulations identify 898 *padus*. The length of a *padu*, reserved by law for the beach seine owner's exclusive use, ranges from 500 metres to 1 kilometre.
- Where there are two or more registered owners or groups for a *padu*, a system rotation of turns, agreed upon by all owners, shall be observed.
- Within a beach seine *waraya*, the use of mechanized craft for the operation of a beach seine is prohibited. While a beach seine is in operation, no mechanized boats are to navigate within the waters of a beach seine *waraya.* Boats other than those used exclusively for the operation of beach seines are prohibited to be anchored in the beach seine *waraya* or to be beached on the foreshore adjoining the beach seine *waraya.*
- Within the beach seine *waraya,* the use of any fishing gear or fishing boat other than those prescribed by these regulations are prohibited.

The *Madel* fishing regulations were also a result of the efforts of the *Madel* owners Fisheries Co-operative Society Ltd., which had been formed in 1977 and which promoted the principles of community-based fisheries management. The collective efforts of the fishers through this society towards fisheries community-service facilities included the amelioration of educational facilities for fishers' children, housing, community sanitary facilities, the establishment and management of *Madel warayas,* as well as financial support for the acquisition of fishing craft and gear.

[8] *Gazette of the Democratic Socialist Republic of Sri Lanka (extraordinary)*, No. 337/48 of February 1985.

Implementation of regulations, monitoring and compliance

While the regulations have largely worked as far as the designation of beach seine areas are concerned, they have ceased to work as far as the regulations of fishing effort and of the types of craft and gear are concerned that can be used for beach seining in the designated beach seine fishing areas.

The Sri Lanka case study concludes that there is an urgent need to update and amend the regulations of 1984 to take into consideration the changes in fishing technology that have taken place since the regulations were promulgated. In addition to the three types of boats specified in the regulations, mechanized boats are often being used to operate the net and tractors are used to haul it. Synthetic netting and ropes are used, all of which are not in conformity with the definition of "*Madel*" in the regulation. The fact that most of the fishing craft and gear currently used in the designated beach seine fishing areas are not in conformity with the regulations makes enforcement difficult if not impossible.

The lack of enforcement is also reflected by complaints from beach seine fishers and small-scale fishers about the intrusion of mechanized vessels such as trawlers into their fishing grounds.

There are also shortcomings in the present regulations regarding the registration of beach seine craft, which have negative consequences for the safety of fishers and seaworthiness of beach seining crafts. According to the regulations on fishing vessels in Sri Lanka, any person who wants to operate a fishing boat in Sri Lankan waters including for beach seining needs to obtain a certificate of registration. One of the conditions for the issuance of the certificate of registration is that the application for registration should be made together with a certificate of insurance in respect of the boat obtained by forwarding to the insurer a valid certificate of the boat's seaworthiness issued by a marine engineer of the Department of Fisheries.

By virtue of the fact that most beach seine crafts are non-motorized, they are exempted from this requirement because there is a provision in the law that the insurance certificate is not required in the case of non-mechanized boats. The provision was inserted in the law because of the lobbying of owners of non-motorized boats who did not want to pay insurance premiums.

Conflicts with other users of fisheries resources

Conflicts of small-scale fishers with trawlers fishing illegally in inshore waters have been a regular occurrence in Sri Lanka, and there have been public protests and demonstrations by fishers' organizations demanding the strict implementation of existing zoning regulations.

SUMMARY OF FINDINGS: GHANA

This summary is based on the report prepared by Doris Yeboah in 2001: Study of ecological and socio-economic impacts of the beach seine on the livelihood of fishing communities in Ghana.

1. Technological and operational features of beach seine fisheries and their impact on fishery resources and habitats

History and regional distribution of beach seining

Artisanal fisheries in Ghana are the backbone of the fishing industry and account for about 70 percent of the total fish production. They also support the livelihoods of about two million people living along the coast (Quaartey *et al.*, 1997). The main fishing methods used by artisanal fishers in Ghana are purse seines, beach seines, set nets, drift gillnets, and hook and lines.

Beach seining was first introduced in the Volta Region in the town of Keta, most likely in the early nineteenth century by European merchants who were probably of Portuguese origin and hence its local name "Yevudor" in the Volta region, which means white men's net. Even though the fishing method was first adopted by the Ewe ethnic group, it later spread to other regions and other ethnic groups started to use beach seines. In the case study communities of Pute and Katech, the beach seine fishers were mostly the Ga, the Adangbes and the Fantis. They explained that they had learned the method from earlier Ewe settlers who had migrated to their community years ago.

According to fishers interviewed during the field survey, the distribution of beach seines along the coast of Ghana has been influenced by the nature of the coastline and the distribution of rocky sea bottoms in the Gulf of Guinea. Using the town of Tema as a reference point, the fishers who were interviewed during the field survey explained that a rocky ridge on the sea bottom runs parallel to the coastline from Tema to Togo and that the sea bottom tilts at about 45 degrees to this rocky ridge. They further explained that the operational area for beach seines lies between the shore and the rocky bottom areas and widens as one moves eastwards along the Ghanaian coast.

While the area for operating beach seines is limited to 200 metres offshore at the town of Tema, it widens up to about 3 kilometres in Adina near the town of Aflao on Ghana's eastern border with Togo. To the west of Tema and beyond, rocks on the sea bottom are interspersed and occasionally found close to the shore, which is not suitable for beach seining as nets become caught in rocks and are damaged. In such circumstances, beach seine operators prefer to operate close to estuaries. As there are expansive areas suitable for beach seine operations in the Volta region, fishers from the Greater Accra Region, specifically Anyamamu, normally migrate to these areas to fish during the main fishing season from August to May.

Beach seines are operated from 154 landing sites along the entire Ghanaian coast with the help of 790 canoes. Table A1.10 shows that 40 percent of beach seine canoes and 50 percent of beach seine fishers are found in the Volta region where beach seining is the most important artisanal fishing method.

TABLE A1.10
Regional distribution of beach seine canoes and beach seine fishers in Ghana

Region	Volta	Greater Accra	Central	Western	Total
Number of beach seine canoes	317	155	174	144	790
Total number of canoes	472	2 526	3 488	2 155	8 641
Number of beach seine fishers	14 550	5 040	5 610	3 690	28 890
Number of beach seine landing sites	44	36	37	37	154
Total number of landing sites	**51**	**68**	**99**	**92**	**310**

Note: The information in this table reflects the statistical data available at the time of writing the case study.
Source: Marine Fisheries Research Division of the Department of Fisheries, Ghana.

Gear specifications, fishing practices and catch composition

During the field survey in Ghana, two types of beach seines were identified. Smaller beach seines are about 200 to 300 metres long and 2.5 to 3 metres deep. These seines are operated with a canoe of about 9 metres in length. A crew of 12 to 20 fishers is employed for the operation of the smaller beach seines. Larger beach seines are up to 600 metres long and 4 metres deep. They are operated with the help of 11-metre long canoes. A crew of 30 to 50 persons is used to operate the larger beach seines.

When hauling both smaller and larger beach seines, the crews are supported by a large group of helpers comprising the young, the elderly and fishers who are not regular crew members. The number of helpers actually depends on the people present at the beach at the time of hauling the net and the size of the net. The helpers are paid in kind or cash after daily sales.

The beach seine nets used in Ghana are rectangular in shape and composed of different sections. The net consists of two posterior wings of the same length and depth connected to the seine body, a codend and anterior wings or wing extensions, as well as headlines, foot ropes and hauling ropes. The twine used for the netting is made of nylon, i.e. polyamide (PA). Lines and ropes are made from nylon or polyethylene (PE) material. The mesh size gradually increases in size from the codend to the wings.

The two posterior wings are made of two or three sections of netting of different mesh sizes ranging from 25 mm to 37 mm depending on the target species. The codend of the net is the collection point for the fish and the mesh sizes in this section are generally smaller than those of the posterior and anterior wings. The mesh size in the codend ranges from 10 mm and 12.5 mm. The purpose of the wing extensions or anterior wings is to increase its catchment area. The mesh size in the anterior wings ranges from 37 mm to 50 mm and the thickness of the twine ranges from Rtex 230 (210/9) to Rtex 155 (210/6) depending on the target species and the area of operation.

Beach seines are operated from the shore. When a net is to be cast, it is stowed together with its attached hauling ropes in a dugout canoe by a crew. As the canoe is paddled out, the end of the rope attached to one anterior wing of the net is left ashore tied to any available object on the beach, preferably to a coconut tree. The canoe then goes out to sea to the full extent of the rope, which can be between 1 500 metres and 3 000 metres. The net is gradually released and set in the water.

The canoe then turns towards the shore with the other end of the rope. When the second rope is landed, large groups of men made up of crew members and helpers start hauling in the net by pulling in the ropes.

The net is slowly pulled ashore by crew and helpers, moving rhythmically backwards with short stilted steps accompanied by singing. The hauling of the net may take four or five hours or even longer with some intervals of rest. The two wings are brought closer and closer together to enclose the fish driving them towards the body and codend into the seine until the seine is finally ashore. Once the seine is onshore, the codend is then opened to discharge the fish.

Over the years, the basic design of beach seines in Ghana has not changed, but their overall length and size have increased while the mesh sizes have decreased. The size of boats used to operate beach seines has increased accordingly. Fishers explain that these changes were a result of the competition from trawlers targeting the same resources.

Beach seine fishing is generally carried out from August to May. Fishing stops during the rainy season in June and July because of seasonal bad weather and strong winds causing breaking waves on the beaches.

With the exception of 1996, fish catches of the artisanal fisheries sector have been declining annually since 1992, as shown in Table A1.11. The decline in catches is thought to be an indication of overfishing. Beach seines accounted for 11 percent of the total artisanal fish production between 1990 and 1997. While the annual fish landings

of artisanal fisheries in Ghana have been declining, the landings of beach seine fisheries have been increasing since 1994. The explanation of increasing beach seine catches is that more and more juvenile fishes are being caught and that existing mesh size regulations are not being followed.

TABLE A1.11
Fish production of artisanal canoes and beach seines in Ghana, 1990–1999

Year	Total catch of artisanal fisheries sector (tonnes)	Total catch of beach seines (tonnes)	Share of beach seine fishery (percent)
1990	242 000	28 458	12
1991	215 850	21 938	10
1992	307 930	36 520	12
1993	247 240	29 263	12
1994	211 750	11 048	5
1995	210 650	24 157	11
1996	226 080	30 407	13
1997	215 130	31 719	15
1998	189 458	No data available	No data available
1999	164 828	No data available	No data available

Source: Marine Fisheries Research Division of the Department of Fisheries, Ghana.

The catches of the main target species of beach seines in Ghana are shown in Table A1.12. The bulk of landings of beach seines consist of anchovies, juveniles of sardinellas, burrito, cassava fish and shrimps.

TABLE A1.12
Fish landings of beach seines in Ghana by species (in tonnes)

Year/species	1989	1990	1991	1992	1993	1994	1995	1996	1997
Sardinella (*Sardinella*)	4 288	4 975	2 566	8 705	10 844	1 720	6 725	9 457	4 881
Anchovy (*Engraulidae*)	5 857	7 869	5 965	11 801	7 834	3 191	4 611	10 111	15 777
Longfin herring (*Pellona*)	1 374	1 971	2 599	2 383	1 367	512	1 878	2 362	1 576
Cassava fish	342	503	433	483	224	141	257	239	573
Burrito	3 613	4 020	2 511	2 039	2 536	2 684	3 595	2 137	3 465
Bumper fish (*Carangidae*)	2 188	2 835	2 322	1 868	1 469	661	1 598	941	1 581
Moonfish (*Carangidae*)	1 459	1 033	771	721	765	233	683	705	559
Ribbon halfbeak (*Hemirhamphus*)	1 423	816	1 327	3 882	815	422	1 167	1 355	776
Shrimps	1 089	2 309	956	2 031	937	453	1 766	1 027	1 233
Others	2 226	2 127	2 488	2 607	2 472	1 031	1 877	2 073	1 298
Total	**23 859**	**28 458**	**21 938**	**36 520**	**29 263**	**11 048**	**24 157**	**30 407**	**31 719**

Source: Marine Fisheries Research Division of the Department of Fisheries, Ghana.

The seasonal availability of fish in the four communities studied during the field survey in Ghana is shown in Table A1.13. In these communities, the major fishing season commenced in August and peaked in November and December depending on the target species. With few exceptions, the catch throughout the fishing season was dominated by juvenile fishes.

TABLE A1.13
Seasonal availability of fish in communities in Ghana

Community	Season	Type of fish landed	Quantity of fish landed expressed as percentage of total catch	Estimated percentage of juveniles in catch
Adina	Main	Anchovies, juvenile sardinella, jack and frigate mackerels, *Carangidae* spp., shrimps	70	60–80
	Minor	Anchovies, juvenile sardinella, juveniles of mixed species (moonfish, long-finned herrings, shrimps, etc.)	20	80–100
	Lean/off season	Anchovies, juvenile sardinella, juveniles of mixed species (moonfish, long-finned herrings, shrimps, etc.)	10	80–100
Pute	Main	Anchovies, juvenile sardinella, jacks and frigate mackerels, *Carangidae* spp., shrimps	70	60–80
	Minor	Anchovies, juvenile sardinella, juveniles of mixed species (moonfish, long-finned herrings, shrimps, etc.)	20	80–100
	Lean/off season	Anchovies, juvenile sardinella, juveniles of mixed species (moonfish, long-finned herrings, shrimps, etc.)	10	80–100
Katech	Main	Shrimps, threadfin, cassava fish, barracuda, ribbonfish	85	5–10
	Minor	Juvenile sardinella, juveniles of mixed species (moonfish, long-finned herrings, shrimps, etc.)	10	70–80
	Lean/off season	Juvenile sardinella, juveniles of mixed species (moonfish, long-finned herrings, shrimps, etc.)	5	70–80
Amonakrom	Main	Shrimps, anchovies, ribbon fish, threadfin, long-finned herrings, cassava fish, barracuda	70	10–20
	Minor	Juvenile sardinella, juveniles of mixed species (moonfish, long-finned herrings, shrimps, etc.)	15	60–80
	Lean/off season	Juvenile sardinella, juveniles of mixed species (moonfish, long-finned herrings, shrimps, etc.)	15	60–80

Impact of beach seines on fishery resources and aquatic habitat

In recent years, beach seining in Ghana has come under intense criticism by resource managers, policy-makers and environmentalists because of its destructive effect on fisheries resources (Nunoo and Armah, 2007).

The gear is operated mainly around estuaries and in shallow coastal waters, which are the spawning and nursery grounds of most commercial pelagic and demersal species. Also because of the very small mesh sizes used, beach seining catches juveniles of most commercial species and thus reduces the spawning potential of most fish species, in particular, the small pelagic stocks shared by countries along the coast of the western Gulf of Guinea.

There have been calls for restrictions and in some cases for outright bans of beach seines (Fisheries Management Operations Committee, 2000). It has been pointed out that, while this action may be beneficial to restore and conserve the natural aquatic assets of beach seine communities, the country case study highlights that it would also increase the short-term vulnerability and poverty of communities that depend on beach seining for their livelihoods.

2. Social and demographic characteristics of fishers and their access to social services and infrastructure

Ownership, sharing of income, demographic characteristics

In Ghana, beach seining is carried out in the context of companies, which are formed for the duration of a fishing season. A company consists of the owner, who invests capital and supervises the business on a day-to-day basis; a manager and assistant manager, who manage the business on behalf of the owner; one or two company secretaries or clerks, depending on the size of the company, who keep records for the company; and members of the crew, who perform the actual fishing operations and also mend nets and perform other jobs. In cases where there are two secretaries, one keeps records on behalf of the owner, and the other on behalf of the crew. They reconcile both accounts before any sharing is done. All managerial input in the company is remunerated accordingly.

A company is usually disbanded after the fishing season, i.e. eight to ten months of operations. The income is shared after deductions have been made for expenses for repairs, food and drinks for the crew, remuneration of managers and secretaries, and an amount of Ghanaian cedi (GHC) 1 to 2 million has been set aside for the purchase of nets for the next season.

In Ghana, women play an important role in beach seining, as well as in the entire fisheries sector. They provide credit and are engaged in the processing, storing and marketing of fish. The processing activities consist mainly of smoking. The peak season for smoking of fish is between August and September and the main species smoked are sardines, anchovies and shrimps. The fish and shrimps are stored after smoking and sold in March and April.

Illiteracy is widespread among beach seiners in Ghana, as well as in the entire fishing community. During the field study, the level of illiteracy was estimated to range between 10 and 40 percent.

Occupational diversity of beach seine crews and households

Beach seining in Ghana represents the most important income-generating activity of those involved. Most of the beach seine fishers interviewed during the field survey in Ghana did not possess skills in other fishing methods. As far as vocational skills are concerned, some fishers possessed skills in crop cultivation, carpentry, masonry and driving. A few beach seine fishers had previously worked as public servants, teachers, accounts clerks and office staff.

Beach seine fishing was followed by farming as the most important secondary occupation. The main crops planted were maize, cassava and vegetables. They were planted after the land had been prepared in April and harvested in August and September. Women were involved in some areas in salt making as a tertiary occupation.

However, there were also other beach seine fishers in Ghana who did not seem to have secondary or supplementary economic activities and incomes, as suggested by Kraan (2009) who studied Anlo-Ewe beach seine fishers in Ghana in three fishing communities along the Ghanaian coast, in Woe (Volta Region), Akosua Village (Central Region) and Half Assini (Western Region). The Anlo-Ewe fishers had migrated to these places to continue beach seining. Among other things, the study concluded that Anlo-Ewe fishers had fewer alternative job opportunities owing to a lack of skills, funds and access to land, and to having another mindset. Farming, for instance, meant to them to involve a longer process than fishing and an occupation that does not have an immediate reward.

Economic status, poverty, food security and vulnerability

As in other countries in West Africa, poverty in various forms can be found in Ghanaian fishing villages and among fisherfolk involved in beach seining.

Beach seining is part of the traditional social welfare system in coastal areas of Ghana and as such crucial for the food security of vulnerable groups in coastal communities. This includes the physically and mentally handicapped, the elderly, and the poor and sick people to whom beach seine owners are obliged to give fish whenever they need it to meet their nutritional needs.

There are various threats to the livelihoods of beach seiners in Ghana that increase their vulnerability. In places close to urban areas, the land that had previously been used by beach seine fishers for growing crops has been taken over by housing and industrial developments. This has increased the vulnerability of fishers who have lost their secondary employment and source of food as a result of these changes.

Other threats to the livelihoods of beach seine fishers in Ghana identified by the country case study were coastal erosion, outbreak of diseases, sudden price hikes of fishing inputs, and increases in the number of industrial fishing vessels that targeted the same resources as beach seining. Because of coastal erosion, fishers had to move their houses to higher grounds and only maintained temporary shelters close to the sea.

Diseases such as cholera and conjunctivitis usually broke out during the main fishing season. The outbreaks were closely related to the unsanitary conditions prevailing in fishing communities, such as lack of toilets and solid waste disposal facilities, lack of safe drinking-water, and the lack of access to health services.

Strong fluctuations in the Ghanaian currency in the past caused by increases in global oil prices and by declines in prices of cacao and gold led to steep increases in the price of imported fishing inputs such as nets and outboard engines. Without any mechanisms in place to cushion the fishing industry, including the beach seiners against these fluctuations, fishers could not replace nets and engines, and fishing operations were disrupted on many occasions.

Another threat to the livelihoods of beach seine fishers was the ever-increasing number of industrial fishing vessels, mainly trawlers. These vessels operated close to the shore and heavily exploited the same fishery resources that were targeted by beach seines. There were also occasions where trawlers damaged beach seine fishing gear and caused collisions with artisanal crafts putting in peril the lives of beach seiners.

3. Marketing and processing arrangements, access to credit, and costs and earnings of beach seining

Fish caught by beach seines in Ghana was sold to fish processors on the beach, who smoked the fish before selling it. During the peak fishing season, when large quantities of fish were landed, fish was sold on credit. The processors smoked, stored and sold the processed product between March and June, which coincides with the lean fishing season when quantities were smaller and better prices can be had. There seemed to be a steady demand for fish in Ghana throughout the year and also juvenile fish landed during the lean season found buyers.

With regard to the financing of investments in fishing craft and gear used for beach seining, the study carried out in Ghana found that 30 percent of the beach seine fishery enterprises were inherited. Beach seine units in Ghana were registered as enterprises. They used profits and savings from their business operations to invest in canoes and nets. Generally, beach seine fishers and beach seine fishing enterprises did not have access to loans from banks while some other fishers had access to institutional finance. The reason was that many beach seine units did not use boats with outboard engines, which were usually financed by banks.

Fishers obtained financing from their fishing companies, which in turn accessed loans from fish processors, in most cases women. Fishers also borrowed money from moneylenders, who charged as much as between 100 and 200 percent of interest per year. Such interest rates were considered prohibitive by the authors of the case study.

The first global study by FAO on the economic performance of marine capture fisheries included beach seining with both motorized and non-motorized canoes in Ghana (FAO, 1999b: 11). The information, which was collected in 1996, shows that motorized canoes operating beach seines had an ROI of 16.5 percent and a NCF/TE ratio of 10.6 percent. Non-motorized canoes, because of the smaller initial investment cost, had an ROI of 48 percent and an NCF/TE ratio of 25.2 percent.

The country case study on Ghana provides information on incomes, expenditures and revenue to share ratios of beach seine enterprises in four villages surveyed in the context of the country case study. The information confirms the findings of the global FAO study and shows that beach seine enterprises in Ghana were quite profitable and generated substantial revenue for the crew and company.

Table A1.14 shows that the average annual income accruing to the companies ranged between GHC 40 and GHC 70 million. Incomes were lower in Katech because the 1999 season had been rather poor. In Amonakrom, where there was an abundance of shrimps, higher incomes were recorded. It was also mentioned during a meeting conducted during the study in Ghana that a company that was not present at the meeting had earned over GHC 100 million during the 1990 season.

TABLE A1.14
Average expenditure, income and revenues (in GHC) of beach seine fishing enterprises in Ghana, 1999

Community	Annual income	Annual expenditure	Revenue	Crew share/company share
Adina	50 million	10 million	40 million	2:1
Pute	No information	No information	18.5 million	2:1
Amonakrom	70 million	18 million	52 million	1:1
Katech	40 million	30 million*	10 million	1:1

* The high expenditure is due to the fact that during the course of the year a boat owner's net was stolen and he had to construct a new beach seine net.

4. Regulation and management of beach seining, conflicts with other users of fishery resources and shorelines

National legislation and regulations of beach seining[9]

Fisheries management in Ghana has been regulated over the years by a number of laws and regulations. These include the Fisheries Regulations LI 364 of 1964, the NRCD 87 of 1972, the Fisheries Amendment Regulation of 1977, the AFRCD 30 of 1979 (fisheries regulations) and the accompanying regulation, Fisheries Regulation 1979 LI 1235, the Fisheries Regulation 1984 (LI 1294), the PNDC Law 256 of 1991, and the Fisheries Act 625 of 2002.

Major sections in the laws relate to the building and importation of motorized fishing vessels, licensing of fishing craft, manning of motorized fishing vessels and MCS. The laws also address the prohibition of the use of explosives such as carbide and dynamite, gear restrictions and prohibition of the landing of juvenile fish.

The current legislation governing the fisheries sector, Fisheries Act 625 of 2002 provides:

- rules and regulations to control industrial, semi-industrial and artisanal fishing through registration and licensing;
- protection and promotion of artisanal and semi-industrial fisheries through extension services, technology transfer, exemptions, reserved areas for semi-industrial and artisanal fisheries, development of landing facilities, and cooperation among small-scale fish processors and marketers;
- establishment of fishing zones, closed seasons and fishing reserves;

[9] See www.fao.org/fi/oldsite/FCP/en/GHA/body.htm

- protection of juvenile lobsters and other crustaceans, juvenile fish and marine mammals;
- protection of water from pollution;
- proactive MCS and enforcement through a special unit to work in collaboration with the Ghana Navy, Air Force, Ministry of Defence, and Ministry of Justice for effective policing and prosecution of offenders;
- arrest, seizure, detention, fining, forfeitures and temporary bans for offending fishing vessels;
- promotion and licensing of aquaculture projects, ensuring that they conform to environmental laws and specified operational standards; and
- establishment of a fisheries development fund to help partially finance the execution of the fishery development and management strategy and enforce its rules and regulations.

Parliament had enacted the Fishers Regulation 2010 (LI 1968) to give effect to the Fisheries Act 2002 (Act 625). This act prescribes measures for conservation, management and development of fisheries and aquaculture in Ghana. The regulation had prescribed measures and penalties on licensing of semi-industrial and industrial vessels and the use of seine nets in inland water bodies. Other regulations address specifications for netting materials for set nets to be used in marine and inland waters, minimum mesh sizes for the various types of fishing gears, minimum landing size of commercially important fish species, markings on submerged set nets, and equipment to be carried by motorized and non-motorized fishing vessels for fishing trips. Prohibited fishing methods, transshipment of fish, incidental catches of juvenile fish, gravid lobsters and other crustaceans, pollution of fishery water bodies, aquaculture operations are also addressed. There is discussion about the Government's intention to ban beach seine fishing.

The amendment also intends to strengthen the Community-based Fisheries Management Committees (CBFMCs), which were introduced in 1997 during a World Bank-funded fisheries sector capacity-building project. Since their introduction, CBFMCs have been challenged with inadequate organizational capacity, poor human resource capability, inadequate financial resources, lack of workable documents to guide their inner workings and non-gazetting of their by-laws to give backing to their work within the community.

There are 200 CBFMCs for the co-management of marine fisheries in all the district assemblies along the marine coast. While all of these district assemblies have passed their CBFMCs by-laws, only 12 of the by-laws have so far been gazetted.

Twenty-two District Fisheries Management Committee (DFMCs) are being formed to coordinate and take oversight responsibility for all the CBFMCs in the districts. Efforts are being made to give recognition to the DFMCs as subcommittees of the District Assemblies so as to give them a legal standing and a legislative authority.

Fisheries administration and management

As far as fisheries management in the marine fisheries sector is concerned, there are separate management subsystems for small pelagics, large pelagics, demersals, shrimp and lobsters. The main elements of the management regime are limiting industrial vessels' fishing effort, especially the effort of trawlers and shrimpers, by limiting entry into the fishery through a licensing regime and prescribing the mesh sizes to be used in any particular fishery including beach seining in order to limit the exploitation of juvenile or immature fishes.

For the small pelagic fishery, of which beach seines are a part, management rules and regulations have been formulated with the intention of protecting juveniles of sardinella. These regulations are primarily intended to work through input limitation such as mesh size limits.

The demersal fisheries management plan confronts shrimpers and trawlers as the major culprits for stock depletion. The aim is to allow stocks to recover to a sustainable level where they could be harvested in perpetuity. In the short term, the plan foresees that the issuing of permits for the importation and replacement of trawlers and shrimpers is to be discontinued. A closed season is to be imposed on shrimp and trawl fisheries for three years, after which shrimp trawling will supposedly be banned for five to ten years if the three-year closed season does not result in the expected recovery of stocks.

No trawling activity by inshore vessels or industrial vessel would be permitted within the Inshore Exclusion Zone (IEZ), and the IEZ is to be amended from the 30-metre depth line to 12 nautical miles offshore. With regard to beach seining, the plan envisages eventually banning beach seining altogether and in the meantime vigorously enforcing existing mesh size regulations.

There are a few traditional management systems that tend to regulate access to marine fisheries in Ghana and thereby conserve fish stocks. These include a non-fishing day, which is observed each week and used to maintain gear and equipment, rest and for social activities, and a ban on fishing activities for periods up to two weeks prior to and during annual festivals.

Impact of proposed management measures

The case study on Ghana concludes that the proposed changes in fisheries management in Ghana, while helping to restore aquatic resources, will increase the vulnerability of the communities involved in beach seining to poverty and result in loss of employment, social instability, loss of State revenue and loss of national household food security.

There are an estimated 30 000 fishers, landing some 30 000 tonnes of fish and supporting some 60 000 ancillary workers in beach seining. If the ban were to be imposed, a large number of people would suddenly lose their principal livelihoods. This would pose a danger to the immediate communities of beach seine fishers and provoke some social instability.

SUMMARY OF FINDINGS: BENIN

This summary is based on the report prepared by Amélie Gbagnidi in 2001: Study of ecological and socio-economic impacts of the beach seine on the livelihoods of fishing communities in Benin.

1. Technological and operational features of beach seine fisheries and their impact on fishery resources and habitats

History and regional distribution of beach seining

Beach seining was introduced in Benin at the beginning of the last century by Ghanaian fishers. Over the years, it spread all along the coast and became an important economic activity for the coastal population of Benin in terms of employment generation and as an important source of protein. It is estimated that, in 2000, beach seining accounted for as much as 80 percent of the artisanal fisheries production of Benin and that thousands of fishers were employed in beach seining and associated activities such as fish marketing, processing and boat building. Along the 80-kilometre coastline of Benin and during the study period, there were 58 fishing camps where beach seines were used.

The 1970s witnessed the demise of beach seine fisheries on the east coast of Benin in the Department of Ouémé, largely owing to coastal erosion and submerged coconut trees, which obstructed the operation of beach seines. Beach seining remained popular though in the other two coastal departments, i.e. Atlantic and Mono, where it was mainly practised by fishers of Ghanaian ethnic origin as well as by Beninese belonging to the Popo, Feda and Fon ethnic groups.

Gear specifications, fishing practices and catch composition

Beach seines are set from a pirogue at about 2 kilometres from the coast and hauled from the beach by up to a hundred people. The nets are funnel shaped and have both floats and position marking buoys. They are set at a depth of 12 to 16 metres. While the peak beach seine fishing season is from October to January when anchovies migrate along the coast, the fishing season can last from September to May. The lean season is from June to August.

As in the other countries of the subregion, i.e. Ghana and Togo, in the 1970s, beach seines were made by the fishers themselves, and larger mesh sizes were used to avoid catching small fish. Over the years, however, handmade nets were replaced by machine-made ones and mesh sizes were reduced to less than 5 mm in the seine body, resulting in catches of juvenile fish in nursery and spawning grounds. This has reduced the stocks of adult fishes as well as the total biomass. At the same time, fishing effort has increased. Beach seine fishing is practised every day of the week except for a day locally called the fishers' rest day.

According to the beliefs of the fishers, the fishers' rest day is a sacred day of celebration for the deities who live in the sea. It is believed that these deities play a major role in the productivity of the sea and should therefore not be disturbed by fishing on this particular day. The fishers' rest day has different names in different regions. It is called *Zogbodo* on the Atlantic coast from Siafato to Djègbadji and is observed every nine days. The rest day is called *Gelatin* in the area from Dégouè to Ayiguinnou and is observed every five days. The day is also called *Gelatin* in the Mono region between Seko and Agoué and is observed every Wednesday.

Beach seines catch a diversity of fish species, both species of demersal fishes and crustaceans such as sea breams, snappers (*Sparidae, Bramidae*), pikes *(Esocidae)*, shrimps, as well as pelagic fishes such as sardines (*Clupeidae*), anchovies (*Engraulidae*), razor fishes, small caranx (*Carangidae*) and mackerels (*Scombridae*).

The catch of beach seines in Benin accounted for 80 percent of the total artisanal marine fisheries production in 1999. As shown in Table A1.15, the catch of beach seines

decreased by 18 percent between 1997 and 1999. Similarly, the catch per unit effort (CPUE) declined by 31 percent while the fishing effort increased over the same period by 18 percent. The total value of beach seine catches declined over the same period by 27 percent. The decline of the CPUE and the increase of fishing effort over the same period suggest that resources are being overfished.

TABLE A1.15
Catch of beach seines in Benin from 1997–1999

Year	1997	1998	1999
Production (tonnes)	6 245	5 423	5 117
Effort (days/pirogues)	12 995	12 951	15 368
CPUE (kg)	480	424	333
Value (XOF)	2 191 995 000	1 904 155 000	1 605 908 000

One of the main problems of beach seining in Benin is the degradation of the coastal environment. Coastal erosion has caused coconut trees to fall into the sea and obstruct the operation of beach seines, which become caught in the trees. The trees and shifting sandbars off the coast of Benin cause boats to collide with trees, strand on sandbars, and then capsize resulting in frequent loss of lives and injuries to crew.

Another obstacle is caused by the lack of infrastructure at landing sites. None of the fishing camps surveyed in Benin had any facilities at the landing site for sorting, storing or preserving fish except for the traditional fish drying and smoking huts and shelters.

Impact of beach seines on fishery resources and aquatic habitat

The case study carried out in Benin highlights that the depth zone where beach seines are set is considered the spawning and nursery ground for various fish species. No scientifically collected data and information are available for Benin regarding the sizes of different fish species caught by beach seines. The information regarding the maximum and minimum sizes of the principal species caught, shown in Table A1.16, is based on estimates provided by fishers who were interviewed during the field study. The information could not be verified and should be interpreted with caution.

TABLE A1.16
Estimated minimum and maximum length of principal fish species caught with beach seines in Benin, 2000

Fish species	Minimum length (cm)	Maximum length (cm)
Demersals		
Bars/croakers (*Sciaenidae*)	12–20	80–120
Brochets, pikes (*Esocidae*)	8–10	100–120
Lesser African threadfin/Petit capitaine (*Galeoides decadactylus*)	4–6	25 75
Rays (*Actinopterygii*)	25	–
Pelagics		
Sardines (*Clupeidae*)	3–5	20–25
Anchovies (*Engraulidae*)	2–3	7–8
Razor fishes (*Centriscidae*)	3–5	20–30
Small caranx (*Carangidae*)	3–5	20–30
Mackerels (*Scombridae*)	25–40	60–90

Fishers who provided the information in Table A1.16 suggested that about 80 percent of the catch of above species consisted of juveniles. They were aware of the fact that the catch of juveniles has a negative effect on the fish stocks and fishery resources available to them for exploitation.

2. Social and demographic characteristics of fishers and their access to social services and infrastructure

Ownership, remuneration, demographic characteristics

In Benin, beach seines are individually owned or owned by fishing companies. The proceeds from beach seine fishing are shared with the crew after operating expenses for food, drink, fuel and advances paid to skippers. The study in Benin identified four different remuneration scenarios that are used along the coast.

In the first scenario, practised by eight owners of beach seines, the proceeds are divided into three parts. One-third accrues to the owner of the boat and is further divided into three parts, i.e. one for the canoe and two for the engine. Two-thirds of the proceeds accrue to the crew, which includes the owner/s of the beach seine.

In the second scenario, practised by three owners, the income is divided into five parts. Two-fifths of the proceeds go to the owner of the canoe and three-fifths go to the crew, which includes the owner/s of the net.

In the third scenario, practised by three owners, three-fifths of the proceeds go to the owner of the boat and two-fifths go to the crew including the owner of the seine.

In the fourth scenario, practiced by four owners, the proceeds are divided into two equal parts, of which one goes to the owner of the boat and the other to the crew including the owner/s of the net.

In the case of a company, payments are made at the end of the fishing season, either at the end of April or at the end of June. In the case of other fishing units, income is shared after each sale or at the weekly day of rest.

Most women involved in post-harvest operations operate their enterprises as individuals and thus do not share income. However, 13 percent of women involved in post-harvest activities belong to two women's groups which process fish products, and others belong to another group called Akpédjé Aïdo beach. These groups divide the revenue from their sale transactions into three parts. One part goes into the treasury of the group to be used as working capital, and the other two parts are shared among the group members.

Women use four-fifths of their income for everyday household expenses and keep the remaining one-fifth to satisfy their personal needs. Men contribute mostly a few kilograms of fish for daily sustenance to their home. The bulk of their income in cash is used for the purchase of fishing equipment and maintenance of equipment. Beach seine fishers in Benin had an average age of 38 and had been involved in beach seining on average for 21 years. As far as educational achievements are concerned, most fishers had completed the fourth grade of elementary school.

Similarly, women involved in fish smoking had an average age of 39 years and their average working experience was 23 years. Illiteracy is prevalent among fish smokers in Benin. Only 16 percent of the fish smokers who were interviewed during the case study in Benin had gone to school for four to six years. The women engaged in drying of fish were older, i.e. 45 years on average, and had been engaged in their trade longer than the fish smokers, i.e. 30 years on average. Illiteracy was even more widespread among this group.

Women, who in their majority were spouses of fishers, took care of the catch once it had been landed on the beach. Almost all of the women living on the coast were engaged in fish smoking, fish drying and fish marketing. As far as supplementary economic activities are concerned, women were also involved in raising poultry, goats and pigs.

Occupational diversity of beach seine crews and households

While beach seining was found to be the principal economic activity and major source of income for those engaged in it, beach seine fishers in Benin were also found to be involved in a variety of other food and income-generating activities, both fisheries and non-fisheries related.

In addition to their involvement in beach seining, 55 percent of the owners of beach seines in Benin were also involved in fishing with bottom set gillnets and a few, i.e. 3 percent, owned purse seine nets. Likewise, 45 percent of fishers who did not own beach seines but worked as crew, owned and operated gillnets. Twenty-eight percent of the Beninese fishers interviewed were also involved in lagoon fishing with traps, cast nets and gillnets and collected oysters. A few fishers and fish traders were cultivating oysters.

Except for the fishers of Ghanaian origin, who did not own land and were exclusively involved in marine fishing, many Beninese fishing households owned land and practised agriculture. Two-thirds of the Beninese beach seine fishing household surveyed cultivated tubers such as cassava, and cereals such as maize, and also grew vegetables such as onions, tomatoes, chillies and carrots. Growing coconuts was an activity 36 percent of Beninese beach seine owners were involved in. Raising cattle was practised by 5 percent and pig husbandry by 25 percent of Beninese fishers. Women in two-thirds of all fishing households raised poultry and goats.

In addition to employment in fisheries and aquaculture, a small number of beach seine fishers in Benin and their household members also occasionally worked as carpenters, stone masons, hairdressers, outboard and car mechanics, in the construction sector, sand mining, brick-making, picking coconuts and in cabin rental.

In addition to their involvement in fisheries related activities and agriculture, women from fishing households also collected and sold sea gravel, made salt, peanut and coconut oil, shucked oysters, and prepared and sold food and snacks.

Economic status, poverty, food security and vulnerability

In Benin, as in other West African countries, poverty among fishing communities is complex and multifaceted (FAO, 2008b: 2). Fisherfolk have high levels of vulnerability, limited access to health, education and other public facilities and financial services, and illiteracy rates are high, particularly among women. Fishing villages are often in remote areas and many fishers are migrants and thus socially and politically excluded.

The main threats to the livelihoods of beach seine fishers in Benin that were identified by the country case study include the damage of fishing gear by trawlers operating close to shore, unavailability of fishing inputs and steep price increases for these inputs due to devaluation of the country's currency, regular outbreak of diseases, and lack of labour due to outmigration of fishers.

The frequent occurrence and spread of diseases is closely related to the unsanitary conditions prevailing in the fishing camps, such as the lack of toilet and solid waste disposal facilities and the lack of safe drinking-water.

3. Marketing and processing arrangements, access to credit, and costs and earnings of beach seining

The fish landed by beach seines in Benin is received and marketed by wives of crew members, wives of other fishers and, to a lesser extent, by women whose spouses are not fishers. While generally almost all women in the fishing industry both trade and process fish, their main business is fish processing in the form of smoking and drying fish.

In the Atlantic Department, 99 percent of women in the fishing industry who were interviewed were involved in both smoking and drying of fish. In Mono, all women were involved in both smoking and drying of fish. The methods used depended on species and seasons. During the peak fishing season, a smoker processed as much as 25 bowls of sardines *(Clupeidae)*, 20 bowls of razor fish *(Centriscidae)*, 30 bowls of anchovies *(Engraulidae)* and 18 bowls of caranx *(Carangidae)* per week, as well as

1 000 sea bass *(Serranidae),* snook and false capitaine. During the lean season when fish was scarce, processing was slow and only a few kilograms of fish were processed at a time.

Salting and drying was only used for bass, false capitaine and mackerel. During the peak season, a woman would dry weekly an average of 25 kg of bass, 17 kg of lesser African threadfin (*Galeoides decadactylus*) and 11 kg of mackerel (*Scombridae*) per week. During the lean season only 2 or 3 kg of the above species were dried.

As far as fish sales are concerned, during the peak beach seine fishing season, a fish trader sold a weekly average of 1 200 bar fishes, 1 000 mackerels, 2 800 sardines, as well as 30 bowls of anchovies and 25 bowls of razor fishes. During the lean season, these sales declined to 80 to 240 sardines and other small fishes and three to five bowls of razor fishes and mackerels.

4. Regulation and management of beach seining, conflicts with other users of fishery resources and shorelines

National legislation and regulations of beach seining

By the time the country case study in Benin was conducted, none of the ordinances that regulate or affect fisheries in Benin had specific provisions for beach seine fisheries. Benin has meanwhile introduced beach seine gear regulations to minimize capture of juveniles and damage to the benthic habitat. The regulations stipulate the minimum mesh sizes, minimum length of the seine body and maximum total length of beach seines.

The Code of Shipping (Ordinance No. 68-38/PR/MTPTPT of 18 June 1968, as amended by Ordinance No. 69-49/PR/MAE from 9 December 1969) defines the legal conditions in Benin for marine fisheries. It allows for zoning and closed seasons, prohibition of fishing gears, catch limits, regulation of the type of bait to be used, control measures and monitoring of fishing and prohibited activities, as well as measures of hygiene and sanitation for fishery and other products. The code has also provisions for related activities such as shipbuilding, fish trade and ice making.

Other regulations that specify certain conditions for fishing activities, particularly industrial fishing licences, include the Interministerial Decree No. 100/MTPTPT/MDR, 31 July 1968, establishing the conditions governing fishing in territorial waters; Ordinance No. 76-49 of 10 September 1976, establishing the National Fisheries Committee; Decree No. 76-92, 2 April 1976, on the extension of territorial waters to 200 nautical miles (exclusive economic zone – EEZ) and Decree No. 78-18 of 9 February 1978, on the establishment and functions of the Standing Technical Committee of the National Fisheries Committee.

Fisheries management in Benin is the responsibility of the Ministry of Rural Development,[10] which includes the Directorate of Fisheries. Its responsibilities include the implementation of policies and programmes for fisheries development; proposal and implementation of laws and regulations on fisheries and aquaculture; management of fisheries resources; inspection of fishery products and processing facilities and transportation of these products; and the coordination and management of fisheries development projects.

Through its office of enforcement and regulation, the Directorate of Fisheries popularizes laws and regulations related to fishing activities and monitors their application in collaboration with decentralized structures such as the Centres for Regional Action for Rural Development (CARDER). These centres exist in each

[10] Since the time of the study, the ministry responsible for fisheries has been changed to the Ministry of Agriculture, Breeding and Fishery.

region, including the two departments where beach seines operate. Rural development officials and fishery officers work closely with fishing community centres that provide local planning.

The Directorate of Fisheries works closely with the Benin Centre for Scientific Research and Technology (CBRST), which is responsible for coordinating research activities at national level. To accomplish its mandate, the CBRST has established several committees in specific areas of research. The National Centre for Oceanography promotes research in marine science and related services to increase knowledge about the nature of the maritime waters of Benin and resources. The National Union for Marine Fishers Artisans and Allied Workers of Benin is the leading professional association.

As far as traditional fisheries management mechanisms are concerned, a weekly fishing holiday is observed in beach seine fishing communities.

Conflicts and competition with other users of beaches and fishing grounds and perceptions of fishers

Fishers interviewed during the field study in Benin were aware of the negative impact of beach seines and other fishing gear on the resources and the lack of regulation and enforcement. They suggested that the government should prohibit the sale of small mesh netting in the market and regulate the mesh sizes of purse seines, trawl nets and beach seines to make these types of gear more selective and to monitor the implementation of such regulations.

Fishers also suggested that the government should make available more selective gear in the market and assist owners of beach seines to make or acquire netting materials for beach seines with reasonable mesh sizes.

Attention was drawn to conflicts between artisanal fishers and industrial fishing. The government was requested to issue appropriate zoning regulations for artisanal and industrial fisheries and to ensure that these regulations are followed.

SUMMARY OF FINDINGS: TOGO

This summary is based on the report prepared by Maxoe Sedzro in 2001: Study of ecological and socio-economic impacts of the beach seine on the livelihood of fishing communities in Togo.

1. Technological and operational features of beach seine fisheries and their impact on fishery resources and habitats

History and regional distribution of beach seining

In the marine waters, streams and lagoons in Togo, both industrial and artisanal fishing activities take place. In 2000, the marine fisheries sector produced about 12 000 tonnes of fish and accounted for about 70 percent of the total annual catch of Togo. Marine fishing is practised by fishers of various nationalities with the majority originating from Ghana. There are 22 fishing camps located along the Togolese coast. Beach seining is used in 13 of these fishing camps. Beach seining produces approximately 3 000 tonnes of fish per year and accounts for 25 percent of the marine catch. The vast majority, i.e. 88 percent of beach seine fishers, are from Togo.

According to the frame survey conducted in 2000 and part of the case study on Togo, there were 60 beach seine units in operation at the time of the survey. All beach seines were owned by individuals. The beach seine units were operated from 60 pirogues, of which 6 were motorized with outboard engines and 54 were non-motorized.

A total of 1 479 men were found to be involved in beach seining: 739 were classified as principal operators, setting and operating the fishing gear and craft, and 740 assisted in hauling the nets (Table A1.17). There were 401 women involved in associated activities such as fish marketing or processing.

Gear specifications, boats, fishing practices, and catch composition

The pirogues used for operating beach seines were made from wood and their length varied from 12 to 15 metres. Of the six motorized pirogues, four were powered by 40 hp outboard engines, two by 25 hp outboard engines, and one by an 8 hp outboard engine.

As shown in Table A1.18, the length of the beach seines operated in Togo varied between 200 and 1 000 metres. Most of the nets had a length between 200 and 600 metres. The stretched mesh size in the seine body of the net varied from 5 to 24 mm.

Fishing camps in Togo had no facilities for sorting, storing or preserving the catch using ice; with the exception of two camps, all camps were connected by all-weather roads.

Impact of beach seines on fishery resources and aquatic habitat

Beach seining is carried out along the coast within a distance of 2 km from the shore. The major species caught by beach seines in Togo are anchovy (*Engraulis encrasicolus*), sardinella (*Sardinella aurita*), herring (*Sardinella maderensis*), kingfishes, belts, bars, bigeye grunts (*Brachydeuterus auritus*) and razor fishes. Pelagic species migrate during the upwelling, which occurs from July to October. They are usually caught as juveniles in beach seines.

The case study reports that the beach seining fishing grounds of Togo are used by many pelagic and demersal species for spawning. Beach seining is considered to have a negative impact on the stocks of these species. Similar to the case of Benin, the inshore habitat, including nursery and spawning grounds, is further threatened by coastal erosion and there are indications of overfishing of fish stocks.

TABLE A1.17

Number of beach seines, pirogues, outboard engines, fishers, and women fish processors and traders by fishing camp in Togo, 2000

Fishing camp	Pirogues			No. of fishers owning beach seines	No. of beach seines	No. of outboard engines	No. of fishers			
	Motorized	Non-motorized	Total				No. of principal beach seine operators	No. of assisting beach seine operators	Total	Nationality
Ablogamé No. 1	-	13	13	13	13	-	12	200	212	Togolese/Ghanaian
Ablogamé No. 2	-	9	9	8	9	-	140	70	210	Togolese/Ghanaian
Adissem	-	4	4	4	4	-	62	50	112	Togolese/Ghanaian
Aveme	3	2	5	5	5	3	50	25	75	Togolese/Ghanaian
D'Asylveira Condji	-	1	1	1	1	-	14	10	24	Togolese
Dévikeme	-	8	8	8	8	-	90	50	140	Togolese
Djeke/Kpemé	1	2	3	3	3	1	25	60	85	Togolese/Ghanaian
Do Laté Condji	-	1	1	1	1	-	25	30	55	Togolese/Ghanaian
Fante Come	-	5	5	5	5	-	33	53	86	Togolese/Ghanaian
Kodjoviakopé	-	4	4	4	4	-	129	72	201	Togolese/Ghanaian
Kossi Agbavi	-	4	4	4	4	-	64	50	114	Togolese
N'lesi	2	-	2	2	2	4	45	60	105	Togolese/Ghanaian/Beninese
Payeme	-	1	1	1	1	-	50	10	60	Togolese
Total	**6**	**54**	**60**	**59**	**60**	**8**	**739**	**740**	**1 479**	

No. of women involved in marketing and processing beach seine catches			
Fish dryers	Fish smokers	Fish traders	Total
11	12	19	42
4	4	8	16
10	16	4	30
13	15	2	30
1	2	2	5
19	27	5	51
8	12	10	30
8	15	7	30
3	7	8	18
7	13	20	40
12	23	2	37
18	10	12	40
8	19	5	32
122	**175**	**104**	**401**

TABLE A1.18
Distribution and length of beach seines in Togo by fishing camp

Fishing camp	Length (in metres)				
	200–400	400–600	600–800	800–1 000	Total
Ablogame No.1	3	3	6	1	13
Ablogame No.2	3	6	-	-	9
Adissem	4	-	-	-	4
Aveme	-	5	-	-	5
D'Asylveira Condji	-	1	-	-	1
Devikeme	5	-	-	3	8
Djeke /kpeme	1	-	1	1	3
Do Late Condji	-	1	-	-	1
Fante come	3	2	-	-	5
Kodjoviakope	2	-	-	2	4
Kossi Agbavi	2	2	-	-	4
N'lesi	-	-	1	1	2
Payeme	-	-	1	-	1
Total no. of seines	**23**	**20**	**9**	**8**	**60**

2. Social and demographic characteristics of fishers and their access to social services and infrastructure

Ownership, sharing of income, demographic characteristics

At the time of the study, the majority of beach seines in Togo, i.e. 59, were owned by individuals. Five beach seines were owned by families with an average of 11 members per family and one seine was owned by a group of 21 fishers. In most cases, crew members were bonded by kinship ties and related to one another. Even though the patterns of how income was shared differed slightly from fishing camp to fishing camp, the general system was to first deduct operating expenses, such as expenses for fuel, expenses for divers who guide the net over obstacles, expenses for carriers of the net, cash advances for owners and fishers, food expenses, and then divide the remaining income into two halves. One half went to the owner of boat and net and the other half went to the crew.

In Togo, the average age of fishers involved in beach seining as crew members was 40 years, while the average age of beach seine owners was 58 years.

Women in beach seine fishing communities were of the same average age as fishers, i.e. 40. Altogether 401 women were involved in beach seine fisheries. Most of the women were engaged in fish processing, i.e. 175 in smoking of fish and 122 in fish drying, while 104 were involved in the marketing of fish.

The literacy level among beach seine fishers in Togo was low. Sixty-three percent of beach seine fishers were illiterate. Literacy was lower among crew members than among owners of beach seines.

Occupational diversity of beach seine crews and households

The majority of beach seine fishers in Togo, i.e. 90 percent, were full-time fishers while the remaining 10 percent were part-time fishers. Nineteen percent of fishers also operated other fishing gear. Supplementary food and income-generating activities involved crop production (15 percent of households) and raising livestock (5 percent). Nine percent of households were engaged in small trading activities.

Economic status, poverty, food security and vulnerability

Of the beach seine fishers surveyed in Togo, 21 percent owned fishing gear, 9 percent owned agricultural land and 6 percent owned a house. The remaining 44 percent of fishers, who did not own fishing gear, land or a home, were considered to be poor by Togolese standards.

The livelihoods of beach seine fishers in Togo were very vulnerable. Threats to the livelihoods were posed by coastal erosion and pollution of coastal waters, which hampered fishing effort and negatively affected the health of the aquatic environment and resources. Another threat, which increased the vulnerability of beach seine fishers, was the competition from other fishing methods and fishers using purse seines and driftnets close to the shore. This also involved conflicts with the users of these types of gear and theft of beach seine gear.

Diseases also posed a regular threat to the livelihoods of beach seine fishers and other coastal communities. The most common diseases were malaria, cholera, HIV/AIDS, as well as seasonal diseases such as acute respiratory infections.

3. Marketing and processing arrangements, access to credit, and costs and earnings of beach seining

In Togo, financing of beach seine fishing is usually arranged through fishmongers, processors or traders buying fish from their husbands (17 percent), parents (21 percent) and from fishers to whom they are not related (41 percent). Fishing vessels and gear for beach seining are usually acquired through inheritance (33 percent), self-financing (22 percent) or provided by the family or head of the household (22 percent). Other sources (23 percent) also included moneylenders.

Members of the artisanal fishing community, however, including the ones using beach seines, can principally obtain credit to finance their fishing activities from financial institutions. A requirement for obtaining credit is, however, that they open a savings account with a bank. In the case of the Savings Bank of Togo, for example, a fisher credit applicant must have a bank account with that institution with a deposit equivalent to the loan amount requested.

4. Regulation and management of beach seining, conflicts with other users of fishery resources and shorelines

National legislation and regulations of fisheries

By Decree No. 97-108/PR of 23 July 1997, the management of fisheries in Togo is vested with the Department of Agriculture, Livestock and Fisheries (APRM). As part of the APRM, the Directorate of Livestock and Fisheries (DEP) defines fisheries management measures, and follows their implementation, in collaboration with the Planning Directorate, the Institute of Technical Advice and Support (ICAT), and the Agronomic Research Institute of Togo.

The DEP has three divisions, including two which are closely involved in fisheries sector activities, i.e. the Division for the Promotion of Fisheries and Aquaculture and the Legal, Food Hygiene and Veterinary Public Health Division. Regional and Prefectural Directorates of Agriculture, Livestock and Fisheries are responsible for monitoring and control of fisheries and aquaculture activities at their respective levels.

The case study in Togo found that most beach seine fishers were neither familiar with fisheries regulations nor with the fisheries administration. Fishers expressed an interest in learning both fisheries regulations and administration and becoming involved in rule making and implementation.

SUMMARY OF FINDINGS: THE GAMBIA

This summary is based on the report prepared by Asberr N. Mendy in 2008: Impact of beach seines on the environment and the livelihoods of beach seine stakeholders and national food security in the Gambia.

1. Technological and operational features of beach seine fisheries and their impact on fishery resources and habitats

History and regional distribution of beach seining

In the Gambia, fisheries resources are exploited by artisanal and industrial fishing operators both for subsistence and economic gains. While these two fishing subsectors differ in their modes and areas of operations, they compete for the same species. Fisheries statistics in the Gambia distinguish between head fishers and assistant fishers. Between 1983 and 2006, the number of canoes and head fishers operating in the artisanal fisheries subsector had increased from 1 299 and 1 399, respectively, to 1 785 canoes and 1 969 head fishers.

In addition to the head fishers, the artisanal subsector provides direct employment to 4 694 assistant fishers. Of the head fishers, 57 percent are Gambians and 43 percent are foreigners. The head fishers alone provide for an important part of the livelihoods of 11 000 household members. The artisanal sector further supports ancillary workers such as boat builders, fish processors and fish exporters/traders including fish retailers.

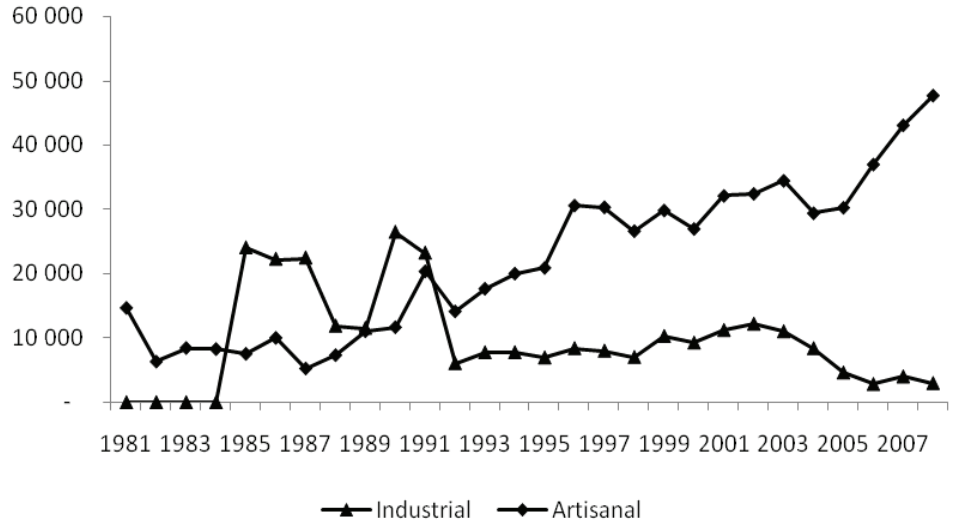
Altogether, 416 head fishers are involved in coastal fisheries, 249 are foreign nationals, mainly Senegalese, and 167 are Gambians. Inland fisheries are dominated by Gambians.

Industrial fisheries are relatively limited in the Gambia. All fishing vessels operating in Gambian waters are foreign owned. These vessels land most of their catches in foreign ports. It is estimated that less than 2 000 people are employed in the industrial fisheries subsector, the majority of whom are women working in fish processing establishments. According to government policy, 20 per cent of the crew of foreign fishing vessels licensed to operate in the exclusive economic zone (EEZ) of the Gambia must be Gambians. There are nine fish processing factories in the Gambia. Most of them operate only intermittently owing to insufficient supplies of raw materials, high energy costs and lack of working capital. As a result, the impact of their operations on the economy in terms of employment and foreign exchange earnings has been minimal.

Between 1981 and 2007, artisanal fisheries production in the Gambia had been fluctuating but with an upward tendency. The steep increases in 2006 and 2007 are explained by the fact that inland catches were included in the 2006 and 2007 figures (Figure A1.2). This was due to more data collectors being recruited to cover key primary sampling units in the Gambia River including the estuarine areas. The total production for 2006 and 2007 was estimated at nearly 37 000 tonnes and over 43 000 tonnes, respectively. While the apparent trend is an upward one, it should be noted that small pelagic, such as *Ethmalosa fimbriata* (bonga shad), constitute the bulk of the catches. The expansion of artisanal fisheries and the use of larger motorized canoes with more efficient fishing gears contributed to the upward trend in fisheries production. Landings of this subsector constituted over 60 percent of total landings in 2007.

The industrial catches had been fluctuating sharply between 1985 and 1993 when they gradually stabilized at around 8 000 metric tonnes for five years. Industrial catches increased again from 1999 to 2002 and declined thereafter. The decline can be attributed to the cessation of operations by the Ghanaian-Gambian joint venture fishing company Seagull Coldstore Ltd, which targeted small pelagic fish from the

FIGURE A1.2
Artisanal and industrial fisheries production in the Gambia (in tonnes, 1981–2008)



Source: Fisheries Statistics Unit.

late 1980s to the early 1990s. Other factors behind the decline of industrial catches are the reduction in the number of licensed fishing vessels and the time they spend in Gambian waters, as many of them also acquire licences for fishing in the waters of the neighbouring coastal states.

As in the other countries of the region, in the Gambia, beach seine fishing was first introduced by migrating Ghanaian fishers in the coastal settlements of Bijilo and Kololi around the middle of the last century. In 1989, beach seining was banned by an Act of Parliament. Until then, beach seine fishing had been a traditional economic activity in Bijilo and Kololi and to a limited extent in Brufut and Gunjur. Altogether five beach seine units were in operation prior to the ban.

Beach seining in Bijilo and Kololi was traditionally carried out by three families with the fishing practice and the fishing gear passed down from one generation to the next. In Brufut, one beach seine had been in use, while in Gunjur some Senegalese fishers operated another beach seine briefly. The ban on beach seine fishing has affected directly and indirectly over 100 fishers and others whose livelihoods depended on beach seining. Compared with other fishing methods though, beach seining in the Gambia was clearly of lesser importance than in the other countries of the subregion.

It was observed that the beach seines used before the ban had been modified over the years by adding more panels and using smaller mesh sizes. Fishers explained that since their catches have declined over the past two to three decades, they had to increase the length of the net and resorted to using smaller mesh sizes in order to catch similar quantities of fish as in the past.

The operation of beach seines requires the use of a motorized or non-motorized boat and a number of people for hauling the seine to the shore. The boats used for beach seining in the Gambia were 15 to 20 metres in length and employed 15 hp outboard engines. The engines were not used during the fishing operation itself but rather for carrying crew and fishing gear to the fishing ground. The net was set or cast mostly when a school of fish was sighted or a group of birds seen hovering over them. Occasionally, the net was also cast without observing these signs.

The end of the rope attached to one wing is left on the shore with a group of fishers. The boat then moves away from the shore in a large semi-circle letting out the rope and the wings and seine body. The boat then moves back to the shore paying out the second rope until the boat reaches the shore and passes the end of the rope to another group of

fishers on the shore. The beach seine group of fishers comprising of about 20 men are now divided into two groups of men, each group hauling the net and the entangled fish to shore. As the net is pulled in, the two groups gradually draw closer to each other. The surrounded fishes are caught in the seine body and hauled up onto the shore.

Scope and site of study, gear specifications, fishing practices and catch composition

The beach seine study carried out in the Gambia consisted of an experimental fishing operation of only eight days in October 2007 to determine the environmental and resource impact of beach seine fishing. At the time of the study, the fisheries department believed that some former beach seine units were still engaged in illegal beach seine fishing, especially at night. Because the use of beach seines in the Gambia was banned, a written consent was obtained from the ministry responsible for fisheries to allow one beach seine unit to operate during the study period.

The scope of the study was rather limited because of the very brief study period and the fact that no prior information existed about the bathymetry and bottom habitats in the study area, spawning seasons and areas, natural mortality rates of juveniles caught by beach seines, and mortality caused by other fishing methods and about other aspects.

The original decision to place a ban on the use of beach seines according to the authorities of the fisheries department of the Gambia was based on the premises that juvenile fishes formed a major part of beach seine catches because mesh sizes smaller than 25 mm were used and the fishing was carried out less than 100 metres from the shore. It was further believed that beach seines destroyed flora and fauna as the net was dragged over the seabed and thus damaged or altered natural habitats used by juvenile fish as refuge and feeding grounds.

Former beach seine operators who were interviewed during the study did not share these views. They thought that the ban on beach seines was not justifiable as there were other fishing types of gear and practices in use in the country which were much more destructive to the fisheries resources than beach seines. These former beach seine fishers cited the trawl net and the purse seine nets as fishing gears which capture juvenile fish in substantially greater quantities than beach seines. They also pointed out that large bottom trawlers dragging their heavy gear over the ocean floor and operating close to the shore caused more destruction to the seabed than beach seines. At worst, the beach seine was considered by former beach seine fishers as a fishing technique similar to purse seines. However, the latter was believed to have greater catching efficiency on account of the greater size of the net and small mesh sizes used and its greater range of fishing including fishing in deeper waters and use of mechanized gear handling devices.

The site where the study was carried out was close to the town of Bijilo. Bijilo lies in the Kombo North District, Western Region, south of Kololi, and includes a section of Atlantic coast beach with white sand. Prior to 1970s, Bijilo was a quiet village of the Kombos, densely carpeted with palm forests and its beaches almost deserted. The beaches were mainly occupied by fishers and sand miners. Bijilo witnessed a rapid growth in terms of new residential and commercial developments, which have sprung up along the coastal highway. The town is now dotted with a number of hotels, restaurants and bars along its shores.

The entire stretch of the beach from Brufut Heights to Kololi to the north of Bijilo is about 7 kilometres long. Beach seining was only done within a 3.5 kilometres stretch from north of Brufut Heights, between Bijilo and Kololi. South of this area up to Brufut Heights are discontinuous rocky spots where beach seines cannot be operated. Beach seining was thus concentrated between Bijilo to Kololi including Senegambia.

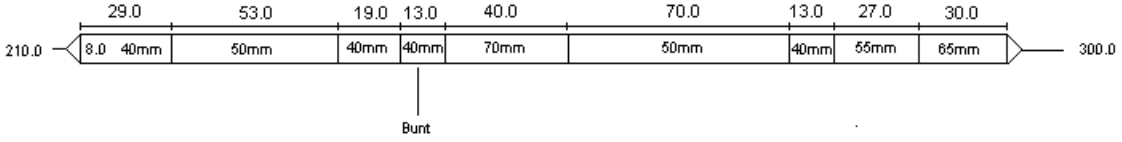
The estimated total fishing area available for beach seines was about 0.52 square kilometres.

The beach seine net that was assembled for the purpose of the study was not representative of the nets previously used. The smallest mesh size in the panels was 40 mm, while the normal practice before the ban was to use mesh sizes between 20 and 30 mm. The experimental beach seine used for the study was further operated without the codend, which had been used before. It could thus be expected that the experimental net would have a lesser impact on fishery resources and habitats than the original net.

Like other beach seines, the seine used during the study consisted of a seine body with two wings attached on either side with long ropes for hauling the net onto the beach. The net had a head rope with floats on the top and a foot rope with lead weights on the bottom. Wooden spreaders were attached at the end of wings to keep them vertically open. The head rope, also referred to as the floatline, keeps the top of the net vertically open while the foot rope with its lead weights keeps the bottom of the net in permanent contact with the bottom, thus creating a barrier to prevent the fish from escaping from the area enclosed by the net. Long ropes were attached to the wooden spreaders and used to haul the net onto the shore once it has been deployed.

The net was designed to have the seine body centrally located, its mesh size chosen to be the smallest and the twine size the thickest of all the panels of the net in order to retain as many fish as possible (Figure A1.3).

FIGURE A1.3
Drawing of the beach seine used for fishing trials in Bijilo, the Gambia



The beach seine net used for the study was made of polyethylene (PE) and nylon (PA) with mesh sizes from 40 to 70 mm. Beach seine nets in the Gambia are typically made by the fishers themselves by joining panels of prefabricated netting of different mesh sizes and attaching floats, lead weights, head, foot, hauling ropes and other accessories.

The fishing trials lasted for eight days. Because of the short study period, it was not possible to discern any seasonal variation in terms of catch composition and percentage of juvenile fishes caught. Fishing seasons are characterized by the type of species that form the bulk of the catch. Beach seine operators consider January to June as the lean season, and catches are poor and mainly of mixed species. The crevalle jack (*Caranx hippos*), or "Sacca" season, as commonly called by fishers, lasts from July to December. From interviews with fishers, it can be concluded that during this period a single beach seine haul can yield on average 500 kg of Sacca species of 2 to 3 kg individual weight.

Just before the most recent and strict enforcement of the ban in October 2006, landings of up to 900 kg of Sacca in one haul a day were not uncommon. It was noted that catches can also be very poor even at this time of the year. During the study period in October 2007, four hauls of beach seines on the first day yielded a total of 40 kg of mixed fish. A total catch of 1 321 kg of fish was landed by ten hauls of beach seines, an average of about 130 kg per haul. The catches though were unevenly distributed. There were two hauls with very good catches (mainly crevalle jack) of 202 kg and 1 060 kg, respectively. The rest of the hauls either had no catch or as little as 1 to 10 kg.

TABLE A1.19
Length composition of species caught in the Gambia fishing trials

Species	English name	Number of Samples	Length class in cm	Min. length – max. length
Polydactylus quadrifilis	Giant African threadfin	3	60–87	up to 200 cm
Scomberomorus tritor	West African Spanish mackerel	1	65	6–9 cm
Alectis alexandrinus	Alexandria pompano	9	31–48	up to 100 cm
Drepane Africana	African sicklefish	4	18–24	8.2–23.5 cm
Pseudotholitus sp.	Croakers	3	20–62	–
Caranx hippos	Crevalle jack	92	56–65	15–65 cm

Length measurements and other parameter analysis were limited owing to the fact that the available time was too short and only one beach seine was used for the whole operation because of the ban. The catch rate per haul was poor and resulted in an inadequate sample for length composition measurement and subsequent analysis. Length measurement was conducted on all catches of hauls 1, 3, 4 and 7. Table A1.19 indicates the species, length class and the maximum length the species could reach in the wild.

Sampling for weight, biological parameters and price was done for each haul. The amount of seaweed hauled with catches was recorded as an indicator of environmental damage. Despite the limited time allocated to fishing operations, the study concluded that beach seining had an impact on the resources and the environment. Considering the length distribution shown in Table A1.19, it seems that the conclusions of the study are not supported by the data because there is no clear indication that the fishes caught were immature or juveniles.

The case study also concluded that the fishing method has the potential to have a negative impact on fisheries resources and the environment especially when the mesh sizes are small or the footrope of the seine drags over the seabed.

Beach seines in Bijilo operate in non-rocky shallow water regimes. It was learned that, close to the shore at Bijilo beach, there are five discontinuous rocky spots. These spots were identified as, from south to north of the landing site: Sanementereng (between Brufut and Bijilo), No. 5, Johey Bundaw, Jatta Bereh and Kerr Sering Bereh. In between these rocky spots are coarse sandy areas where the beach seiners fish. Although it was difficult to ascertain the existence of permanent fauna in the area, seaweeds were hauled on many occasions.

The fishers claimed though that the seaweed was not scraped off the seabed but consisted of dead plants from afar that floated in the water, and that therefore beach seines were not damaging or modifying the habitat. These claims were refuted by fishers using other types of fishing gear as false and misleading and were intended to cover up the destruction beach seine fishers are causing to the natural sea habitat.

Neither of these claims could be confirmed by the study as the bathymetry of the area has not been studied or documented. Similarly, the fisheries authorities in the Gambia believed this area to be a nursery ground and refuge for spawning owing to its proximity to the mouth of the Gambia River and sheltered by Brufut Heights. However, further studies are necessary to confirm this.

2. Regulation and management of beach seining, conflicts with other users of fishery resources and shorelines

National legislation and regulations of beach seining

Fisheries in the Gambia are regulated by the Fisheries Act of 2007 and the Fisheries Regulations of 2008, which cover the artisanal, industrial and aquaculture subsectors.

The Secretary of State entrusted with the fisheries portfolio is responsible for the administration of the Fisheries Act of 2007. The Fisheries Department is the main government agency responsible for fisheries conservation, management and development.

The Fisheries Regulations of 2008 specify conservation measures, including area restrictions, gear restrictions and fish size limitations.

The beach seine was banned by an Act of Parliament in 1989 and inscribed in the revised Fisheries Regulations of 2008 under Part XI – Fisheries Conservation Measures. The case study in the Gambia did not find reasons for the ban in the literature. It is assumed that the decision for the ban is premised on the same reasons cited on why it is regarded as a destructive method, and this is not based on any scientific study.

Implementation of regulations, compliance and conflicts

According to the fishers interviewed during the brief field study in Gambia, the ban was actively enforced and by and large complied with up until the late 1990s, when two or three units resumed beach seining clandestinely, especially at night. There were no more than five active beach seine units in the Gambia prior to the institution of the ban in 1989.

Beach seine fishers stopped fishing openly in 2006 following a clash between beach seine operators of Bijilo and Senegambia Hotel staff. The contention was that fishers were accused of fouling and littering the beach used by tourists in addition to drawing large crowds to the beach seining area with potential risks to the tourists. The clash resulted in some operators being detained briefly for contravention of the law banning beach seining.

SUMMARY OF FINDINGS: KENYA

This summary is based on the report "Social, economic and environmental impacts of beach seining in Kenya" prepared by Davide Signa, Paul Mboya Tuda and Melita Samoilys in 2008; and on the report "Capacity building, awareness and consultation workshops and exchange visits for artisanal fisheries in Kenya" prepared by Melita Samoilys and Paul Mboya Tuda in 2009.

1. Technological and operational features of beach seine fisheries and their impact on fishery resources and habitats

Marine and artisanal fisheries

Kenya's marine fisheries consist of three distinct subsectors, i.e. artisanal small-scale fisheries operating in inshore areas, industrial and semi-industrial local fishing vessels, mainly prawn trawlers, operating in territorial waters within the 12 nautical miles from the shore, and 115 industrial foreign and 1 local fishing vessels supposedly operating in Kenya's EEZ waters beyond the 12 nautical mile zone (Samoilys *et al*., 2007).

The marine catch of Kenya was estimated at around 7 605 tonnes in 2006. It represents approximately 5 percent of the total fish catch in the country. Based on marine fish prices in 2007 (about Kenyan shilling [KES] 180 per kg), the value of the annual marine catch was estimated by the case study to be around USD 13 689 million.[11] More recent preliminary data of the Kenya Department of Fisheries suggest that the catch had increased to 8 200 tonnes by 2008.

Artisanal fishers operate from approximately 115 registered beach landing sites, but only 12 of these have any structures or facilities (Karuga and Abila, 2007). The distribution of fishing effort is reflected by the distribution of landing sites, with 31 percent of all the landing sites being in Kwale District in the South Coast, followed by Mombasa (21 percent), Lamu (20 percent), Kilifi (13 percent), Malindi (11 percent) and Tana River (4 percent). Comparing the 2006 with the 2004 marine waters frame survey (Kenya Department of Fisheries 2004, 2006a, 2006b), an increase of 12 percent in the number of fishers can be observed.

At the time of the study in 2007, there were 10 154 registered artisanal fishers operating 2 368 artisanal fishing vessels of various types, mainly dugout canoes and sailboats, of which less than 10 percent were motorized. Most of these boats were operated individually and their catch was sold individually, too. Kenya's artisanal marine fishery includes a wide range of fishing gears (Glaesel, 1997).

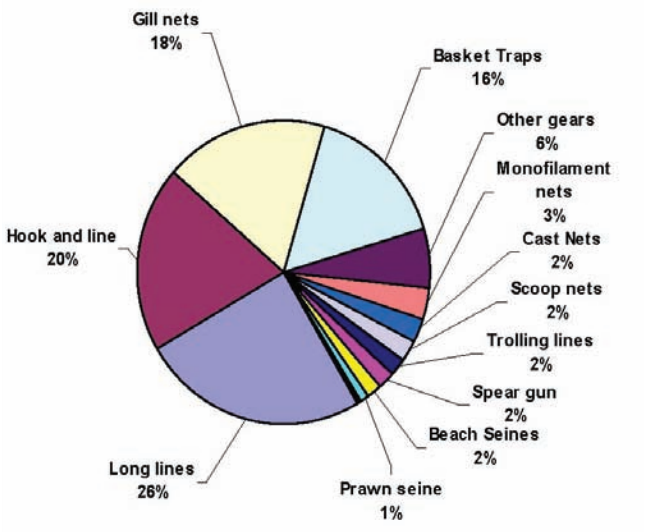
The 2006 marine waters frame survey of the Kenya Department of Fisheries showed that longlines accounted for 26 percent of all fishing gear, followed by hook and line (20 percent), gillnets (18 percent) and basket traps (16 percent). Beach seines only accounted for 2 percent. Of equal lesser importance were cast nets, scoop nets, trolling lines, spear guns and prawn seines (Figure A1.4).

The authors of the case study, however, suggest that as far as the use of beach seines is concerned, these figures probably reflect misreporting because beach seines have been illegal in Kenya since 2001 and few fishers will admit to using beach seines. Just two years earlier, i.e. in the 2004 frame survey, the Kenya Department of Fisheries had still found a total of 294 beach seines in operation throughout the 110 landing sites in the six districts along the coast.

Most artisanal fishing activities take place between September and April when the calmer northeasterly winds, locally called "kaskazi", blow. During the rest of the year, the stronger southeasterly winds, locally called "kusi", prevail. Because of the lack of statistics, reliable information of the catch composition of the artisanal fisheries is not available.

[11] Exchange rate of 9.11.2009; KES 1 = USD 0.01.

FIGURE A1.4
Fishing gears used in artisanal fisheries in coastal Kenya



Lake Victoria fisheries

Lake Victoria is the second largest freshwater body in the world, with a surface area of 68 800 square kilometres. Six percent of the lake surface, i.e. 4 128 square kilometres, fall within the sovereignty of Kenya. According to a 2006 frame survey, Kenya has 316 beaches on Lake Victoria, located in seven administrative districts, namely Bondo, Busia, Homa Bay, Kisumu, Migori, Nyando Rachuomyo and Suba.

The fishery yield from Lake Victoria, including Tanzanian and Ugandan waters, is estimated to be between 700 000 and 800 000 tonnes and valued at USD 350 million to 400 million. The Lake Victoria fishery provides raw material for about 30 processing establishments with a combined capacity to process about 1 800 tonnes of fish per day. The Nile perch *(Lates niloticus)* fishery which dominates the industry uses gillnets, beach seines and longlines. The economic value of this fishery is reflected in the management, regulation and research efforts and attention the lake has received from the Government of Kenya, the United Republic of Tanzania, Uganda and the Lake Victoria Fisheries Organization. The Kenyan marine coastal fisheries have received less attention.

History and regional distribution of beach seining

Coast

Despite the ban in 2001, beach seining is still in use in several landing sites along the Kenyan coast and it remains one of the primary types of gear in coastal Kenya. Historically, the beach seine fishery is believed to have originated from Pemba Island in the United Republic of Tanzania, where local fishers are referred to as "Wapemba". The Wapemba introduced the beach seine to Kenya in the 1960s following their first settlement at the Mvuleni landing site on the southern coast of Kenya. The Wapemba fishers intermarried with local women, purchased land and eventually became part of local Kenyan communities. Over time more Wapemba have moved from the United Republic of Tanzania to the Kenyan coast due to the decline of fishery resources in the United Republic of Tanzania.

In the late 1990s, however, local fishers complained about the deteriorating fish stocks in Kenyan coastal waters and blamed the Wapemba fishers and the operation of beach seines for the deterioration of fishery resources. This led to confrontations with

Wapemba fishers, which forced most of the beach seine crews to move to less hostile areas further north towards Mtwapa, Mayungu Bofa and the Bajun Archipelago in Lamu District.

At the origin of this conflict was the fact that the beach seining fishing activities of the newcomers disregarded traditional norms that guided fishing activities among the local dominant ethnic groups, particularly the Digo. Among these norms were prohibitions regarding fishing in areas where traditional sacrifices were made, called *msimus,* and restrictions on fishing on days when sacrifices were offered.

There had also been prohibitions on the use of poison for fishing, and prohibitions on overharvesting and the catching of young and juvenile fish. These norms had traditionally contributed to the conservation of fish stocks and the sustainability of fishery-based livelihoods. Over time, these beliefs have weakened among Kenyan fishers and most of these practices are not any longer respected or honoured by fisherfolk as many are seen as a restriction on how much fish can be harvested for a living.

Nowadays, beach seine fishers are highly migratory. At sites where a variety of types of gear are operated, beach seining is carried out during the lean fishing seasons when the local fishers cannot venture out to fish with other gears due to rough sea conditions. At protected locations and sites, where other fishing gear is not available or operated, beach seines are operated throughout the year. Locally, the beach seine is referred to as *juya* on the northern coast and *nyavu ya buruta*, *kukokota* or *nyavu kigumi* on the southern coast. *Kimia* refers to the fine meshed seine body of the net.

Lake Victoria

Until the mid-1970s, the fisheries of Lake Victoria were exploited solely by small-scale fishers. Few fishers possessed more than one canoe, and normally the boat was operated by the owner and relatives and other men from the community. Processing and trading was dominated by small-scale operators, most of them women from local communities.

The Government collected statistics and formulated regulations, which were rarely enforced. There was in principle an open access to fishing grounds but in practice local rules were developed and followed by lakeside communities. The rules stipulated who may fish during which season, what type of gear to use and the size of fish to be caught.

Total landings of fish from Lake Victoria were about 100 000 tonnes per year. There was a great variety of fish species in the lake. During the period 1980–1985, fishing for Nile perch developed rapidly. The fish had been introduced in the lake in the 1950s and, being a predator, fed on most of the species in the lake. By 1980, the composition of fish caught in the lake and the fishery had changed drastically from a multispecies fishery to a "three species fishery", where the Nile perch was the dominant species followed by small freshwater sardines (*Rastrineobola argentea*), locally called *dagaa*, and other fish, mainly Nile tilapia (*Oreochromis niloticus*), another introduced species that had replaced many of the indigenous tilapia.

Fish was sold in local markets that initially had problems to absorb the increasing catches of Nile perch. Initially, many people living around the lake did not like Nile perch, which was perceived as an oily and fat fish. After a few years, however, the fish became more popular and spread to new markets all over East Africa. During these years, the Nile perch became a popular fish with an affordable price in wide areas around the lake and many new jobs were created for fishers, processors and traders. It is estimated that an additional 180 000 jobs were created through the Nile perch fishery in the 1980s.

From 1985 onwards, fish processing factories that exported Nile perch fillets to international markets began to appear. As a result, an increasing part of the Nile perch

catch was withdrawn from the local and regional markets. This had two effects: the amount of fish available for local consumption started to decrease and employment in the processing and trading sector started to disappear. Traditional processing methods such as smoking and salting disappeared to a large degree save for the most remote places. The new developments drastically reduced employment.

Following the banning of beach seining in Kenya in 2001, the number of beach seines operated in the Kenyan waters of Lake Victoria rapidly declined. Before the ban, about 5 800 beach seines operated in Kenyan waters of Lake Victoria, but the number declined to 553 by 2006 according to the biannual frame survey of the Department of Fisheries. The highest numbers of beach seines are still found in Suba (51 percent), followed by Bondo (29 percent), Busia (6 percent), Rachuonyo (5 percent), Migori (3 percent), Nyando (2 percent), and Homa Bay with less than 1 percent of the total number of beach seines.

Scope and site of study

Coast

The coastal survey of the beach seine fishery in Kenya was conducted at four landing sites of the Coast Province of Kenya, i.e. Gazi, Nyali, Marina and Reef. Gazi is located about 20 kilometres south of Mombasa in Kwale. It has the highest number of beach seine fishers according to the 2003–2006 fishers census conducted by the Coastal Oceans Research and Development in the Indian Ocean (CORDIO). The fishing community largely consists of Wapemba fishers. In this area, spear guns and beach seines were widely used before the ban. Gazi presents a good example of the beach seine fishery and the challenges of enforcement because it is the most common and preferred gear in that area.

Fishing is by far the primary livelihood for the Gazi community followed by small-scale farming, in few cases, as complementary activities during the lean fishing and the rainy season. Fishing mainly takes place inside the reef and has increased the pressure on already overexploited lagoon resources. Several monitoring projects are in progress with strong support from the community and by and large the fishers. Efforts by the Department of Fisheries to enforce the beach seine ban in this area have not been successful. The area is also characterized by an influx of commercial fishers from areas such as Shimoni, Vanga and Pemba during the peak fishing season.

The Nyali, Reef and Marina landing sites are neighbouring sites within the Mombasa Marine Park and Reserve. About 250 fishers operate from these landing sites. Originally, the landing sites formed part of the Bamburi beach before the establishment of the Marine Park in 1986. However, most of the fishers were evicted owing to the enactment of strict measures restricting fishing in the park and permitting only traditional fishing gear in the reserve. The beach seine is, however, the primary fishing gear in these neighbouring sites and fishing takes place in the reserve despite the restriction and frequent monitoring of illegal fishing gears by the Kenya Wildlife Service. The fishing community is composed of both the locals and the Wapemba fishers, who own the majority of the beach seines.

The Marina landing site lies in Mtwapa creek at the boundary of Mombasa and Kilifi Districts. The majority of the fishers at the landing site are drawn from the Giriama, one of the subtribes of the Mijikenda community.

Lake Victoria

The survey on Lake Victoria was carried out in Suba District, which was carved out of the greater South Nyanza District in 1995. It neighbours Bondo District to the north, Homa Bay to the east, Migori to the south and Bugiri District of Uganda to the west, and has a shore line of about 222 kilometres and an area of 1 788 square kilometres, of which 737 square kilometres are covered by the waters of Lake Victoria.

There are 16 islands in Suba District. Out of these, only Mfangano, Rusinga, Remba, Ringiti, Takawiri, Kibwogi, Ngodhe, Kiwa and Sukru islands are inhabited. The islands provide rich fishing grounds. Suba has a total of 108 fish landing sites, both on the mainland and on the islands. About 15 585 fishers operate from the landing sites. A further 186 336 people depend on fishing and fishery-related activities for their livelihood in Suba District.

Gear specifications, fishing practices and catch composition

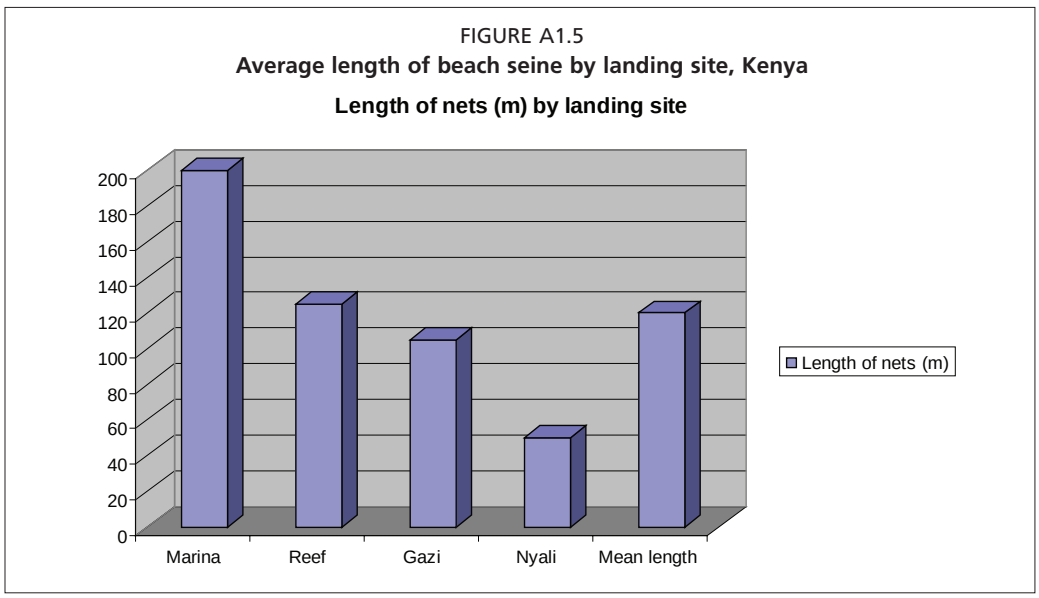
Coast

The size of the beach seines used on the coast depends on the number of net panels joined, depth of operation, number of fishers involved and their number and availability to pull the seine. The majority of the surveyed beach seines had lengths varying from 50 to 200 metres and depths of 2 to 10 metres. The average length of a beach seine was approximately 120 metres. The seines consisted of two to eight pieces. The anterior wings had mesh sizes ranging from 25 to 40 mm and the posterior wings had mesh sizes ranging from 18–27 mm. The codend had a mesh size of 10 mm. The body portion of the nets ranged from 10 to 20 metres in length with a depth of 6 metres. The nets targeting sardine, locally called *simusimu,* and Indian mackerel had very small mesh sizes of 1 mm and used mosquito nets in the codend. There were also beach seines without codends with mesh sizes ranging from 1.5 cm to 2 cm consisting of two pieces of nets.

The Nyali landing site had nets without codend but a longer head rope with lengths from 100 to 400 metres. Some fishers observed the net underwater and guided it over corals and other obstacles. Beach seines with codend and a shorter head rope were locally called *Kigumi,* while nets without a seine body but a longer head rope were called *Cha cha cha*.

The average length of beach seines by landing site is shown in Figure A1.5.

FIGURE A1.5
Average length of beach seine by landing site, Kenya



As far as the catch of beach seines is concerned, parrotfish (*Scaridae*) and rabbitfish (*Siganidae*), both families largely herbivorous, represented more than half of the landings and at times made up the entire catch of the day. These were followed by emperor (*Lethrinus*) and barracuda (*Sphyraena*). Seasonally, the catch was composed solely of sardines (*Spratelloides*) and Indian mackerel (*Rastrelliger kanagurta*) targeted by specially modified nets. This period was commonly associated with an influx of other fishers and a general shift to the beach seine fishery.

A list of all species that were sampled as part of the Kenya case study is shown in Table A1.20.

TABLE A1.20
Commonly landed fish by beach seines in Kenya

Common name	Genus/scientific name	Family name
Surgeonfish	*Acanthurus blochii*	Acanthuridae
Surgeonfish	*Acanthurus triostegus*	Acanthuridae
Unicornfish	*Naso* sp.	Acanthuridae
Triggerfish	*Odonus niger*	Balistidae
Needlefish	*Strongylura incisa*	Belonidae
Trevally	*Carangoides orthogrammus*	Carangidae
Trevally	*Scomberomorus commersoni*	Carangidae
Sprat/sardine	*Spratelloides* sp.	Clupeidae
Halfbeak	*Hemiramphus far*	Hemiramphidae
Emperor	*Lethrinus variegatus*	Lethrinidae
Emperor	*Lethrinus* spp.	Lethrinidae
Squid	*Loligo* spp.	Loliginidae
Snapper	*Lutjanus monostigma*	Lutjanidae
Flathead	*Platycephalus indicus*	Platycephalidae
Parrotfish	*Calotomus spinidens*	Scaridae
Tuna/mackerel (kingfish)	*Scomberomorus commersoni*	Scombridae
Mackerel	*Rastrelliger kanagurta*	Scombridae
Lionfish	*Pterois miles*	Scorpaenidae
Rabbitfish	*Siganus sutor*	Siganidae
Barracuda	*Sphyraena acutipinnis*	Sphyraenidae
Cutlass fish	*Trichiurus lepturus*	Trichiuridae
Stingray	*Himantura uarnak*	Dasyatidae
Sea urchins	*Diadema* spp.	Diadematidae
Eel catfish	*Plotosus lineatus*	Plotosidae

With regard to discards, the study in Kenya observed that fish caught by beach seines was rarely discarded. There were fish species which were of lower or no market demand. The fish that could not be sold were usually taken home by fishers and used for their own home consumption. These species thus contributed to the food security of fishers and their households. Species that were not sold but used for home consumption included dorado *(Coryhaena hippurus)*, also known as Mahi Mahi, which was thought to be very bony and time consuming to prepare and eat; surgeonfish (*Acanthurus blochii*), which was considered to have a strong smell when cooked; halfbeaks (*Hemiramphus far*), which had a low market value; masked triggerfish (*Sufflamen fraenatus*) with a tough outer skin; and a large collection of juvenile fish of varied species collectively locally referred to as *bobwe.*

The catch recorded per crew ranged from a minimum of 13 kilograms to a maximum of 400 kilograms of fish with a mean catch of 74 kilograms. The maximum catch occurred at least six times in a month, while the minimum catch occurred seven times in a month. For most of the month, catches fluctuated depending on the season and the landing sites. Figures A1.6 and A1.7 show the average as well as the maximum and minimum daily catches at the four landing sites studied.

Lake Victoria

Suba District produces about 60 percent of the fish that is landed on the Kenyan side of Lake Victoria. The current production is conservatively estimated at 56 000 tonnes. The main fish species that are landed are Nile perch, silve cyprinids (*Rastrineobola argentae*), tilapia, African lungfish (*Protopterus*), *Momyrus,* grasscutter catfish/African butterfish (*Schilbe*) and cichlids (*Haplochromis*).

FIGURE A1.6
Average daily catch of beach seines by landing site, Kenya

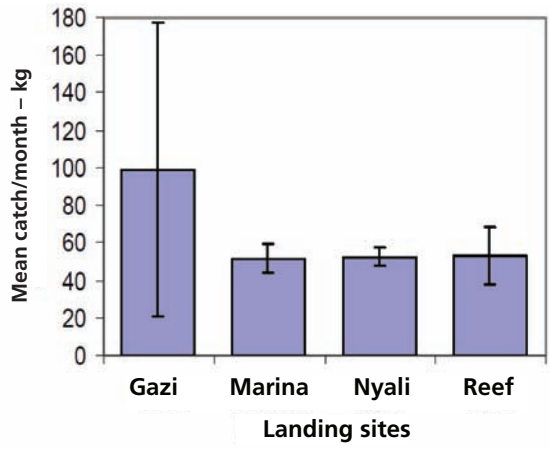
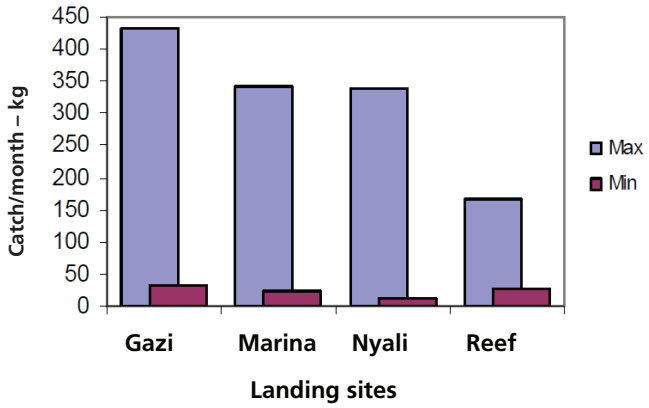


FIGURE A1.7
Maximum and minimum daily catch of beach seines by landing site, Kenya



There are 15 585 fishers in Suba District, who operate from 4 910 boats consisting of dugout canoes as well as smaller vessels, locally called *sese* and *jwenge* vessels. The majority of these vessels are propelled by either oars or sails. Only a small fraction of canoes are motorized, mostly with 15 hp engines. Among the nets used, beach seines are most common followed by gillnets, longlines, and hook and line.

The beach seines operated from Kaswanga and Utajo beaches varied from 300 to 600 metres in length and consisted of three to four net panels. Most of the nets had mesh sizes varying from 20 mm in the seine body to 50 mm in the wings. It was observed that, over time, many fishers had increased the lengths of nets by joining more net panels and, with the purpose of increasing the catch efficiency of the nets, had started to use mesh sizes smaller than the traditional 20 mm in the seine body. Crew sizes had also increased. Nile perch dominated the beach seine landings contributing 75 percent of the total catch.

Impact of beach seining on habitats and resources

Coast

Recent research projects carried out in limited areas along the Kenyan coast argue that Kenyan marine fisheries are exploited well beyond the maximum sustainable yield of most species and that many of the fished ecosystems are heavily degraded in terms of

biodiversity and ecological functions (McClanahan, 2007). The degradation of habitats is attributed to an increase in human population, destructive fishing methods and other human activities that damage important fish habitats, including coral and mangroves and fishing mortality of juveniles. The fishing methods that have been criticized as being destructive and indiscriminate include beach seining, trawling and the use of dynamite.

Mangi and Roberts (2006) and Mangi (2006) studied the environmental impacts of artisanal fishing gear on coral reef ecosystems in the multigear fishery of southern Kenya to evaluate which types of gear have the greatest impact on coral reef biodiversity. The gear types studied were large and small traps, gillnets, beach seines, handlines and spear guns. The levels of coral damage, proportion of juvenile fishes and discards, size and maturity stage at first capture were quantified and compared among the gear types. According to the authors, the results indicate that fishers using beach seines, spears and gillnets cause the most direct physical damage to corals.

At a beach seine stakeholder consultation, feedback and awareness-raising workshop held by the CORDIO as a follow-up to the country case study in 2009, coastal fishers did not agree with some of the findings of these studies with the argument that they do not use nets over coral reefs as this would destroy the net.

According to the studies carried out by Mangi and Roberts, 6.5 percent of the daily beach seine catch is discarded into the sea as the fish is too small to sell. The same studies found that beach seine fishers also landed the highest percentage of juvenile fish. The size and maturity stage at first capture for 150 of 195 species caught by all gear types was well below the length at which they mature. Across all gear types, 23 to 50 percent of the catch consisted of juvenile fish. On a per gear basis, beach seines were found to have the most negative impact on coral reef biodiversity.

Lake Victoria

Beach seining in Lake Victoria employs an encirclement technique where small boats lay out the nets across a bay or suitable catchment area and the nets are then hauled up onto the beach. As beach seining is done in the littoral waters where fish breed, spawn and shelter, the authors of the case study maintain that it has a negative impact on both habitats and resources.

As far as bycatch is concerned, at the Kaswanga and Utajo landing sites, Nile perch was the target species and tilapia, walking catfish (*Clarias*) and cichlids were considered as bycatch by beach seine crew. All bycatch, however, was utilized and sold for local consumption to local women traders. It was not observed during the study that fish had been discarded.

2. Social and demographic characteristics of fishers and their access to social services and infrastructure

Ownership, sharing of income, demographic characteristics

On the Kenyan coast, the beach seine units and vessels used for beach seining were usually owned by Tanzanians from the island of Pemba, while the crews were usually nationals of Kenya. According to the case study, 20 percent of the sale proceeds from beach seining went to the owner of boat and nets while 80 percent was shared among the crew.

The majority of beach seine fishers on Kenya's coast were middle-aged and belonged to the age group between 30 and 50 years. As far as gender is concerned, the case study on Kenya highlights that women are involved in the hauling of seines as well as in the sorting of the catch. While medium- and larger-scale fresh fish trade is usually dominated by men, women are commonly engaged in buying small fishes from beach seine catches and frying and selling them in villages.

On Lake Victoria, the majority of the beach seine crew members were in the age bracket of 30 to 49 years. The crew was largely selected based on experience in beach seine fishery, strength and age rather than because of kinship ties.

In most cases, the net was owned by the operator in partnership with his family. In other cases, the vessel was co-owned by skipper and crew. In some cases, the seines were owned by a so-called investor, who did not participate in the fishing operation. Investors also owned the outboard engines because of their relatively high cost.

Occupational diversity of beach seine crews and households

With few exceptions, communities along the coastline mainly depended on the marine and coastal environment and its associated resources for their livelihoods. The six coastal districts facing the Indian Ocean exhibited more or less homogeneous agroclimatic conditions and similar livelihood systems. The main fishing methods as well as the seasonal patterns of small-scale fisheries were similar along the coast.

Fisheries constituted the main livelihood for coastal people followed by mixed farming, forestry and tourism. Marine artisanal fisheries were the main source of employment in fishing communities, directly and indirectly employing approximately 20 000 people and providing monetary incomes to about 70 percent of the coastal population. Sport fishing had become an increasingly popular activity in the area with tourists and residents as main clients. The catch from sport fishing was difficult to quantify and evaluate as it was consumed locally or sold directly to hotels.

Complementary and alternative livelihood options included mangrove cutting, agriculture, tourism, conservation activities, sand excavation, raising livestock and, on a limited scale, seaweed farming and other mariculture.

While livelihood diversification in coastal communities was still low, several promising initiatives by NGOs, the Government and other development projects along the southern coastline were already bearing fruit. Some complementary and alternative economic activities had been adopted and were mainly undertaken during the rainy season, including coconut and sisal plantation and the cultivation of cashew nuts, coconuts, citrus and mangoes.

Many communities along the northern coastline and those on the islands of Lamu relied mainly on fishing. During the lean fishing seasons when the sea was too rough to go fishing, older and middle-aged men concentrated on repairs of their boats and nets rather than becoming involved in other income-generating activities. The younger men preferred to work in the tourism industry as tour guides, skippers of boats and hotel workers.

Small-scale aquaculture was still carried out at an experimental level. Shrimp culture had been piloted in the Ngomeni area of Malindi District, while mud crab fattening was being tried in the Gazi and Mtwapa areas. Kwale and parts of Mombasa had started tilapia culture on a small-scale level.

There was an over-reliance on fisheries as the main livelihood on the Kenyan side of Lake Victoria similar to that seen among Kenyan coastal communities. Another determining factor that can be considered an incentive to the over-reliance on fisheries is the fact that fishing on the lake can be practised almost all year round and that most of the crews are regularly employed and therefore largely depend on the fishery for sustenance.

Apart from fishing activities, Lake Victoria fishers frequently engaged in other income-generating activities, such as poultry-raising, followed by crop farming, boat transport, horticulture and cattle rearing.

Economic status, poverty, food security and vulnerability

In 1992, half of Kenya's rural population lived on less than USD 1 a day, which means in absolute poverty.[12] Poverty is also widespread among coastal fisherfolk, including those involved in beach seining. The case study on Kenya highlights that both the fishing communities on the coast and on Lake Victoria exhibit the highest levels of poverty in Kenya. The overexploitation of marine resources has led to increased poverty levels. In 2006, the United Nations Development Programme country report stated that the Coast Province had the highest rate of unemployment in the country, at 62 percent, and was the second poorest after the Western Province.

Many fishers' households and women-headed households live below the poverty line. The country case study concluded that economic benefits from the lucrative Nile perch fish processing industry did not trickle down to the most vulnerable groups and to the small-scale fishers, which, in order to survive, are increasing their pressure on other natural resources and fish stocks.

3. Marketing and processing arrangements, access to credit, and costs and earnings of beach seining

As far as post-harvest activities are concerned, very few communities in Kenya are equipped with appropriate processing and market facilities needed to add value, reduce post-harvest losses and support livelihoods.

The main market segments, to which coastal beach seine fisheries in Kenya cater, include household consumption of fresh fish, which accounts for about 6 200 tonnes annually, or approximately 88 percent of Kenya's total marine fish production, as well as hotels and restaurants, which buy fresh, chilled and/or frozen fish (Karuga and Abila, 2007). These two market segments offer the highest potential for growth in demand and therefore income generation and poverty alleviation.

Other smaller market segments include the export markets for fishmeal and processed fish and the live ornamental fish. Many fishers are still disadvantaged in market transactions by selling their catches mostly on an individual basis and in fresh form. Beach management units (BMUs) do not play a role regarding negotiating power. The lack of access to credit also hampers the access to more safe fishing boats, gear and refrigeration and other fish preservation facilities. Because of a lack of credit, fishers buy gear that is affordable and, in many cases, is not resource friendly, leading to unsustainable fishing. Obtaining formal loans is very expensive in Kenya, with bank interest rates ranging from 20 to 30 percent annually and, in addition, the irregular income of fishers due to seasonality only adds to this difficulty.

In the case of Lake Victoria, with its well-developed and export-oriented fish processing sector, selling of fish directly to the processing factories is the preferred practice, particularly in the case of Nile perch.

4. Regulation and management of beach seining, conflicts with other users of fishery resources and shorelines

National legislation and regulations of beach seining

Fisheries in Kenya are governed by the Fisheries Act Cap 378 of 1989, which lays down the legislative framework for the management, development, exploitation, utilization and conservation of the fisheries resources within inland waters, public dams, swamps, rivers and marine waters. The Act is implemented by the Fisheries Department, in the newly established Ministry of Fisheries Development (previously Ministry of Livestock and Fisheries Development) in conjunction with the Coastal Development Authority.

[12] At www.kenya-advisor.com/poverty-in-kenya.html

In 2001, Kenya Gazette Notice No. 7565, Vol. CIII., No. 69 of 9 November 2001, published the ban on beach seining and spear guns. In 2003, further subsidiary legislation was introduced (Legal Notice 214) to prohibit the use of scuba gear for collecting lobster and sea cucumbers.

The Act and its subsidiary regulations represent the primary instrument for the management of Kenya's coastal fisheries resources. It provides for the powers of authorized officers to control the use of illegal gear and methods, to protect critical fish habitats, and to control capture and trade in immature fish.

The Department of Fisheries further introduced subsidiary regulations under the Fisheries Act in 2005 related to BMUs. These were introduced as an innovative co-management tool for small-scale fisheries and this was initially developed and gazetted in the United Republic of Tanzania in 2003 for the Lake Victoria Region.

The objective of the BMU regulations are to facilitate the establishment of a BMU for each landing station in order to strengthen the management at fish landing stations, support sustainable fisheries development, help alleviate poverty, and improve livelihoods of BMU members. This would be done through good governance, democratic participation and self-reliance, by recognizing the roles of different sections of the community, including women, ensuring high-quality fish products, building management capacity of BMU members, and by reducing conflicts in the sector.

The regulation also provides a legal framework for the operation of BMU structures, functions, roles and responsibilities of the different BMU organs such as the assembly and the executive committee.

The by-laws of the BMUs are approved by the Director of Fisheries. The area of co-management jurisdiction of each BMU is defined together with the authorized fisheries officer. The BMUs levy fees, fines and other charges from its members or other users of the beach and from other external financial sources. Not all landing sites have the capacities to effectively manage using BMUs.

Owing to low capacity and experience of most fisherfolk, monitoring, control and surveillance (MCS), law enforcement, conflict resolution and overall fishery resources management present very big challenges.

Implementation of regulations, monitoring and views and compliance of fishers

As far as the ban on beach seining is concerned, it is seen by a large portion of fishing communities on the coast as an action that will have a very negative impact on their livelihoods, leading to a further increase in poverty levels. The beach seine fishers interviewed during the field study felt victimized, citing the ban as "harassment" by staff of the Fisheries Department. They also stated that they cannot accept that the gear is banned without a consultative process.

When the interviewed groups were asked to provide management or policy options, they demanded almost unanimously that the ban should be lifted and softer management options sought. Conflicts between different gear users are very common on the Kenyan coast and it is likely that other fishers not using beach seines would not support these demands.

Most beach seine fishers lacked alternative employment opportunities. All groups and individuals interviewed during the study criticized the fact that no alternatives, either in terms of fishing methods or in income-generating activities, were promoted before the ban was introduced. This lack of alternatives therefore forces them to be non-compliant because they would be left without food and livelihoods.

As a follow-up to the case study in Kenya, in 2009, awareness-raising workshops were held on Lake Victoria and on the coast. The workshops were organized by the CORDIO East Africa, in collaboration with the Department of Fisheries and other key stakeholders, to raise awareness on illegal beach seine fisheries at the coast and at

Lake Victoria. Further to this, training and capacity-building workshops, stakeholder consultation on the ornamental fish fishery and exchange visits were implemented.

At the workshops, fishers offered additional views and explanations regarding the catch of juveniles and damage of aquatic habitat by beach seines. Beach seine fishers from Lake Victoria explained that they used smaller mesh sizes in their seines because fish traders demanded small Nile perch for their customers. Coastal fishers said that studies that had concluded that beach seines were responsible for damaging coral habitats were not correct because they did not use their nets over coral reefs because nets would become caught and entangled in the corals and would be damaged and destroyed.

When comparing the issues raised and the recommendations made at the workshop between the coast and Lake Victoria, there were differences as well as similarities. The similarities reflected the underlying causes of the persistence in this illegal gear in both locations, i.e.:

- poverty and a lack of other employment opportunities;
- a high demand by consumers for undersized fish in rural and semi-urban centres;
- the fact that beach seine fishing provided a source of employment for youth, widows and orphans, who in turn provided cheap labour;
- high catch rates of beach seines when compared with other gear; and
- political interference with the enforcement of the ban on beach seining.

These problems were probably greater at the coast where enforcement was weaker and the use of beach seines was actually increasing. In both regions, fishers strongly requested support for alternative livelihoods and enterprise development with training for fishers to engage in different livelihoods.

There were also differences between the two regions as well as between different regions along the coast. There was unanimous agreement among stakeholders at the Lake Victoria workshop to completely eradicate the gear. At the coast, this view was not held by all. A portion of participants, largely coming from Lamu District in the north, supported the gear. This area has a long history of beach seine fishing, with the earliest beach seines traditionally woven from natural fibres. Beach seine users in Lamu District argued that beach seines are suited to the resources and the marine environments in the Lamu archipelago and do not cause damage to these environments.

In both the coastal regions and on Lake Victoria, the prevailing perception is that aquatic resources cannot be exhausted. This perception seems to be based on religious beliefs that God will continue to provide for humankind and, when resources decline, it is viewed as a punishment from God rather than an issue of biological sustainability.

When asked for their views on alternatives to beach seine fishing in terms of other fishing gear, fishers interviewed on the coast regarded ring nets as the best option because of their high catch rates and large crews involved similar to beach seines. Gillnets and handlines also ranked highly. It is interesting to note that, in terms of quantity of total catch, ring nets and gillnets used for shark were highly preferred; however, for fishers who fish by themselves, line fishing and use of basket traps were much preferred.

When asked about income-generating activities that would be accepted as an alternative to beach seine fishing, most of the beach seine fishers preferred small-scale businesses. In terms of becoming involved in small-scale businesses as individuals or part of a group or collective venture, fishers were in favour of individual businesses that generate direct benefits to the individual.

Fishers operating on Lake Victoria stated that they would prefer longlines and gillnets as an alternative to beach seines and, if given the opportunity, would like to engage in aquaculture. This attitude is reflected in the actual increase in the numbers

of longlines and gillnets operated on Lake Victoria owing to increased enforcement of the beach seine ban.

Among the alternative income-generating activities, poultry farming was the most preferred activity, followed by crop farming and water transport. As most of these activities are already a part of the fishers' secondary source of incomes, fishers requested support to expand these activities, which they prefer to the beach seine fishery, but required additional investment.

SUMMARY FINDINGS: MOZAMBIQUE

This summary is based on the report prepared by James Wilson and Julio Zitha in 2007: Social, economic and environmental impact of beach seining in Mozambique.

1. Technological and operational features of beach seine fisheries and their impact on fishery resources and habitats

History and regional distribution of beach seining

The beach seine fishery in Mozambique supplies a very significant proportion of the fish consumed in the national market. Beach seining in Mozambique has modernized through the introduction of mechanized hauling devices. This innovation eventually contributed to overfishing and the self-demise of mechanized beach seining. Almost in contradiction, the beach seine fishery in Inhassoro was the first recognized example of a co-managed fishery in the country.

In Mozambique, beach seining is one of the most widely used types of fishing gear and the largest employer of fishers. The gear is found in all of the coastal provinces, but with greater concentrations in those of the Sofala Bank, an area covering the coast of the provinces of Sofala, Zambézia and Southern Nampula.

The most recent catch data for marine artisanal fisheries in Mozambique by gear type and province are shown in Table A1.21. It suggests that beach seines account for about 70 percent of all artisanal marine fish production.

TABLE A1.21
Marine artisanal fisheries catch of Mozambique by province and gear, 2005

Province	Beach seine	Handline	Gillnet	Other	Total	
Cabo Delgado	2 500	3 300	2 100	4 100	12 000	(a)
Nampula	12 263	1 500	2 081	–	15 844	(b)
Zambézia	20 775	2 123	5 100	–	27 998	(b)
Sofala	1 936	1 198	2 793	1 620	7 547	(b)
Inhambane	2 358	1 005	404	–	3 767	(b)
Gaza	1 200	100	600	100	2 000	(a)
Maputo	111	65	2 415	–	2 591	(b)
Total	**41 143**	**9 291**	**15 493**	**5 820**	**71 747**	

Sources: (a) Almeida, J.T. As Pescas Marinhas de Moçambique – Marine Fisheries of Mozambique. Draft, 2006.
(b) Data of Instituto Nacional de Investigação Pesqueira – National Institute for Fisheries Research. 2005.

The above estimate is considered to be conservative by the authors of the country case study as the data only cover the areas that are included in the official system for the collection of fisheries statistics. Bycatch collected from the industrial fishery does not appear to be included and catches in Sofala Province appear to be seriously underestimated.

Beach seines have been used in Mozambique since the first part of the twentieth century. In Inhambane Province, there are verbal reports that the first net was introduced by a fisher from India in the 1940s and then copied and further developed by immigrants of Chinese origin. Descendants of these Chinese immigrants are still involved in the fishery today.

Older fishers still recall using beach seine nets made of natural fibres from the bark of trees. The natural fibre nets were succeeded by seines made from sisal and cotton. Synthetic fibres were used during the 1970s, but during the 1980s, when imported goods became increasingly difficult to purchase, fishers resorted to making nets using the nylon fibres from old car tyres. Today, the nets are made from polyamide and polyethylene, and conventional floats and weights are used. The most radical technical

development of the beach seine occurred in the 1950s in Inhassoro District, Inhambane Province, when a tractor-powered winch was used to haul in the net. Mechanized beach seining declined during the 1990s and currently there are no mechanized units operating.

Beach seines are predominantly used in the provinces of Nampula, Sofala and Zambézia. These are the provinces with limited coral reef fisheries and the littoral geography is characterized by slowly shelving sandy beaches that are favourable for the operation of beach seines.

On a national basis, handlines are the most widely used gear reflecting the subsistence nature and low capitalization of artisanal fisheries. These are particularly abundant in Cabo Delgado Province, where coral reef fisheries are relatively accessible. The three southern provinces of Mozambique have low concentrations of fishing units.

Gear specifications and fishing practices

As in other countries, in Mozambique two principal types of beach seine nets are used, i.e. beach seines with codends and those without. They are also locally distinguished as beach seines with mosquito net and those without mosquito net sections owing to the wide use of mosquito nets for fishing in the country. The catches of the beach seines with codends are concentrated in the codends, while the catch of the beach seine without a codend is concentrated in the central part of the net, which have smaller mesh sizes than the rest of the net. These central net panels are hung loosely, thereby forming a sack. Beach seine nets are generally composed of two anterior wings made up of two to three net panels as well as posterior wings.

Beach seines in Mozambique are not usually of uniform construction. The hanging ratio typically increases from the seine body or central part from 0.45–0.50 to 0.70–0.75 in the anterior wing panel. Mesh sizes also increase from seine body to anterior wings while the diameters of twines and panel heights decrease.

The net panels are made of multifilament polyamide (PA) or of multi-monofilament polyethylene (PE), which is often locally manufactured. Traditional floats are made from pieces of wood from trees, and pieces of slippers are commonly attached to the head rope. Twenty-litre empty oil containers are used as marker buoys. The foot ropes are weighted down with sinkers, which might be stones, pieces of concrete or lead. Hauling ropes are made of PE between 8 and 18 mm in diameter and attached to the anterior and posterior wings. The ends of the wings are kept open vertically by wooden sticks.

The average length of a beach seine in Mozambique is about 250 metres. In some areas, they can be up to 300 metres. Various mesh sizes are used throughout Mozambique even though the regulations for marine fisheries, which also apply to inland waters, define the minimum mesh size in the seine body as 38 mm. In violation of these mesh size regulations and responding to the need to capture small-sized species such as anchovy (*Stolephorus*) and a sardine-like fish, locally named *Ussipa*, mainly in Angoche and Lake Niassa, mesh sizes of 6 mm and 13 mm (in Moma) and 25 mm (in Inhassoro) are commonly used. Mosquito nets with even smaller mesh sizes (1 mm) can also be found in the codends of beach seines. Depending on the fishing season, species targeted and the financial status of the fisher, nets are modified and mesh sizes are changed in order to increase the efficiency of the gear.

The main fishing areas are located along the coast from Maputo Bay up to the Northern Province of Cabo Delgado as well as in inland waters. The major concentration of beach seine fisheries is on Sofala Bank in the province of Nampula in the districts of Angoche and Moma. Beach seines operate typically up to 600 metres from shore or from fishing centres located on the islands along the coast or lake shores. Beach seines in Mozambique are operated in a similar fashion as described in previous country case studies.

Impact of beach seines on fishery resources and aquatic habitat

As far as environmental and resource impacts of beach seines are concerned, the principal negative impacts, which have been cited in some studies, are the capture of juvenile shrimp and fish, primarily as a result of the use of mosquito nets in the codend, decline of the targeted stock as a result of fishing effort, capture of turtles and damage caused to the seabed.

Although damage to marine habitat has been cited as a problem on many occasions, in Mozambique no specific studies have been carried out about the damage caused to the seabed by beach seines. Underwater videos taken of the hauling of mechanized beach seines by the National Institute for the Development of Small-scale Fisheries (IDPPE) in 1998 show that the footrope of the seine is actually clear of the seabed during hauling; however, this may change with hauling force, water depth, net buoyancy and the net height.

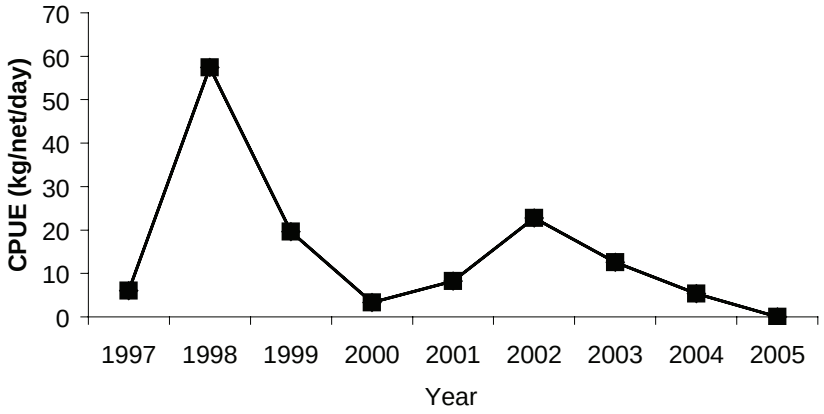
It was interesting to note during the case study in Inhambane that, although a large amount of seagrass was landed with each haul, the seagrass was invariably dead, had been floating in the water and showed no signs of having just been removed from the seabed. Furthermore, on the Sofala Bank there is little marine vegetation near the shore that could be damaged by beach seines. While it is certainly possible that beach seines may damage the seabed, the case study carried out in Mozambique did not find any evidence to support this. The authors of the case study on Mozambique suggest that whatever the damage to bottom habitat that could be caused by beach seines, the type and amount of damage will be influenced by the technical specification of the net and can possibly be mitigated or reduced through modification of the gear.

With regard to other negative impacts of beach seines on the aquatic environment and resources, the incidental capture of turtles in beach seines was reported to occur more frequently in the southern part of the Sofala Bank and the northern part of Inhambane Province, especially between August and October when the wind blows from the northeast. When mechanized beach seines were operating, turtle catches were reported (MICOA, 2006) to have been in the order of 20–35 per month. Beach seine fishers interviewed in the course of the study indicated that in the south of Inhassoro District, beach seines can catch four or five turtles per net per year, while in the north of the district catches rise from 10 to 14 turtles per net per month during the northern winds. The little information that exists on current turtle catches confirms that they are still being caught in manually operated beach seines and more than 80 percent of turtles caught are green turtles. The most recent assessment on the status of turtles indicated that populations are declining. Beach seining, along with other gear types including longlining, trawling, other subsistence fishing and habitat degradation and coastal construction, were identified as causes of turtle mortality. Turtles caught in beach seines are usually still alive when landed and therefore may be released with minimal impact on the stock; however, the extent to which this happens is unclear. Although fishers are aware that they should release turtles, their meat is considered a delicacy and there is demand for shells and artefacts made from shells from both foreign and national tourists. This creates a financial incentive not to release live turtles caught in beach seines. Any turtles incidentally caught in beach seines should be carefully handled and released immediately. If this procedure is followed beach seines do not need to have a negative impact on turtle populations.

Both fishers and government staff were of the opinion that the productivity of the beach seine fishery had declined in recent years, primarily as a result of excessive fishing effort. The fisheries statistics from Nampula Province appear to support this. From 2000 to 2005, the fishing effort in the beach seine fishery in Angoche had tripled while the CPUE rose until 2002 and since then declined steadily.

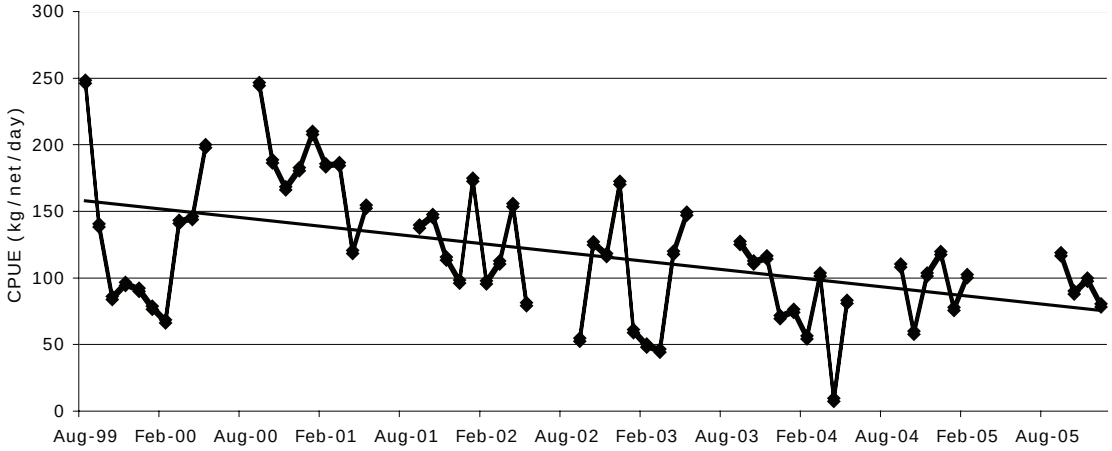
Figure A1.8 shows the evolution of CPUE for Angoche between 1997 and 2005. Figure A1.9 shows the evolution/decline in CPUE for beach seines in Inhassoro, Inhambane Province, between 1999 and 2005.

FIGURE A1.8
CPUE for *Thryssa* spp., Angoche, Nampula Province, 1997–2005



Source: Instituto Nacional de Investigação Pesqueira, 2006.

FIGURE A1.9
CPUE history for beach seines, Inhassoro, Inhambane Province, 1999–2005



Source: Instituto Nacional de Investigação Pesqueira, 2007 (unpublished data set).
Note: Data for the closed season periods have been excluded.

In both graphs, the decline in CPUE is evident. However, the long-term catch-rate history (Figure A1.9) reflects a declining fishery, even over the period when mechanized seines were operating at a low level. It should be noted that catch and effort for mechanized and non-mechanized beach seine units are not separated in the data set, and some of the decline in CPUE may be due to the withdrawal of the last large mechanized nets from the fishery (the last one ceasing operation in 2004). There are, however, other factors that may have contributed to the decline in productivity, including readjustments to the marine environment following the cyclone in 2000.

As a result of overfishing in Inhassoro and Petane in Inhambane Province, mechanized beach seines started to become less viable in the 1990s and eventually disappeared again by 2004. Owners contacted in the course of the study cited diminishing productivity as the principal cause, as well as increases in the cost of maintenance. The manual seines continued, but have now been joined by mini beach seines with lower investment costs and with smaller mesh sizes. The design of a mini seine is shown in Annex 2.

TABLE A1.22
Beach seines using mosquito nets in the codend, Nampula and Inhambane Provinces, Mozambique

Province	District	Number of seines	% with mosquito nets
Nampula	Angoche	473	67
	Ilha de Moçambique	45	62
	Memba	51	100
	Moma	497	5
	Mogincual	112	71
	Mossuril	78	64
	Nacala Velha	33	88
	Nacala Porto	30	83
Inhambane	Cons	8	0
	Maxixe	95	0
	Jangamo	0	0
	Morrumbene	13	0
	Massinga	0	0
	Vilanculos	185	45
	Govuro	37	0
	Inhassoro	121	13
	Inharrime	0	0
	Zavala	0	0

The capture of juveniles is perceived as the most severe negative impact of beach seining on the aquatic resources. The incidence of juveniles in the landings is closely correlated with the use of small meshes and even mosquito nets in the codend of seines, as shown in Table A1.22.

The district of Angoche stands out as having a large number of beach seines with a high percentage of use of mosquito nets. This phenomenon can be partially explained by the existence in Angoche of beach seine fisheries targeting anchovy (*Stolephorus*) and shrimp (*Acetes*), the adult of which is typically less than 4 cm long. Fishers maintain that these species can only be effectively caught with seines fitted with mosquito nets. The authors of the case study, however, highlight that this view is not correct as these species can be effectively caught with a 6 mm mesh size net.

2. Social and demographic characteristics of fishers and their access to social services and infrastructure

Ownership, sharing of income, demographic characteristics

The profile of a beach seine team in Mozambique varies from area to area. The team generally consists of a limited number of specialized crew members with specific responsibilities, who receive additional remuneration. The core of the team consists of a fishing master, who is responsible for the fishing operation, a net master, who is responsible for maintenance and repair of the net, and a representative of the owner in case he does not participate in the fishing operation. The remaining members of the team are usually adult males, but in Inhambane Province children are often part of beach seine teams responsible for coiling the ropes.

Both specialized and unspecialized crew members usually stay with the same beach seine crew throughout a fishing season. In addition to these crew members, the fishing master or owner may engage additional help on a day-by-day basis depending on weather and tidal conditions. These transient helpers may be men or women and they are remunerated with a small share of the catch or given preferential access to purchase part of the catch.

The remuneration of crew and owner in the beach seine fishery follows a similar basic principle, irrespective of location. Firstly, fish for immediate consumption is

deducted from the catch. The amount of fish may be around 1 kilogram per person or up to 5 percent of the total catch. The remaining part of the catch is then divided into two equal parts between the owner and the crew. The part accruing to the crew is distributed equally between participating crew members. Depending upon the catch of the day, casual labourers may be given a slightly larger share of the fish for consumption than crew members because they do not receive a share of the divisible catch.

Modifications to this principle may include:

- an allocation of up to 30 percent of the fish taken by the owner of the beach seine and the remaining 70 percent being shared equally among the crew members;
- a deduction of fish by the owner without crew share from the divisible catch. This deduction is usually first grade fish (Inhambane);
- a share greater than 50 percent of the divisible catch accruing to the owner should the net be set using a motorized rather than a non-motorized boat; and
- an allocation of only a half share of the divisible catch to young boys who are part of the crew.

High-value species in the catch such as shrimp may be sold directly to specialized traders, and the revenue is distributed as per the divisible catch. Specialized crew members such as the fishing master and the net master do not receive any additional share of the catch but are paid a premium by the owner at some stage during the season.

All expenses related to fishing operations, including licensing, the maintenance of the net, fuel and the maintenance of the boat, are borne by the owner.

The participation of net owners in the fishing operations varies with location. In the northern part of the Sofala Bank in Nampula Province, beach seine owners tend not to participate in fishing operations, while in Inhambane beach seine owners will not only be present at the beach but will also participate in fishing operations. The owner of the beach seine is usually also the owner of the boat used to set the net.

Occupational diversity of beach seine crews and households

Crew, however, do engage in other activities, both within and outside the fisheries sector. Almost all will help in the harvest of agricultural crops and other activities, including house construction, bycatch collection (on the Sofala Bank), handlining and gillnetting. Some of these will be done before or after fishing operations, and only substitute fishing during closed seasons or low periods. Both of these vary significantly with location.

The country case study highlights that, in Mozambique, households involved in fishing including beach seining depend equally on both fishing and agriculture for their livelihoods. However, there are important regional differences, which are exemplified by the two areas where field investigations were carried out. In one of the study sites, i.e. Mponha in Inhassoro District, the dependence on the beach seine fishery is much greater than in the other study site, i.e. Petane in Moma District, owing to the lack of other employment opportunities and the fact that fisheries resources are more abundant than in other areas. In Mponha, one-third of the households who are engaged in beach seining are also involved in fish marketing and processing.

It is estimated that beach seine fisheries account for 40 percent of all household income of the households surveyed in Mponha. Another 10 percent of the total household income originates from other fishing activities while the remaining part is contributed by involvement in agriculture.

Economic status, poverty, food security and vulnerability

In Mozambique, poverty and absolute poverty are widespread also among coastal fishing communities including those practising beach seine fishing. In 1996, 78 percent of the population lived on less than USD 2 per day and more than one-third of the

entire population, i.e. 38 percent lived in absolute poverty – on less than USD 1 per day. More than two-thirds of the population, i.e. 68 percent, did not have access to improved sanitation, and less than half of the population, i.e. 43 percent, had access to safe drinking-water.[13]

Petane, one of the locations where the case study was carried out, is situated on the outskirts of Inhassoro and overlooks the sheltered shallow waters between the mainland and the Bazaruto archipelago. It has a population of about 1 500 but no public facilities. None of the houses have either mains electricity or running water and most of the households involved in beach seining live in absolute poverty.

The same is true for Mponha, the other study site, which comprises about 440 households and is situated on the top of a high escarpment overlooking a series of vegetated dunes interspersed with small coastal lakes beyond which is a wide slowly shelving sandy beach. The village is accessible by vehicle, but from the village there is only foot access to the beach, the pathway passing through a lake area. Beach access changes with the seasons, and in the wet season fishers have to wade through the lakes up to chest deep in order to reach the beach.

The village has a school, a single well and no other public facilities. Electricity is limited to a couple of small private generators and solar panels.

3. Marketing and processing arrangements, access to credit, and costs and earnings of beach seining

Products from the major beach seine fisheries are almost entirely destined for high-volume, low-value national markets with the exception of shrimp caught near urban areas where processing facilities exist.

Catches from beach seines are either consumed locally or distributed to inland markets fresh or processed. In areas close to towns and cities, higher value species are taken to these markets to be consumed fresh or put on ice for transport to other larger urban centres. By far the largest part of the catch is processed by sun drying, either with or without salt. Table A1.23 shows the processing and marketing channels of beach seines by species.

TABLE A1.23
Processing and marketing channels of beach seine catches in Mozambique

Product	Species	Final market	Areas
Fresh products with ice	Shrimps (*Penaeidae*)	Premium national markets or regional exports	Semi-urban fisheries, Sofala Bank
Fresh products with no ice	Shrimps (*Acetes* and small *Penaeidae*)	Local rural and urban markets	Sofala Bank
	Squid (*Loliginidae*)		All
	First grade fish		All
Sun-dried products with salt	Small pelagics/anchovies (*Thryssa dussumieri*), largehead hairtail (*Trichiurus*)	National inland markets	Zambézia, Sofala, Inhambane
	Small demersals	Inhambane	
	Larger pelagics		
Sun-dried products with no salt	Shrimps (*Acetes*, small *Penaeidae*)	National inland markets	
	Small pelagics/anchovies (*Thryssa* spp.), smelt (*Atherina*), largehead hairtail (*Trichiurus*)		Nampula
Smoked products	Shrimps (*Acetes*, small *Penaeidae*)	National coastal markets	
	Second grade fish		
	Rays (*Actinopterygii*)		
	Larger pelagics		

[13] See earthtrends.wri.org/povlinks/country/Mozambique.php

Higher value products from beach seines, i.e. first grade fish such as groupers, emperors, cobs, jacks, shrimp and squid, are usually sold fresh to specialized traders. These products are either sold in the immediate vicinity or put on ice and taken to urban markets. The availability of ice in the coastal zone is limited and the amount of products from beach seine catches sold fresh is therefore also limited. The owner may also sell low-value fish in fresh form if he is not interested in processing. This fish will be either sun dried or salted and dried by the purchasing trader.

Salting and subsequent sun drying is probably the most common form of processing of beach seine catches. There are still many areas though where salting is not practised. Smaller fish are salted whole while larger fish (> 15cm) are gutted and split. Salting is either done in concrete tanks or in sacks. After keeping the fish in salt for 24 hours or longer, it is dried either on the ground or on raised racks. The drying time is relatively short, about four hours, after which the fish is packed in 50-kilogram sacks and transported to inland markets.

Sun drying of fish without salting is still common in areas with limited access to salt, such as the locality of Matadane, immediately northeast of Moma. Small fish are simply spread out in the hot sand soon after capture and left to dry for up to 24 hours depending on weather conditions. In some areas, fish are dried on raised racks resulting in a product of improved quality. Ribbon fish (*Trichiurus*) are often gutted and hung on a line to dry rather than spread on the ground. After drying, the fish are packed in sacks for transport to markets.

Only certain species of fish are smoked and these are often the larger ones. The practice, however, varies significantly geographically and fish as small as scads (*Hilsa kelee*) may be smoked in certain areas. Two techniques are used, namely an improved smoker based on the Chorkor kiln, and a traditional method where fish is smoked in a hole in the ground. Larger fish are gutted, split and also cut into large pieces before smoking.

The major producing areas on the coast of the provinces of Inhambane, Nampula, Sofala and Zambézia supply inland consumers and the redistribution markets in Alto Molocué, Chimoio, Mocuba and Nampula city. Products from Cabo Delgado Province are redistributed via Montepuez and Nampula, and these are mostly from open-water seines rather than beach seines. Fish is transported by hired lorry or pickup trucks if quantities justify or, more often, by public transport.

The distribution of fresh and iced products from beach seine fisheries is radically different. The intermediate markets for shrimp are focused on coastal cities with processing facilities, namely Angoche, Beira and Maputo, from where the frozen product may be exported or sent to a larger national urban market, with fresh and frozen fish from Inhambane being sent mainly to Maputo. Fresh and frozen product is distributed by road or even sent by air if the quantities are small and the product is of sufficient value.

The main products from the beach seine fisheries are small pelagics and to a lesser extent small demersal fish and shrimp. At the retail level in rural and urban markets, these fish are sold in amounts of six to eight small individuals, being sufficient for at least one family meal and also easily divisible between persons. The small size of the fish caught is thus appropriate for poor consumers. The fish that beach seines supply is both vast and very important in the context of nutrition and poverty alleviation. In some inland areas, salted fish is preferred to unsalted fish principally because the consumer does not have to buy additional salt.

The agricultural cycle is an important source of demand for dried fish. On larger farms and agro-industrial enterprises, harvest labourers are still partially paid in food, including dried fish. There is, therefore, an important link between the price for dried fish in the major redistribution markets such as Nampula city and the harvest of the principal commercial crops such as cotton and tobacco.

In Mozambique, information on the financial performance of beach seine units was collected in the course of the country case study in Petane village in Inhassoro District and in Mponha village in Moma District. The analysis is based on data collected during the course of this study. It is worth noting that the stated catches appear high compared with the data of Instituto Nacional de Investigação Pesqueira, 2006. Monthly operations are summarized in Table A1.24.

TABLE A1.24
Monthly operational data, Petane

	J	F	M	A	M	J	J	A	S	O	N	D	Total
Days	31	28	31	30	31	30	31	31	30	31	30	31	
Fishery closure*	4	4	4	4	4	30	31	31	5	4	4	5	
Lost to weather	6	6	-	-	-	-	-	-	-	-	-	6	
Lost to labour	4	4	4	4	4	-	-	-	4	4	4	4	
Total operational days	**17**	**14**	**23**	**22**	**23**	**0**	**0**	**0**	**21**	**23**	**22**	**16**	**181**

*The beach seine fishery is voluntarily closed July–August (inclusive) and there is no fishing on Sundays.

Daily catch rates are presented in Table A1.25. Note should be taken of the high peak immediately after the end of the closed season.

TABLE A1.25
Declared catch rates by month, Petane

	J	F	M	A	M	J	J	A	S	O	N	D	Total
Boxes/net/day	2	3	6	4	1	-	-	-	10	6	5	3	
Kg/net/day	40	60	120	70	20	-	-	-	200	120	100	60	
Kg/net/month	680	840	2 760	1 540	460	-	-	-	4 200	2 760	2 200	960	16 400

Although the composition of catches varies significantly throughout the year, average declared composition has been used in this model. The price at first sale for each of the major species is shown in Table A1.26 together with an index of composition.
The average calculated price for the species composition was MZM 13.2 per kilogram (equivalent to USD 52 per tonne). Note the different states of conservation by species at first sale.

TABLE A1.26
Catch value by species, Petane

Species	Price MZM*/kg	State	Fresh wt price MZM/kg	Composition
Peixe-coelho (*Promethichthys Prometheus*)	15	Dried	11.5	0.132
Emperor (*Lethrinus harak*)	25	Fresh	25.0	0.059
Machope (*Scomberoides tol*)	15	Dried	11.5	0.015
Sardinha (*Clupidae* spp.)	15	Dried	11.5	0.343
Parrot fish (*Scaridae* spp.)	15	Dried	11.5	0.018
Squid (not specified)	38	Fresh	38.0	0.045
Melanurio (not specified)	15	Dried	11.5	0.165
Zebra fish (*Malacanthidae* spp.)	8	Dried	6.2	0.069
Barracuda (*Sphyraenidae* spp.)	15	Dried	11.5	0.119
Salmonete (*Mullidae* spp.)	15	Dried	11.5	0.035

*MZM = Mozambique metical.

The primary division of catch, showing the amounts taken out for immediate consumption and set aside for the owner, is shown in Table A1.27. The value of fish for consumption is estimated at 1 kg/head/day, excluding the higher value species (squid and emperor fish). The first grade fish (emperor fish) accrues to the owner before the general division of catch.

TABLE A1.27
Primary division of catch, Petane

	MZM	USD
Annual value of production	215 760	8 630
Fish taken for consumption	27 031	1 081
First grade fish (to owner)	24 030	961
Divisible catch	164 700	6 588

The values accruing to the various classes of participants are summarized in Table A1.28. Note that the earning of the crew is in the range of USD 2 to USD 3 per worked day.

TABLE A1.28
Division of catch between participants, Petane

	Number of persons	% share/pp	Share (MZM/pp)	Consumption (MZM/pp)	Extras (MZM/pp)	Total (MZM/pp)	Per day (MZM/pp)	Per day (USD/pp)
Owner	1	50	82 350	1 931	24 030	108 310	598	23.9
Specialized crew	2	4.2	6 862	1 931	4 000	12 793	71	2.8
Ordinary	9	4.2	6 862	1 931		8 793	49	1.9
Boys	2	2	3 431	1 931		5 362	30	1.2

Note: pp = per participant.

The owner is responsible for all maintenance costs, which are detailed in Table A1.29. The net return on investment (before financing costs) of 94 percent is considered to be very high, especially in the context of the low return accruing to the crew.

TABLE A1.29
Owner's costs and earnings, Petane

Owner earnings	**(MZM/year)**	**(USD/year)**
Share	82 350	3 294
First grade fish	24 030	961
Expenses		
Bonuses	8 000	320
Net maintenance	23 100	924
Vessel maintenance	3 000	120
Licence	600	24
Inspection	500	20
Net earnings	71 180	2 847

Investment	**(MZM)**	**(USD)**
Net and ropes	68 686	2 747
Boat	7 000	280
Investment cost	75 686	3 027

Return on investment	94%

The return on investment drops to 40 percent if an outboard motor is used to set the net.

The financial and economic performance of a beach seine unit in Mponha village, Moma District, is described below. The following analysis is based on data (including levels of activity, catch rates and composition) collected under this study.

Monthly operational data are summarized in Table A1.30 and have been taken from average data submitted by beach seine owners. Note that the model foresees zero compliance with the closed season.

TABLE A1.30
Monthly operational data, Mponha

	J	F	M	A	M	J	J	A	S	O	N	D	Total
Days	31	28	31	30	31	30	31	31	30	31	30	31	
Closed	0	0	0	0	0	0	0	0	0	0	0	0	
Lost to weather/other	23	18	25	24	20	14	16	16	15	16	15	21	
Lost to labour	1	0	1	1	1	1	0	0	0	0	0	0	
Total days fishing	**7**	**10**	**5**	**5**	**10**	**15**	**15**	**15**	**15**	**15**	**15**	**10**	**137**

Daily catch rates proved difficult to estimate, primarily on account of the fact that fishers measure the catch in boxes, baskets and sacks, all of which have different dimensions and weights. However, as mentioned above, the overall estimate of catch per day, although on the high side, is not considered unreasonable. The average declared catch rates by month are presented in Table A1.31.

TABLE A1.31
Declared catch rates by month, Mponha

	J	F	M	A	M	J	J	A	S	O	N	D	Total
Boxes/day	4	4	7	7	9	5	4	4	2	5	6	4	
Kg/day	137	151	256	252	301	168	140	133	84	175	203	140	
Kg	956	1 505	1 278	1 260	3 010	2 520	2 100	1 995	1 260	2 625	3 045	1 400	22 953

Although the composition of catches varies significantly throughout the year, average declared composition and values have been used in this model. Different species are sold in different processing states (Table A1.32).

TABLE A1.32
Catch value by species, Mponha

Species	Price (MT/kg)	State	Fresh wt price (MZM/kg)	Composition
Ocar de cristal (*Thryssa vitrirostris*) and Ocar cornudo (*Thryssa setirostris*)	14	Dried	10.7	41%
Peixe-fita comun (*Trichiurus lepturus*)	6	Fresh	6.3	18%
Roncador striado (*Pomadasys stridens*)	7	Dried	5.4	10%
Corvina (*Otolithes ruber*)	8	Fresh	7.6	7%
Camarao (*Fenneropenaeus indicus*)	17	Fresh	17.3	4%
Anchoveta do indico Stolephorus indicus	14	Dried	10.8	3%
Other	14	Dried	10.8	16%
			Average price 9.5 MZM/kg	
			378 USD/tonne	

The cash value of the catch will be divided up after fish has been taken out for immediate consumption, as detailed in Table A1.33. Unlike Petane, the owner does not have an exclusive right to the high-value species, and these are divided up among participants along with the other fish.

TABLE A1.33
Primary division of catch, Mponha

	MZM	USD
Annual value of production	216 911	8 676
Fish taken for consumption	17 576	703
Divisible catch	199 336	7 973

The values accruing to the various classes of participants are summarized in Table A1.34. Note that the crew member's earnings is in the order of USD 2.5 to USD 4 per worked day.

TABLE A1.34
Division of catch between participants, Mponha

	Number of persons	% share/pp	Share (MZM/pp)	Consumption (MZM/pp)	Extras (MZM/pp)	Total (MZM/pp)	per day (MZM/pp)	Per day (USD/pp)
Owner	0	50	99 668	1 255		100 923	737	29.5
Specialized crew	3	3.6	7 119	1 255	4 000	12 375	90	3.6
Ordinary	11	3.6	7 119	1 255		8 375	61	2.4

Note: pp = per participant.

As in Petane, the owner is responsible for all maintenance, investment and licensing costs, and this is illustrated in Table A1.35. The net return on investment (before financing costs) of 80 percent is again considered high, but realistic, especially in the context of the fact that the gear continues to attract investment.

TABLE A1.35
Owner's costs and earnings, Mponha

Owner earnings	(MZM/year)	(USD/year)
Share	99 668	3 987
Expenses		
Bonuses	12 000	480
Net maintenance	23 100	924
Vessel maintenance	3 000	120
Licence	600	24
Inspection	500	20
Net earnings	60 468	2 419
Investment	**(MZM)**	**(USD)**
Net and ropes	68 700	2 748
Boat	7 000	280
Investment cost	75 700	3 028
Return on investment	80%	

4. Regulation and management of beach seining, conflicts with other users of fishery resources and shorelines

National legislation and regulations of beach seining

The principal legal instruments regulating fisheries in Mozambique are the *Lei das Pescas* (Fisheries Law) 3/1990 and the *Regulamento Geral da Pesca Maritima* (General Regulation of Marine Fishing) Decree 4/2003. These instruments set out competences, licence conditions and basic technical specifications for the major types of fishing gear and vessels. The beach seine fishery is subject to annual licensing by the Ministry of Fisheries and this responsibility was formally devolved to local authorities in October 2006. Beach seines, along with other artisanal fishing gear, are subject to an annual licence fee equivalent to USD 24 per year since 2007. In all artisanal fisheries in Mozambique, including beach seining, access is not limited and any number of gear can be licensed. The design of the gear is not restricted, but mesh sizes are limited by regulation.

There are also local regulations governing the use of fishing gears in national parks. Beach seine fisheries in Mozambique are subject to closed seasons, although an exception was granted for the districts of Moma and Angoche. Concerns for the status of shrimp resources, a resource targeted by the industrial fishery, resulted in the beach seine fishery in these two districts being included in the closed season of 2005/2006 and again in 2006/2007.

The regulations make provision for fisheries co-management institutions based on local community fisheries councils (CCPs) and representative fisheries co-management committees (CCGs). The CCPs should secure participative management of fisheries,

secure compliance with regulations and manage conflict resolution. Community fisheries councils should represent CCPs and be comprised of fishers, local research staff, maritime authority, fish processors and traders.

The immediate inshore zone, up to one mile from the high water line, is set aside exclusively for artisanal fishers. In certain areas, including the Sofala Bank, this area is extended to three miles. The regulation stipulates a minimum mesh size of 38 mm for all beach seines and makes provision for the implementation of other measures to protect resources. In the case of the beach seine fisheries, they are subject to a closed season, the duration and timing of which varies by area. On the Sofala Bank, the fishery is closed from 15 November to 1 March in keeping with the closed season for the industrial shrimp fishery.

Implementation of regulations, monitoring, compliance and conflicts

In the beach seine fishery, there is very limited compliance with the management measures established by the ministry both as far as closed seasons and minimum mesh sizes are concerned. The use of mosquito netting in the seine body of beach seines is still common in certain areas on the Sofala Bank and mesh sizes smaller than 38 mm are often found in the seine body of nets that do not use mosquito netting.

In areas where there are self-imposed closed seasons, compliance is reported to be total. Kristiansen and Polosse (1996: 5–9), who conducted a case study of fisheries co-management in the community of Inhassoro in the northern part of the province of Inhambane, about 800 kilometres north of the capital of Mozambique, Maputo, came to the same conclusion. They observe that in Mozambique compliance with regulations in beach seine fisheries is improved when fishers themselves choose the season the government will declare closed. Beneficial side-effects of co-management include a stronger sense of community and individual responsibility towards the common good.

Recent work on compliance in industrial fisheries indicates that in the shallow water shrimp fishery, the most frequent infraction committed is fishing either in a prohibited season or area. In practice, it is relatively easy to control the closed season compliance by verifying a vessel's presence in port, and it is reasonable to assume that fishing in prohibited areas, including estuaries and the inshore area set aside for artisanal fishers, is the most common infraction committed in the shallow water shrimp fishery and is focused on areas on the Sofala Bank where trawls can be operated. This may have direct impact on artisanal fisheries, either in the form of the destruction of artisanal gear by inshore trawlers or in the interruption of artisanal fishing activities.

In certain parts of the country, especially in Inhambane Province, there are conflicts between tourism and the beach seine fishery. It was not possible to confirm reports that fishers were being prevented from using specific stretches of beach by operators of tourist establishments, but there was certainly disruption to beach seine activities caused by tourists driving cars along the beach, an activity that is illegal in Mozambique but that is in some instances the only way to gain access to remote locations.

SUMMARY OF FINDINGS: PERU

This summary is based on the report prepared by Carlota Estrella in 2007: La pesca con chinchorro en litoral de San José (Lambayeque) y Huacho (Lima), Peru.

1. Technological and operational features of beach seine fisheries and their impact on fishery resources and habitats

History and regional distribution of beach seining

Artisanal fisheries have traditionally provided employment for many families that live along the coastline of Peru. Over the last decade, artisanal small-scale fisheries in Peru have experienced a strong growth owing to the open access nature of this subsector.

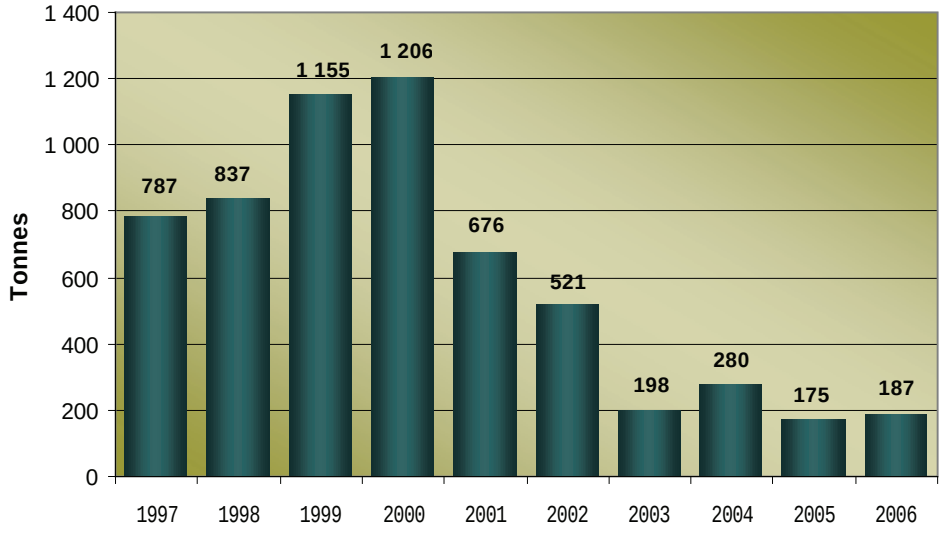
Fourteen major fishing methods are used in Peru. Beach seining is one of the methods but of minor importance when compared with other fishing methods. Beach seining is carried out both in a mechanized form, where nets are hauled with the help of motor vehicles, and manually, where nets are hauled onto the beach manually. Even though mechanized beach seining has been banned in Peru, it is still being practised. Manual beach seining, which is still allowed, is no longer commonly practised.

From 1997 to 2007, beach seining was practised in 301 locations, extending from latitude 3 degrees 23 minutes to latitude 15 degrees 43 minutes south. Most of these beach seine fishing grounds, i.e. 71 percent are located in the northern zone between latitudes 3 degrees 23 minutes and 10 degrees south. The second largest concentration of beach seines, i.e. 21 percent occurred in the central zone between latitudes 10 degrees 1 minute and latitude 13 degrees south, while only 7 percent of beach seines were operating in the southern zone between latitudes 13 degrees 1 minute and 18 degrees 20 minutes south.

The most productive fishing grounds are in the northern zone off the beaches of San José and Huacho, where 15 of the 301 beach seine grounds are located. These locations account for 53 percent of the total beach seine production and for the same percentage of all beach seine operations, respectively.

During the last decade, catches of beach seines in Peru amounted to 6 021 tonnes and accounted for 0.3 percent of the total catch of Peru. As shown in Figure A1.10, the beach seine landings from 1997 to 2006 show an increasing trend until 2000, followed by a steep decline over the following three years and a stagnation at a rather low level ever since then.

FIGURE A1.10
Annual beach seine landing in Peru, 1997–2006



Gear specifications, fishing practices and catch composition

Beach seine catches follow a clear seasonal pattern, as can be seen from Figure A1.11. Catches peak in spring and summer due to the fact that the weather is usually calm and allows for the operation of beach seines, while autumn and winter have many stormy days with strong surf and winds which impede the use of beach seines.

FIGURE A1.11
Monthly/quarterly beach seine landings in Peru, January 1997–December 2006

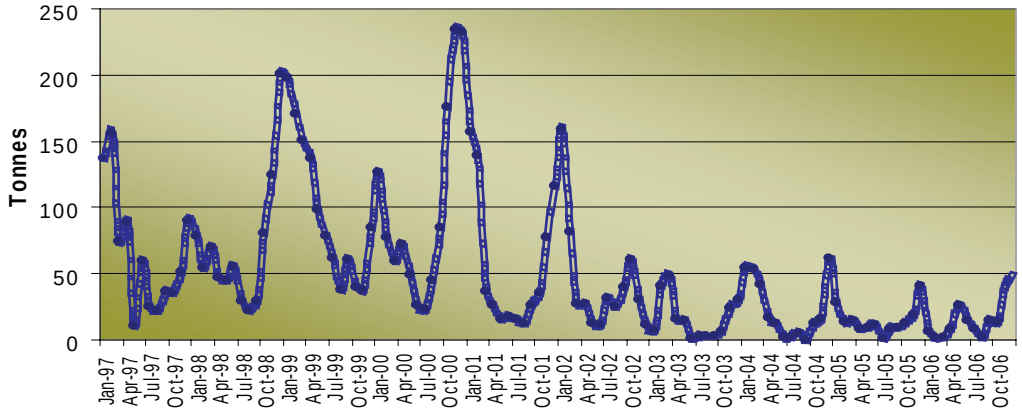


Figure A1.12 shows the contribution of different fishing areas to the annual beach seine catch. The figure shows that from 2001 onwards, the previously important fishing area of San José experienced a strong decline. After 2003, the other previously important fishing area, i.e. Huacho, also experienced a decline. It is further important to note that during the last three years, beach seine landings have been reported from only seven areas – Punto Pizarro, Puerto Rico, San José, Holy Rose, Chimbote, Huacho and San Andrés – while other areas did not report any, or very insignificant, beach seine landings.

FIGURE A1.12
Contribution of annual catches according to landing site, 1997–2006

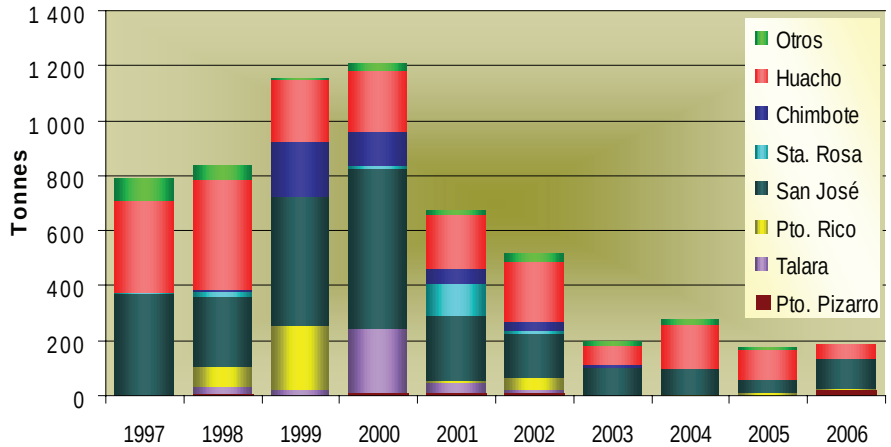
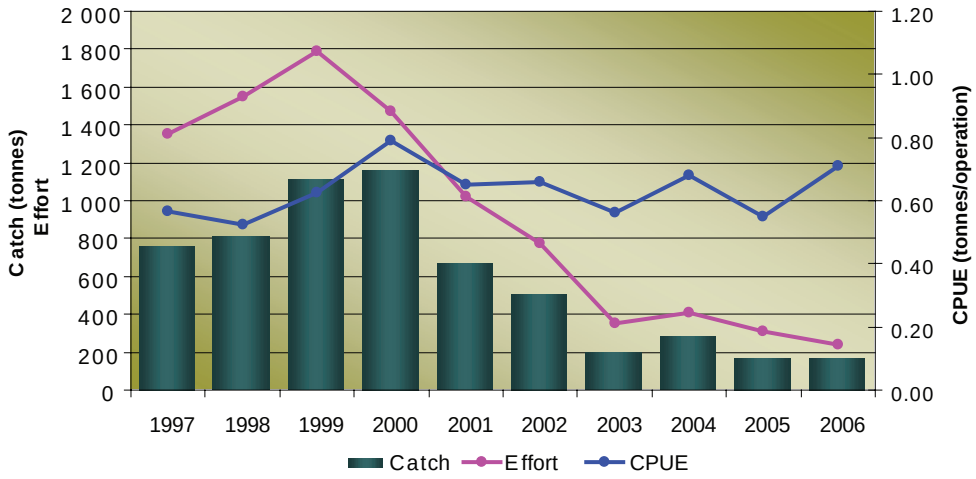


Figure A1.13 shows the number of beach seine operations and the catch per unit effort (CPUE). From 1997 to 2006, 9 258 fishing operations were carried out, making an average of 926 fishing operations per year. The highest fishing effort can be observed in 1999. Fishing effort declined continuously from 1999 to 2006, while the CPUE remained relatively stable with an annual average of 0.6 tonnes of fish per beach seine

FIGURE A1.13
Annual variation in catch compared to CPUE of beach seine landings in Peru, 1997–2007



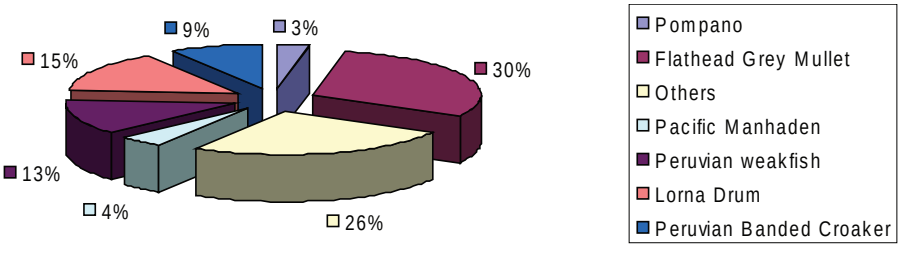
operation. The CPUE remained stable while both the catches and the number of beach seine operations declined. From 1997 to 2006 onwards, beach seining became concentrated and confined to those locations and seasons where and when resources were available and was not any longer carried out at locations where resources were no longer available.

Altogether, 147 species of fish and invertebrates were identified in beach seine catches in Peru. Overall, 90.5 percent of the catch was composed of fish and 8.8 percent of invertebrates. Most of the fish caught were croakers (*Scianidae*), *Caranx* (*Carangidae*), sea basses and groupers (*Serranidae*) and smooth dogfish sharks (*Triakidae*). Of the invertebrates, squids (*Loliginidae*), crabs (*Xanthidae* and *Portunidae*) and prawns (*Penaeidae*) dominated the invertebrate catch, the latter ones being caught during El Niño. Incidental catch of beach seines also included sea turtles.

In terms of biodiversity, only six species accounted for 74.2 percent of the total catch. Flathead mullet (*Mugil cephalus*), locally called *lisa*, was the most common species caught accounting for 29.8 percent of the catch; followed by Lorna drum (*Sciaena deliciosa*), locally called *lorna* (15 percent); Peruvian weakfish (*Cynoscion analis*), locally called *cachema* (13.1 percent); Peruvian banded croaker (*Paralonchurus peruanus*), locally called *coco*; Pacific menhaden (*Ethmidium maculatum*), locally called *machete*; and Paloma pompano (*Trachinotus paitensis*), locally called pámpano. Other species accounted for 25.8 percent. The species composition of beach seine landings is shown in Figure A1.14.

Beach seine fishing in Peru, particularly mechanized beach seining, is carried out on flat and sandy beaches. Fishing boats and nets are transported by trucks or pickups

FIGURE A1.14
Catch composition by species caught (%)



along the shore to the fishing area. The operation is similar to the operation of beach seines in other countries, except for the fact that the hauling of the net is done with the help of motor vehicles, usually four-wheel drive jeeps or trucks. After a shoal of fish has been sighted, the net is carried out by the boat to encircle the shoal. Once it has been encircled, the net is hauled onto the beach mechanically with the help of four-wheel drive jeeps. Table A1.36 shows boats and cars and their specifications which are used for mechanized beach seining along the southern coastline.

TABLE A1.36
Technical characteristics of boats and cars used for mechanized beach seining along the southern coast of Peru

Characteristics		Region							
		Tacna		Mollendo		Camaná		Lomas	
Boats	**Name of boat**	**Jesús Nazareno I**	**Jesús Nazareno II**	**Russel y Marcel I**	**Russel y Marcel II**	**Maria Alejandra I**	**Maria Alejandra II**	**Ivan I**	**Ivan II**
	Length (m)	4.58	4.58	4.18	4.18	4.18	4.18	4.27	4.27
	Beam (m)	1.82	1.82	1.68	1.68	1.68	1.68	1.68	1.68
	Height (m)	1.00	1.00	1.03	1.03	1.03	1.03	1.03	1.03
	Draft	0.4	0.4	0.5	0.5	0.5	0.5	0.5	0.5
	Horsepower	60	60	60	60	60	60	60	60
	Construction material	FRP	FRP	FRP	FRP	FRP	FRP	FRP	FRP
	Engine	Yamaha	Yamaha	Yamaha	Yamaha	Yamaha	Yamaha	Yamaha	Yamaha
	Operating speed when shooting seine (knots)	8	8	8	8	8	8	8	8
Cars	**Year**	**1980**	**1980**	**1974**	**1974**	**1974**	**1985**	**1971**	**1980**
	Make	Toyota	Toyota	Toyota	Toyota	Toyota	Nissan	Toyota	Toyota
	Model	Land Cruiser	Land Cruiser	Land Cruiser	Land Cruiser	Land Cruiser	Patrol	Land Cruiser	Land Cruiser
	Engine	Nissan diesel	Nissan diesel	Toyota diesel	Toyota gasoline	Toyota diesel	Nissan gasoline	Toyota diesel	Toyota gasoline
	Horsepower	120	120	111	111	111	120	108	120
	Operating speed when hauling seine (km/hr)	5	5	5	5	5	5	5	5

Note: FRP = fibre-reinforced plastic.
Source: Salazar *et al.*, 2000.

Peruvian beach seines consist principally of anterior and posterior wings, a seine body and codend, weighted foot ropes, buoyed head ropes and hauling ropes. In the case study, five mechanized beach seines are described, which were operated in the areas of Mollendo, Camaná and Lomas. The length of each wing and seine body of these nets ranges from 46 to 54 metres and the height of the wings ranges from 5.7 to 7 metres. The nets consist of 4 to 9 panels. The mesh size in the seine body ranges from 57 to 64 mm and the maximum mesh size in the wings ranges from 127 to 179 mm.

The case study also describes six manually operated beach seines in Huacho and five manually operated beach seines in San José. The manual beach seines of Huacho consist of 5 to 7 panels of netting. The length of the wings and seine body ranges from 109 to 177 metres. The mesh size in the seine body of these net ranges from 30 to 55 mm and the maximum mesh size in the wings range from 45 to 200 mm. The length of a wing and seine body of manual beach seines in San José range from 240 to 305 metres. The mesh size in the seine body of these net ranges from 40 to 51 mm and in the wings the maximum mesh size ranges from 56 to 89 mm.

The technical specifications and design of both mechanized and manual beach seines used in Mollendo, Camaná and Lomas are shown in Annex 2. Table A1.37 shows the technical specifications of beach seines in Palomino, Tassara, Cleto and Méndez.

TABLE A1.37
Technical specifications of beach seines in Peru

Characteristic	Beach seine no. 1 (Palomino)	Beach seine no. 2 (Palomino)	Beach seine no. 1 (Tassara)	Beach seine no. 2 (Tassara)	Beach seine no. 1 (Cleto)	Beach seine no. 1 (Méndez)
Material	Multifilament PA	Multifilament PA	Multifilament PA	Multifilament PA	Multifilament PA	Multifilament PA
Colour	Green	Green	Green	Green	Green	Green
Twine size	210/48	210/48	210/48/72	210/48/36/72	210/60	210/36
Mesh size	52.7-57.15	63.5	63.5	57.25	45-60	63.5
Length of panel (m)	9-5.5	11.3	6.3	7.81	7.5-6.4	8.08
Width (no. of meshes)	100-110	103			142-127	
Height (no. of meshes)	240-121	240			112-92	

Source: Salazar *et al.*, 2000.

Impact on environment and resources

As far as the impact of beach seine fishing on the marine habitat is concerned, only a minority of beach seine fishers (16 percent in San José and 20 percent in Huacho) who were interviewed during the case study agreed that beach seining had a negative impact, while the majority (80 percent in Huacho and 30 percent in San José) did not think that beach seine fishing had a negative impact on the environment.

However, fishing experiments in Peru show though that the percentage of juveniles in the catch of beach seines can be as high as 50 percent owing to the small mesh sizes used.

2. Social and demographic characteristics of fishers and their access to social services and infrastructure

Ownership, sharing of income, demographic characteristics

Fishers in San José were between 18 to 28 years of age and many of them were students, while in Huacho fishers were older, 30 to 49 years of age. As far as the level of education is concerned, in the region of San José, the level of education among those involved in beach seine fisheries was found to be comparatively low. About 55 percent of all interviewed attended primary school but not all completed it. Forty-two percent had a secondary education and only 3 percent reached some level of higher education. However, in Huacho the educational level of fishers was higher, with some 33 percent having attended primary school at least for some time and 58 percent completing primary education and undergoing secondary education for some years. Seven percent reached some level of higher education.

Occupational diversity of beach seine crews and households

As far as occupational diversification and supplementary sources of income are concerned, beach seining in the study areas and at the national level is a complementary economic activity. Only 7 percent of the persons interviewed in the case study areas (similar to the national level) practise it year round. For the other 93 percent, beach seining is a part-time or occasional occupation since their main occupational involvement is in industrial fishing, agriculture, transportation, construction, carpentry and other professions/crafts.

With regard to other income-generating activities, the study found that in San José industrial fisheries is the most important occupation, carried out by about one-third of beach seine crews. Nine percent are involved in other types of artisanal fisheries. Forty-two percent of the beach seine fishers of San José had other sources of income in addition to those from fishing, while 58 percent depended entirely on fishing as their source of income. In Huacho, almost two-thirds of beach seine fishers also had other forms of income while about one-third depended entirely on fishing for their income.

About one-fourth of beach seine crews were involved in agriculture and 12 percent were involved in other types of supplementary employment, such as carpentry, transportation and construction work. In Huacho, the most important other income-generating activities were other types of small-scale fishing (28 percent) followed by industrial fishing. Carpentry, transportation, construction work (11 percent) and agriculture (4 percent) were of lesser importance.

Economic status, poverty, food security and vulnerability

With a view to determine the level of poverty of beach seine fishers, the case study carried out in Peru included an assessment of whether the basic needs of beach seine fishers were met. The concept of basic needs covers various aspects related to size of family, demographic characteristics, income, expenses, assets, quality of housing, sanitary conditions and facilities, access to safe drinking water, health and other services, as well as education.

In order to determine the level of poverty of the beach seine fishers, the field team used the methodology of unsatisfied basic needs. In Peru, five basic indicators are considered using the minimum criteria for measuring absolute poverty (Statistical Methodologies, Instituto Nacional de Estadistica e Informática, 2000).

The indicators used were as follows:

Households with inadequate physical characteristics. This indicator predominantly deals with the materials of the walls and floors. Those houses that did not meet the minimum requirements were those where the main material of the exterior walls were made of thatch, stone, clay, wood or other materials, and informal dwellings made of cardboard, zinc walls, mud, etc.

Houses with overcrowded spaces. This indicator relates to the number of inhabitants relative to the number of rooms (bathroom and kitchen are not counted). When there are more than three persons per room, this is considered overcrowding.

Houses without any type of drainage. The availability of basic hygienic services is essential. Toilet or a place to deposit excreta reduces the risk of contamination and disease. The minimum requirement is that households have toilet connected to pipe work or to a cesspit.

Households with high economic dependence. This is a household where there is high burden on the household as there is no member of the household working and the head of the household did not finish primary school, thereby limiting his/her possibilities for income.

Critical level of education of the head of the household. The head of household is in general the only one that brings income to the household. In this sense, the critical education level is when the head of household did not complete primary education.

The team then identified the houses that lacked each indicator, then the proportion of houses that lacked each indicator was calculated in relation to the total number of corresponding houses. The houses were then placed into four groups, as follows:

Group 1 = Households with 1 basic necessity unsatisfied
Group 2 = Households with 2 basic necessities unsatisfied
Group 3 = Households with 3 basic necessities unsatisfied
Group 4 = Households with 4 basic necessities unsatisfied

In these four groups, the sum and aggregation of the index of basic unsatisfied needs that represents the homes with at least one basic unsatisfied need were summarized using the formula:

INBI = Index of basic unsatisfied needs; HOGi = Homes with at least one basic need unsatisfied reflected in each indicator; and HT = Total houses.

$$INBI = \sum_{i=1}^{n=4} \frac{HOG_i}{HT} * 100$$

Three groups were generated as follows:

- Homes with basic satisfied needs, considered not poor and have all basic needs satisfied.
- Homes with basic needs unsatisfied. These were identified as poor and in this group were homes that had a least one basic need unsatisfied.
- Homes with two or more basic needs unsatisfied. These were considered extremely poor.

For the San José region, the study concluded that one-fourth of beach seine fishers and their households were living in poverty. Out of these, 22 percent were not considered extremely poor as only one of their basic needs was not met. Three percent of beach seine fishers in San José were considered to live in extreme poverty as two or more of their basic needs were not satisfied. The situation was very similar in Huacho, where about one-fourth of beach seine fishers and their households were found to live in poverty and 5 percent were found to live in extreme poverty.

3. Regulation and management of beach seining, conflicts with other users of fishery resources and shorelines

National legislation, regulations and management of beach seining

Small-scale fisheries in Peru, including beach seining, is regulated by the General Fisheries Law (Supreme Decree No. 005-89-PE of 1.4.1989) and various ministerial resolutions, among others the Ministerial Resolution No. 067-98-PE of 14.2.1998, in force from 15 February to 30 June 1998 and extended to 30 November by Ministerial Resolution No. 314-978-PE, Ministerial Resolution No. 080-99-PE of 10.3.1999, Supreme Decree No. 012-2001-PE, Supreme Decree No. 008-2002-PE of 3.7.2002 and the regional ordinance of Lambayeque (No. 022-2006-GR.LAMB/CR).

Mechanized beach seine fishing was banned by Ministerial Resolution in 1998. The minimum mesh size in the seine body for manual beach seines was regulated as 38 mm. The regional ordinance of Lambayeque (No. 022-2006-GR.LAMB/CR) of 2006 increased the minimum mesh size in the seine body to 63.5 mm.

Fisheries management in Peru is undertaken by the Department of Fisheries in consultation with the fishery industry and fishers' associations.

As far as the ban on mechanized beach seining is concerned, it has been observed that the ban is not effective and that mechanized beach seining is still being carried out.

Conflicts and competition with other users of beaches and fishing grounds

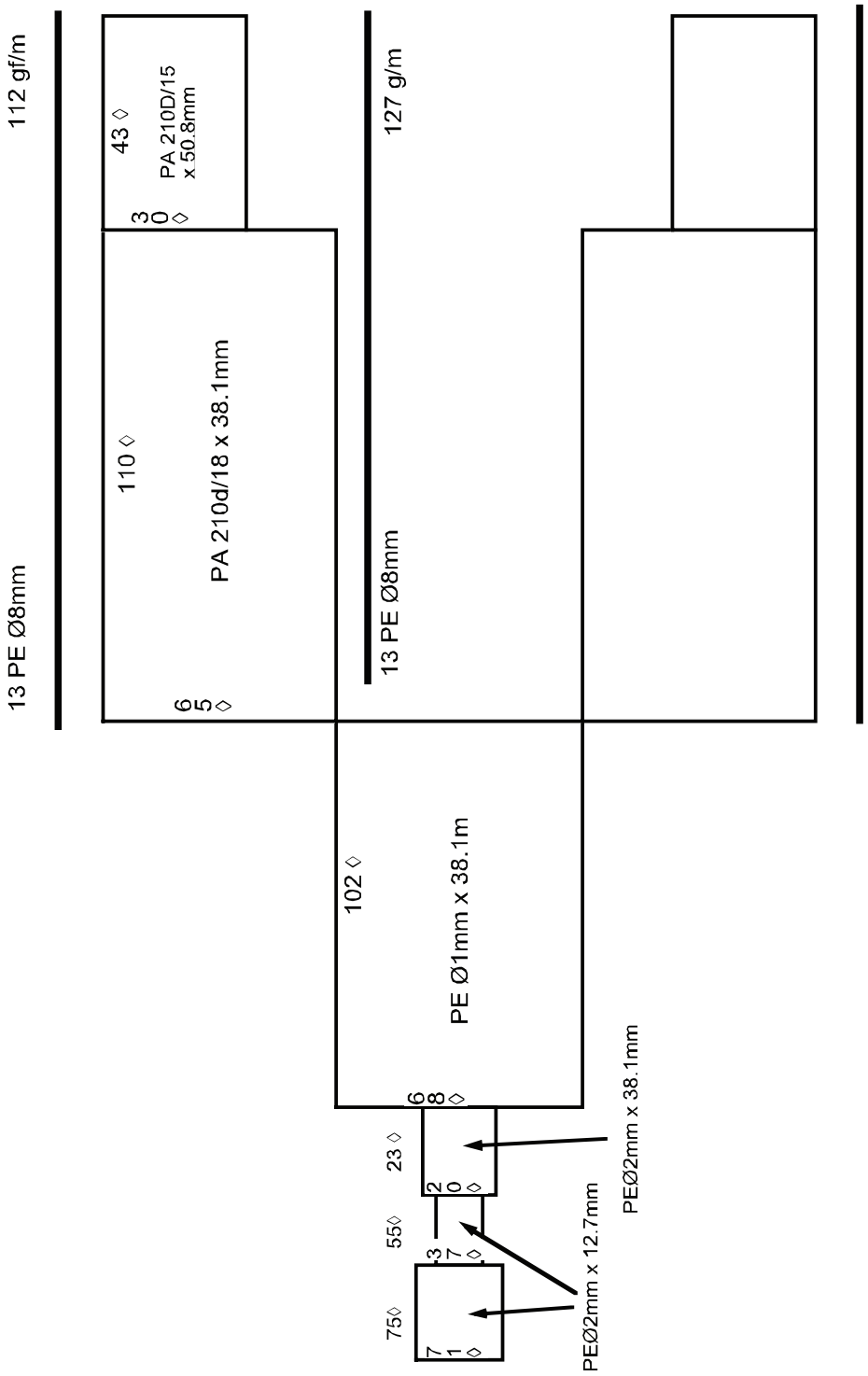
Conflicts with other fishers were common in both locations where the field study was carried out, i.e. San José and Huacho. These conflicts are related to competition for similar resources and for space on the same fishing grounds.

While beach seine fishers were aware of a negative impact of beach seines because of the catching of juvenile fish, they were also against the ban of mechanized beach seining but not against regulating beach seine fisheries. The appropriate management measure supported by them was the setting of minimum mesh size requirements.

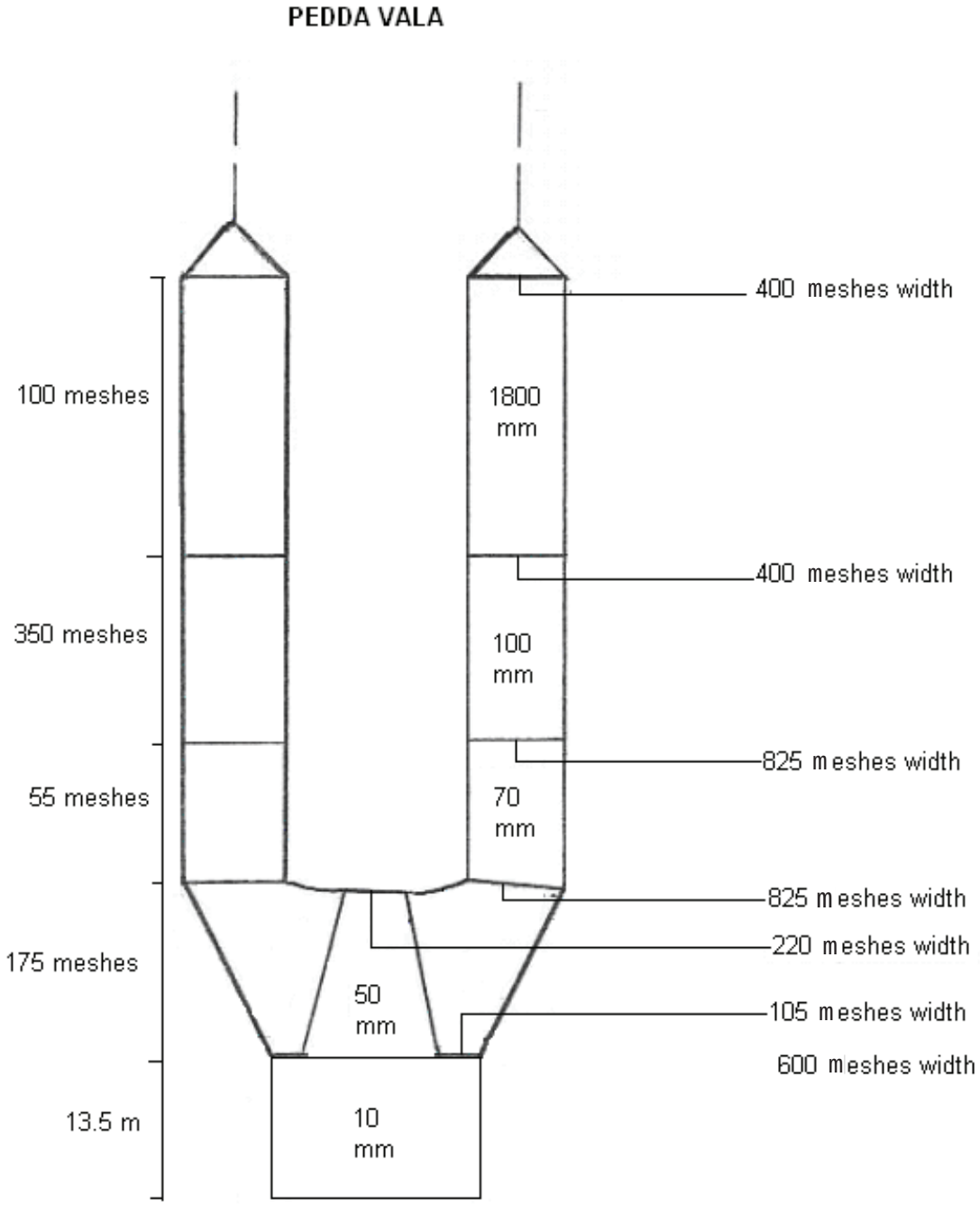
Annex 2

Designs of beach seines from the case study countries

Mini beach seine design, Inhassoro and Petane, Inhambane Province, Mozambique



***Pedda vala* beach seine with codend, northern Andhra Pradesh, India**

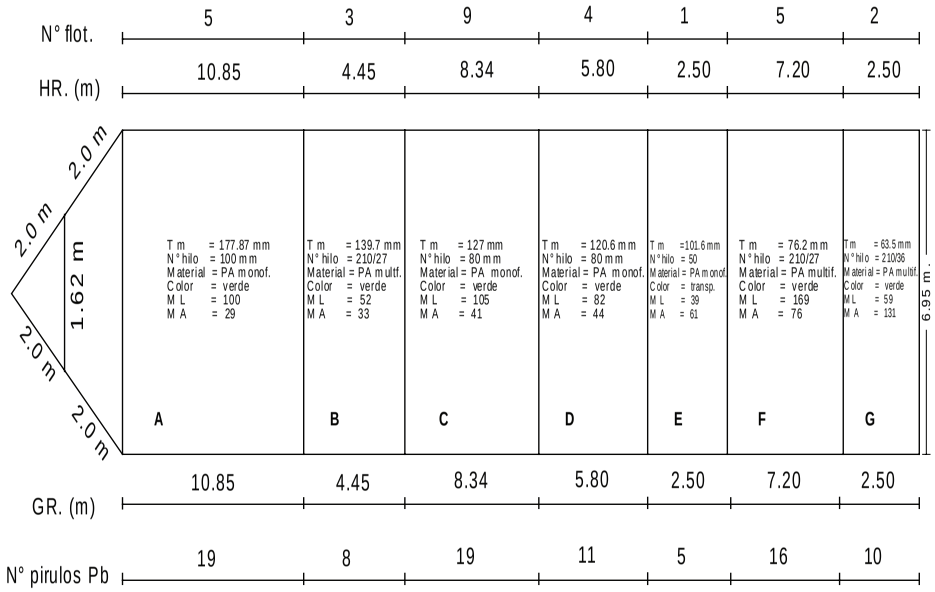


Design of mechanized beach seine used in Camaná, Peru, in 2006

RED CHINCHORRO N° 1

Tipo : Mecanizado
Propietario : Luis Tassara
Lugar : Camana
Pesca : Lorna, Machete, Sardina, otros.

ALAS N°1 y 2



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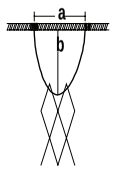


HR = Relinga Superior
GR = Relinga Inferior
Tm = Tamaño de malla
ML = Mallas de Largo
MA = mallas de Alto

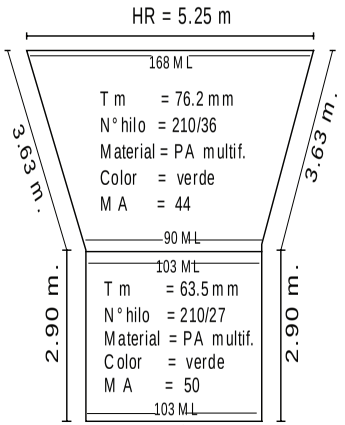
Source: Salazar *et al.*, 2000.

RED CHINCHORRO N° 1

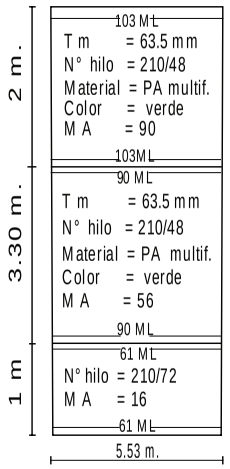
Tipo : Mecanizado
Propietario : Luis Tassara
Lugar : Camana
Pesca : Lorna, Machete, Sardina, otros.

TUNEL

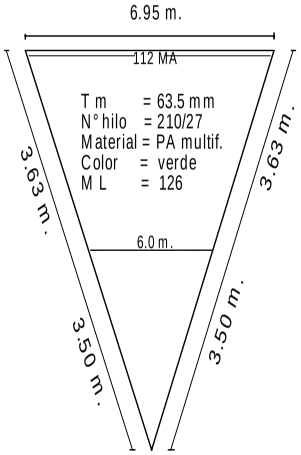
PANEL SUPERIOR e INFERIOR



COPO



LATERALES



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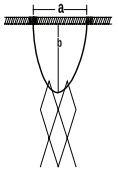


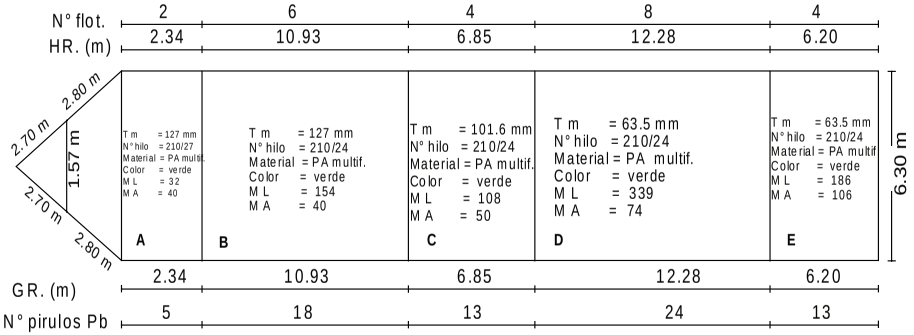
HR = Relinga Superior
GR = Relinga Inferior
Tm = Tamaño de malla
ML = Mallas de Largo
MA = mallas de Alto

Design of mechanized beach seine used in Lomas, Peru, in 2006

RED CHINCHORRO N° 1

Tipo : Mecanizado
Propietario : Elver Mendez Quispe
Lugar : Tanaka
Pesca : Lorna, otros.

ALAS N°1



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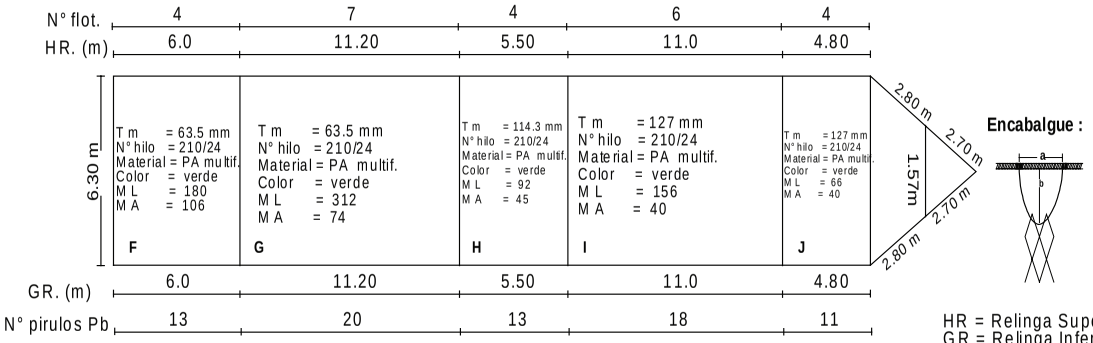


Encabalgue :

HR = Relinga Superior
GR = Relinga Inferior
Tm = Tamaño de malla
ML = Mallas de Largo
MA = mallas de Alto

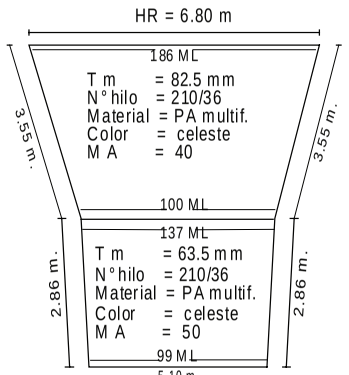
Source: Salazar *et al.*, 2000.

RED CHINCHORRO N° 1

Tipo : Mecanizado
Propietario : Elver Mendez Quispe
Lugar : Tanaka
Pesca : Lorna, otros.

TUNEL

PANEL SUPERIOR E INFERIOR



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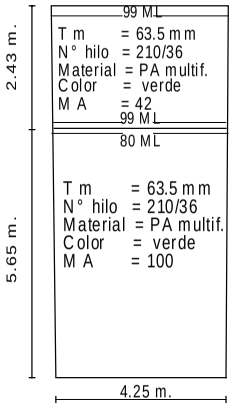
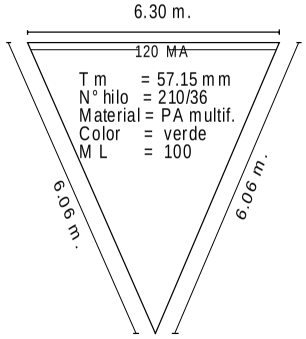


LATERALES



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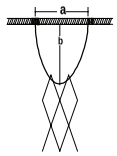
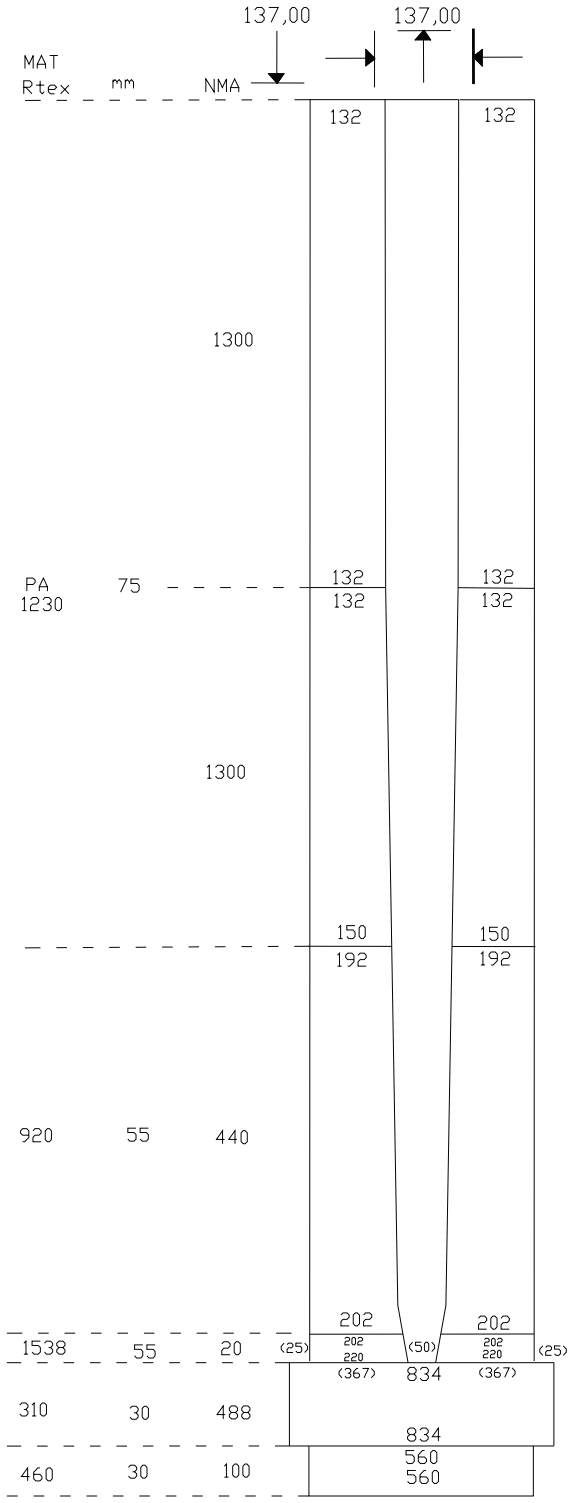


HR = Relinga Superior
GR = Relinga Inferior
Tm = Tamaño de malla
ML = Mallas de Largo
MA = mallas de Alto

Design of manual beach seine used in Huacho, Peru, in 2006



RED CHINCHORRO
Especie Calamar

Embarcaciones:

Don Jose I &	DonJose II
Et = 5,0 m	Et = 6,5 m
m = 1,30 m	m = 1,80 m
p = 0,70 m	p = 0,80 m

A

Source: Salazar *et al.*, 2003.

Design of manual beach seine used in San José, Peru, in 2006

REFERENCIA
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Instituto del mar del Perú

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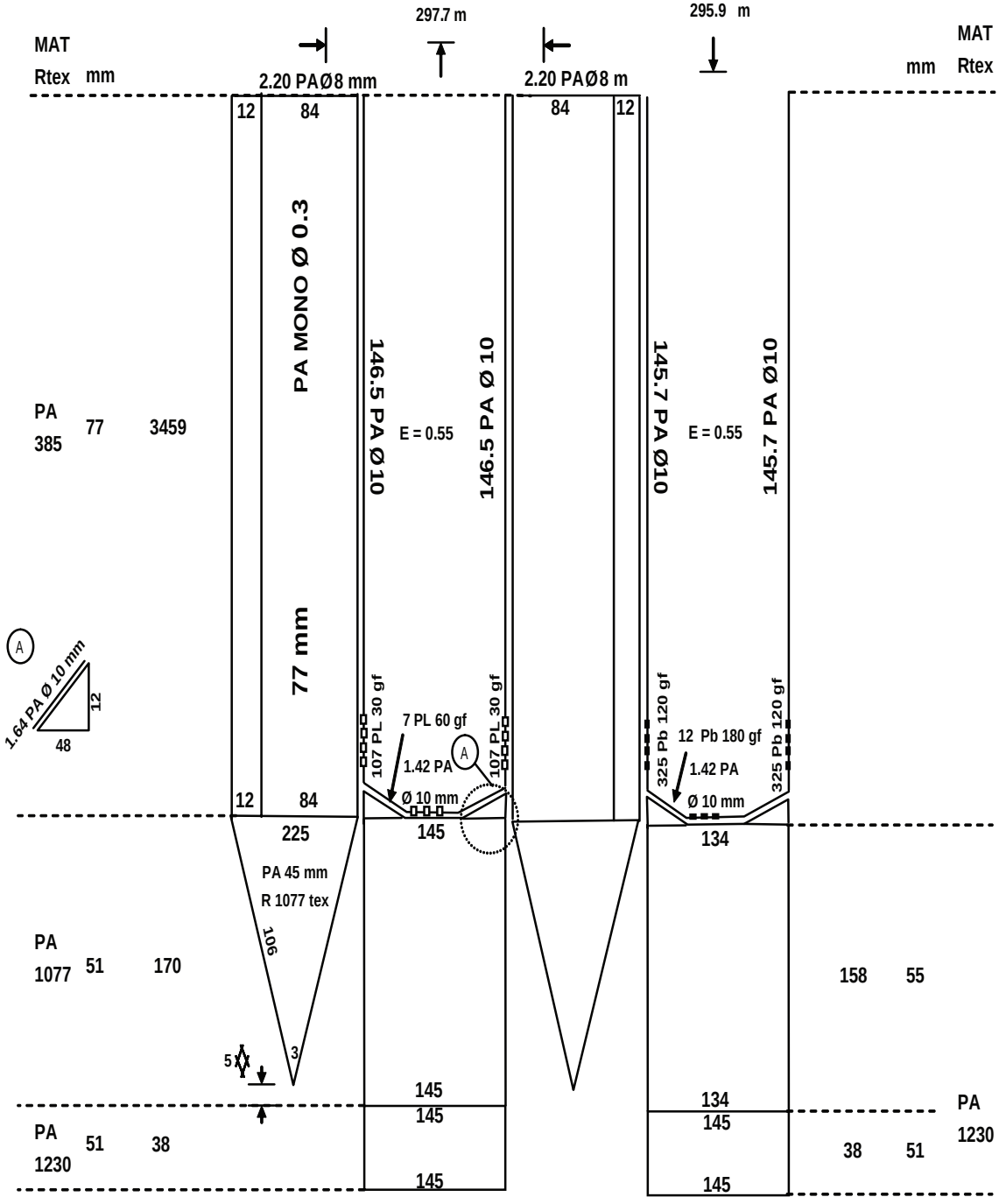
Red Chinchorro Manual
Cachema, Suco, Lisa y otros recursos costeros
Caleta de San José – Lambayeque - Perú

PROPIETARIO
Juan Carrillo Ayala
Red 1
Malla diamante



Source: Ganoza *et al.*, 2007.

Annex 3

Financial and economic study of beach seining in Sri Lanka

Monthly earnings and expenditure (in LKR) of beach seine operations in the northwestern and southern regions of Sri Lanka (Fernando, 2001)

Catch rates, value and expenditure	Northwestern region			Southern region		
	Mampuri (n=34)*	Sinnapadu (n=28)	Udappu (n=40)	Mawella (n=71)	Kalametiya (n=38)	Welipatanwila (n=50)
Average catch per operation (kg)	198.2	404.6	203.7	81.8	290.7	167.3
Average value of catch per operation (LKR)	4 034	16 132	6 467	3 330	10 250	6 222
Average monthly earnings (LKR)	80 682	322 654	129 341	71 160	222 660	129 440
Average monthly expenditure (LKR)	35 000	35 000	35 000	5 000	15 000	5 000

*Number of beach seine operations on which data are based.

Cost of non-wooden motorized boat (wooden *vallam*) in Udappu was LKR 100 000. Cost of the beach seine was LKR 200 000 (2001).

Assumptions made for calculations:

- annual depreciation of a *vallam* as 15 percent;
- annual depreciation of fishing gear as 20 percent (FAO, 1999b: 5);
- average seven-month beach seine operating season per year; and
- annual interest rate of 5 percent, taking into consideration the availability of no or low-interest fisheries credit programmes in Sri Lanka in the 1990s.

Annual net cash flow and return on investment (in LKR) of beach seine operations in the northwestern and southern regions of Sri Lanka

Indicator/location	Northwestern region			Southern region		
	Mampuri	Sinnapadu	Udappu	Mawella	Kalametiya	Welipatanwila
(a) Total annual earnings (TE)	564 774	2 258 578	905 387	498 120	1 558 620	906 080
(b) Annual operating costs	245 000	245 000	245 000	35 000	105 000	35 000
(c) Annual depreciation of boat and net	55 000	55 000	55 000	55 000	55 000	55 000
(d) Interest	15 000	15 000	15 000	15 000	15 000	15 000
(e) Operating costs and depreciation and interest (b+c+d)	315 000	315 000	315 000	105 000	175 000	105 000
(f) Annual net cash flow (NCF) (a-e)	249 774	1 943 578	590 387	393 120	1 383 620	801 080
(g) Annual return on investment (ROI) (%) (f/300 000)	83	648	197	131	461	267
(h) NCF/TE (%) (f/a)	44	86	65	79	89	88

This document provides a global overview of beach seine fisheries and identifies key issues relevant for the responsible use of beach seines and the sustainable livelihoods of beach seine fishers. It also gives guidelines for fisheries managers and other stakeholders on how best to address the issues of management processes and measures, which have the mutually beneficial goals of restoring and conserving the health of fishery resources and their habitats and safeguarding the livelihoods of fishers and their communities. The document draws on the findings of case studies coordinated and funded by the Food and Agriculture Organization of the United Nations (FAO) Fisheries and Aquaculture Department in the Gambia, India, Kenya, Mozambique, Peru and Sri Lanka, and by the FAO/United Kingdom Department for International Development (DFID) Sustainable Fisheries Livelihoods Programme (SFLP) in Benin, Ghana and Togo. In addition to the findings of the case studies, other studies and publications on beach seines were reviewed and used for the preparation of this document.

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