Sea cucumber fishery in Tanzania: identifying the gaps in resource inventory and management

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Abstract

The story of over-exploitation of sea cucumbers in Tanzania has been repeated in many locations throughout the Indian Ocean. Collection methods include (i) hand-picking, (ii) collection by free diving using homemade goggles and (iii) SCUBA diving in a few locations. Neither fishery regulations, nor mariculture or resource inventories have been conducted as steps towards management and conservation of sea cucumber in Tanzania. Data was compiled from various works carried out on the sea cucumber resource in Tanzania and from questionnaires that were given to sea cucumber dealers and fishery officials. This approach revealed several factors underlying the lack of management of sea cucumber resources, notably (a) the extent to which the stock size of this resource is known to fishers of Tanzania, (b) the lack of a proper management framework and stock assessment on sea cucumbers, and (c) scientific orientation of funding agencies and research findings contrary to dealers' level of education and technological capacity. The appropriate actions to achieve successful management of sea cucumbers should be taken in phases. That is, to raise the fishers awareness, carry out resource assessment, implementation of regulations and establishment of a pilot small-scale mariculture activity of the most known species in Tanzania, *Holothuria scabra*.

Keywords: Holothurians, exploitation, mariculture, Western Indian Ocean

坦桑尼亚的海参渔业：资源量和渔业管理之间的差距

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摘要

坦桑尼亚海参资源遭到过度捕捞在印度洋地区广为人知。捕捞的方法有以下几种：（1）手拣，（2）戴上自制的潜水镜潜水捕捞，（3）穿轻潜水服潜水捕捞。在坦桑尼亚既无渔业法规，也无海参养殖，更不了解本国的海参资源量，故在资源管理和保护上举步维艰。本文中的资料来自于不同途径，有来自于分发给海参商贩的调查问卷，也有渔业官员提供的情况。结果显示，根本性的问题是缺乏对海参资源的管理：（1）不了解坦桑尼亚海参资源的状况，（2）缺乏一套对海参资源施行正确管理的框架和资源评估方法，（3）资助机构和科研部门所确定的方向与海参商贩的文化素质、技术能力相悖。 欲在海参渔业管理上取得成功，应该采取如下措施：让渔民了解海参的现状，开展资源评估，执行渔业法规，以及在坦桑尼亚建立一个示范性的海参养殖场，来繁殖培育坦桑尼亚最有名的糙海参（*Holothuria scabra*）

关键词：海参、开发、海水养殖、西印度洋

Introduction

Sea cucumbers have been harvested in the Indo-Pacific region for over 1 000 years (Hamel *et al*., 2001). In East Africa the fishery began in the 18th century (Conand and Sloan, 1989). However, inadequate management of the sea cucumber fishery has resulted in severe overfishing in many countries, resulting in widespread depletion of stock.

Overfished populations of sea cucumbers, especially *Holothuria scabra,* could take decades to recover if harvesting continues, unless ways to protect or manage the stock are implemented. James *et al*. (1994) suggested that most

overexploited species are likely to be depleted unless conservation measures are adopted. Lokani (1996) proposed a number of potential measures to protect the resource. These include: establishment of minimum size limit for capture, introducing strict quotas, limiting numbers of fishers, closed seasons, banning SCUBA diving, establishing reserves and promoting stock enhancement.

In recent times, numerous countries have increased interventions to protect the resource through different approaches (Hashim *et al*., 1999). In Malaysia, the Malaysia Network for Holothurians Conservation established conservative management guidelines and baseline surveys prior to the start of a fishery (Hashim *et al*., 1999). There is also a national programme to monitor sea cucumber fisheries at the landing sites (Baine and Choo, 1999). In Saipan Mariana Island, the Association of Coastal Resources Management Office (CRMO) conducts surveys of sea cucumber resources and documents any changes in populations (Tsuda, 1997). In the Galápagos Islands, prohibition of fishing for sea cucumber was a presidential decree (Martinez, 2001) and they practice a consensus-based, participatory management involving fishing, tourism, science, education and the national port authority.

In some areas of India, fisheries are restricted in waters between 2 and 3 m depth as juveniles are located in shallow coastal waters (Guruman and Krishnamurthy, 1994). In Yemen protective measures include the minimal legal fresh size limit of 10 cm and restriction of the harvest season (Gentle, 1985).

Sea cucumber fishery in Tanzania

During the first fishery survey in Tanzania, completed in 1963 (FAO/UNDP, 1964), emphasis was placed on efficient exploitation of the aquatic environment including marine waters (Singh, 1976). Sea cucumbers constitute one of the marine resources of Tanzania (Semesi *et al*., 1998). There has been rapid expansion of sea cucumber exploitation at some sites of Tanzania (Mgaya *et al.,* 1999). The fishery developed without baseline biological data and without any monitoring. Therefore to date, Tanzania has an unknown and unquantified resource of sea cucumber, but the fishery provides income to local collectors and generates exports. The fishery is largely artisanal with small commercial operations owned by exporters. Tanzania does not yet have the resources for regulation or to enforce restrictions on catches.

Local exploitation occurs year-round on reefs close to the shore sheltered from prevailing winds. The main collection seasons are October to December and April to May when winds are usually light, and trips can be made to the outer reefs. Sea cucumbers are purchased by a number of traders based in Dar Es Salaam, Tanga and Zanzibar from where they are exported to eastern Asia and elsewhere, mainly Hong Kong SAR (China) and Singapore (Marshall *et al*., 2001). Some importation statistics for sea cucumbers collected at Hong Kong during January-March 1996 showed that Tanzania ranks high in the Western Indian Ocean region (Infofish Trade News, 1996). Apart from official trade records, during this survey, traders claimed that illegal and unrecorded trade in beche-de-mer exists between Zanzibar, Tanga, Dar Es Salaam and Mombasa, Kenya. Barnett (1997) reported that beche-de-mer is sometimes exported as fish offal or fish maws to evade duty. Table 1 depicts official export figures for the period 1989 to 1997, showing the increase in the trade flow over the years.

Table 1. *Official beche-de-mer export statistics from Tanzania from (1989-1997 (metric tonnes).*

Year	1989	1990	1991	1992	1993	1994	1995	1996	1997
Export (tonnes)	107.9	189.2	193.0	219.9	398.2	565.6	292.8	324.6	277.9
Export (US$)	333 143	460 030	351 299	414 449	481 098	884 169	353 910	450 405	-

Source: Marshall et al., (2001).

The age and scale of various fisheries can be estimated from historical export data. In Tanzania it is not known whether the historical activity of the sea cucumber fishery fluctuated according to resource availability or for other reasons, and whether the fishery has been exploited on sustainable basis. However, during an informal interview with retired fishers, the common issue that arose was that trawling by commercial harvesters of prawns in the 1970s was

clandestinely fishing for sea cucumbers. This trend is still active in the southern regions of Tanzania. Commercial prawn trawlers in Kilwa and Bagamoyo often land a small by-catch of sea cucumbers. Commercial species collected in Tanzanian waters are shown in Table 2.

Some studies that have been done along some coastal villages in Tanzania are part of wider programmes of research work. These studies are generally scattered and localised to specific areas such that there is no national approach for establishment of fishery regulations and management of the resource.

Table 2. *Commercial species of sea cucumber in Tanzania (Source: Modified from Richmond, 2002).*

Scientific name	Common name	Local name	Value[1]
Actinopyga mauritiana	Surf Redfish	Mbura-Khaki	2
A. miliaris	Blackfish	Kijino	2
Bohadschia argus	Leopardfish	Barango	3
Holothuria atra	Lollyfish	Pesa	3
H. edulis	Pinkfish	-	3
H. fuscogilva	White Teatfish	Pauni-nyeupe	1
H. leucospilota	-	Sumu	3
H. nobilis	Black Teatfish	Pauni–nyeusi/Chui	1
H. scabra	Sandfish	Jongoo mchanga	1*
Thelenota ananas	Prickly Redfish	Spinyo mama	2

*Note1: Value rankings: * = the most over-exploited species, 1= high, 2= medium, 3= low.*

Collectors and opportunists sell the sea cucumbers to the processors at prices ranging from US$ 0.10 to 0.50 per fresh animal, processors sell the dried product to middlemen for US$ 0.90 to 6.00/kg, who in turn sell to exporters at US$ 3.00 to 17.00/kg dry weight. The export prices range from US$ 1.80 to 23.70/kg dry weight (some after reprocessing).

Resource assessment and fishery regulation

The fishery and processing activities are generally carried out by small scale localised enterprises, therefore statistics are scarce, not detailed and resource assessment is generally based on direct visual evaluation (Mmbaga, 2002). There is general lack of fishery management.

According to the Fisheries Act of 1970 and the Fisheries (General Amendment) Regulations of 1997 there are three types of licence fees paid annually by dealers and exporters. These licences include, (a) Local-individual or company with approved shore-based fish processing facilities, (b) Local-individual or company without approved shore-based fish processing facilities, and (c) Foreigner-individual or company with approved shore-based fish processing facilities. Foreigner-individual or company without approved shore-based fish processing facilities is prohibited (Marshall *et al.,* 2001). There is no specific legislation existing in Tanzania that refers to sea cucumbers and indicators of overexploitation are seen in many landing sites (Mmbaga, 2002).

This study aims to identify the knowledge gaps and analyses the existing situation in order to determine the proper ways to train fishers, processors and traders for better resource inventory and management.

Materials and methods

Study sites

Site selection was based on the extent of sea cucumber fishing, infrastructure, distance from the main port and disturbances due to tourist activities. Kunduchi (long exploited site and most disturbed shore), is compared to Sahare (in Tanga, the north region of Tanzania), Kaole at Bagamoyo (a moderately disturbed site with a long history of

exploitation), Mjimwema (near the port South of Dar Es Salaam with no history of exploitation), Buyuni (remote site of Dar Es Salaam with poor infrastructure and undisturbed site) and Kilwa Masoko (disturbed site with a long history of exploitation south of Dar Es Salaam). These sites represent main sea cucumber exploitation areas along the mainland coast of Tanzania.

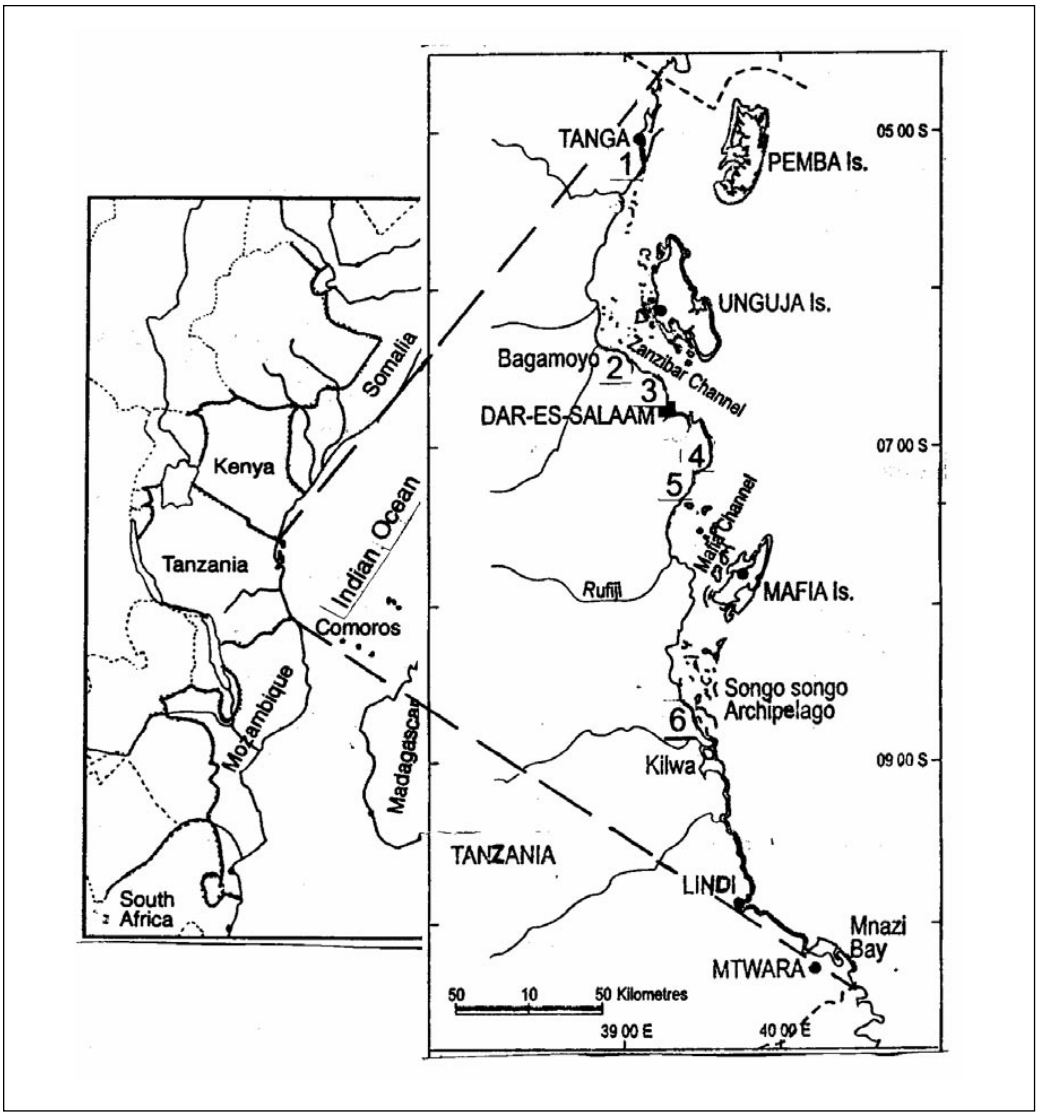


Figure 1. *Map showing study sites:* ***1****. Sahare,* ***2****. Kaole,* ***3****. Kunduchi,* ***4****. Mjimwema,* ***5****. Buyuni,* ***6****. Kilwa.*

Data collection

Data on sea cucumbers from studies so far carried out in Tanzania was searched from libraries and the internet while information on potential and key issues for mariculture in Tanzania was obtained using informal interviews and questionnaires given to sea cucumber dealers at the landing sites, homes, market places, and also to mariculture specialists and fisheries authorities. Data were collected from January to September 2002. The main characteristics of the surveyed population were obtained by noting: geographical distribution, number of people and gender, age, civil status, principal occupation, part played in sea cucumber fishery, education, access to sea cucumber information (fishers, radio, newspapers, TV and the internet) and communication with other sea cucumber dealers.

Results

A review of sea cucumber studies carried out in Tanzania revealed that most recommendations relate to fishery resource use and management measures (Table 3). No study on the sea cucumber stock size and area conducive for sea cucumber mariculture has been conducted in Tanzania. The recommendations from the studies do not show a methodological approach to be used in implementation of management measures.

***Table 3**. Review of previous studies carried out on sea cucumbers in Tanzania.*

Study	Coverage	Study category	General / Specific species	Recommendations
Tanzania/SWIOP (1985)	Handling and processing of sea cucumbers (Dar Es Salaam)	RU	General	Collectors and processors could gain by joining to form co-operatives.
Darwall (1996)	Resource use (Songo Songo)	RU	General	Appropriate conservation, management and regulatory measure.
Jiddawi (1997)	Reef dependent fisheries (Zanzibar)	GE	General	Sea cucumbers be looked upon and considered for farming.
Guard (1998)	Resource use (Mtwara)	RU	General	Regulatory measures should be established.
Horsfall (1998)	Sea cucumber depletion indicators (Tanzania)	DI	General	The role of sea cucumber on coral reefs and effect of their over-exploitation should be studied.
Mgaya *et al.* (1999)	Fishery and resource use in Bagamoyo District	RE	General	Need for effective enforcement of existing regulations and proper management.
Marshall *et al.* (2001)	Trade (Tanzania)	T	General	Develop legislation, limiting exports of juveniles and closed seasons in depleted areas.
Mmbaga (2002)	Fishery, ecology (Traded species) and biology of *Holothuria scabra* (Dar Es Salaam)	FEB	Specific	Provision of permanent transect for extensive data collection. Establishment of section to deal with: Stock assessment, Licensing, Quality control and Educational programmes.
Kithakeni & Ndaro (2002)	Some aspects of reproductive biology of *Holothuria scabra* (Dar Es Salaam)	RB	Specific species	Banning harvesting of juvenile *H. scabra* below 16.8 cm and during spawning season (August-September and December-January). More studies needed on the status of the resource. Application of closed season in most overexploited shores.

*Key: **RU** =Resource Use, **GE** = General Ecology, **DI** = Depletion Indicators, **RE** = Resource Evaluation, **RB** =Reproductive Biology, **T** = Trade, **FEB** = Fishery Ecology and Biology.*

Questionnaire findings

The percentage contribution of sea cucumber dealers for each village, out of the total number of dealers in sites surveyed, varied widely (Figure 2). The proportional number of dealers depended on the level of awareness, sea cucumber abundance, infrastructure development, nature of the shore and species available. The number of sea cucumber dealers was not the same all the year round. During the survey, a shifting of dealers was noted depending on the weather and abundance of sea cucumbers. Once the weather turns poor or an area is depleted, dealers move to the next shore where the animals are abundant.

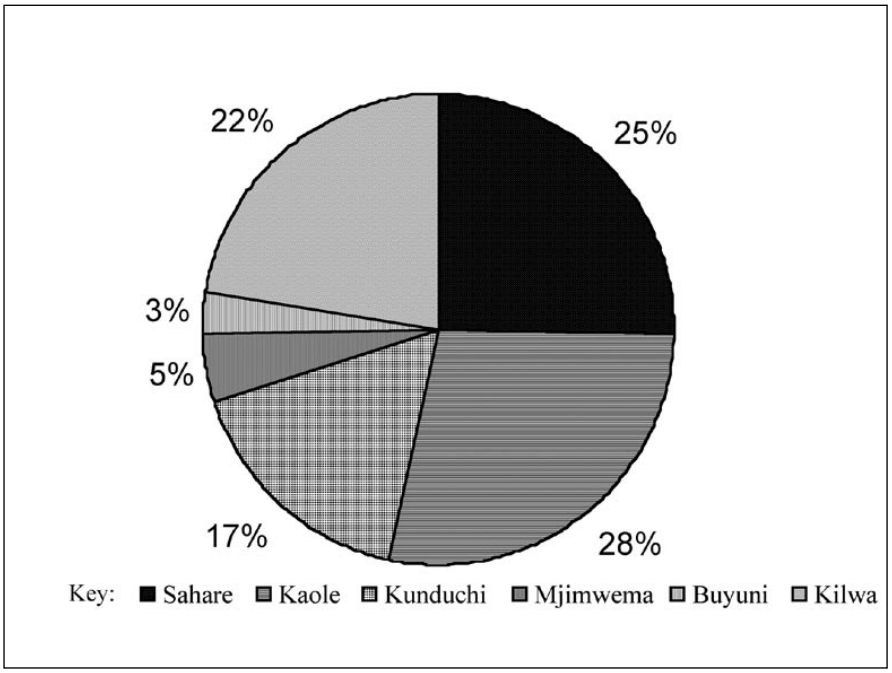


Figure 2. *Percentage number of sea cucumber dealers in the selected sites.*

The percentage of opportunists (people who collect sea cucumbers just because they have come across them) is high (32 %) compared to other dealers, namely, collectors (23 %), middlemen (17 %), processors (16 %) and traders (12 %) in the fishery.

Adult males predominantly operate this fishery (male = 99 %, female = 1 %) because collection is physically difficult. This is due to scarcity of the resource, which necessitates exploiting sub-tidal areas by diving. Married people indulge in sea cucumber fishery more than young unmarried people (66 % and 34 %, respectively).

Almost all adult male members (31-50 age group) of the remote coastal village communities participate in this fishery. Some peasants and people from other occupations collect sea cucumbers as a supplementary way to earn income (fishers 73 %, peasants 12 %, traders 12 %, middlemen 1 % and teachers 2 %). The large number of traders is an indicator of the lucrative nature of the business, as most processors are not aware of the relationship between prices and processed quality of sea cucumbers. For example, highly valued species like *Holothuria nobilis* and *H. scabra* are sold with low valued species.

Most sea cucumber dealers are primary school leavers (45 %) or below. Few secondary school leavers from Form 4 and 6 and diploma holders (19 %, 2 % and 2 % respectively) are middlemen and exporters in many surveyed areas. This implies that most of the information available (since it is in English language) cannot be understood and applied for fishery regulation and management of the resource.

The major source of information is from sea cucumber dealers (84 %), followed by television (10 %), newspapers and journals (3 %), radio (2 %) and the internet (2 %). There are neither NGOs nor dealers' associations addressing issues of sea cucumbers (e.g. overexploitation, legal size limits, prices in relation to species and required quality of the dried products in Tanzania). Problems faced by most sea cucumber dealers in this fishery include: lack of proper processing equipment, poor preparation knowledge, low price, lack of transport facilities to the selling station, scarcity of sea cucumbers in accessible depth and shores and lack of information on markets.

Some fishers are aware and against the collection of juveniles, but blame a lack of legal recognition of the traditional systems of management. Under the traditional system of management, older fishers command respect and authority on customs and traditions related to fishing practices. However, this system has collapsed as a result of the erosion of the authority of the elders as guardians of the system. Political developments (e.g. grouping of villages in communes) encouraged newcomers who did not feel that they had to submit to the authority of elders or adhere to long established

customs. The elders' ability to impose sanctions on individuals who disregarded the regulations was hampered by the growing importance of government regulations.

Currently when sea cucumber dealers face problems related to price, quality and preparation methods they consult middlemen, processors and collectors. Middlemen, followed by the processors and collectors, seem to be the most informed group in this fishery in all surveyed sites.

Discussion

Problem analysis - sea cucumbers fishery

Most studies carried out on sea cucumbers in Tanzania are based on resource use, particularly processing, exploitation and trade. A recent study (Mmbaga, 2002) focused on reproductive biology of *Holothuria scabra*. Studies on biology, morphometrics, reproductive cycle and size at sexual maturity of most commercial species are lacking. Research results on the biology, stock status and trade can provide important information for application of surplus-yield models. The paucity of data on species catches and size of the processed products leads to a failure in management on a sustainable basis. These studies are essential if size limits and seasonal breeding closures are to be considered as management criteria (Conand, 1983). Some scientific methods of assessment have been employed in different countries to reveal the standing stock of sea cucumber depending on the nature of the fishery and environment (Conand, 1983).

For proper initiation of fishery management systems in Tanzania, the standing stock of commercial species should be assessed; catches should be recorded as a contribution on the fishery statistics. Broad scale patterns of distribution of commercially important species of holothurians combined with significant correlation of abundance with characteristics of the main habitats should be known. Surveys of boats, processors and traders of sea cucumber should be undertaken so as to get an insight into the status of the sea cucumber fishery in Tanzania.

The Tanzania/SWIOP workshop conducted in 1985 imparted some knowledge on how to process sea cucumbers. This was endorsed by some people (middlemen) among the surveyed group who admitted that the elementary knowledge they have was obtained from this workshop. The workshop on processing was vital for the fishery as the price of sea cucumber depended on their processed quality.

After many years of overexploitation, the sea cucumber price is currently affected by the reduced size of the animal and poor quality hence the differences in export earnings between Tanzania and neighbouring Madagascar. Although Tanzania leads in terms of tonnage (73.8 tonnes), the overall export income is lower (HK$ 1.676 m) compared to Madagascar (40.3 tonnes; HK$ 4.242 m). Low earnings are likely to continue as newcomers to the trade lack the necessary technology to prepare quality beche-de-mer.

The collectors, processors and some middlemen were concerned over the lack of sea cucumber fishery information (stock size, spatial distribution and biology). The information available in publications such as the *SPC Beche-de-Mer Information Bulletin* is not accessible to fishermen, given their low education, lack of money and lack of access to the internet. However, most of the surveyed population get information from their peers while a very few have information on processing methods from the 1985 Tanzania/SWIOP workshop documents, with others obtaining general fishery information from radio and television. This calls for an immediate start of a radio broadcast in Kiswahili, newspapers and television educational programmes to raise people's awareness about sea cucumbers and its fishery potential.

Tanzania, like other sea cucumber producing countries, should strive to disseminate information on sea cucumbers useful to dealers from within and outside the country. In Madagascar, Conand *et al.* (1998) suggested that sustainable management requires that scientific knowledge about the fishery biology be disseminated as soon as possible to dealers. Again, in Madagascar a National Trepang Traders group (ONET) has been set up to conduct national meetings to exchange information between the different participants in the beche-de-mer fisheries system (fishermen, processors, traders, administrators and scientists) (Hamel *et al.,* 2001).

Proper Management Framework

The lack of proper management in Tanzania is shown by a lack of documented regulations for the sea cucumber fishery. The Fisheries Act of 1970 is general and does not specify anything on sea cucumber exploitation and management. The Government should address the following issues: (i) research and documentation, (ii) identification and implementation of sustainable management actions, and (iii) exchange of information through seminars and workshops. The sustainable management of sea cucumber fisheries requires production models that combine data on fishery activity, population dynamics and socio-economic aspects that are particularly important for these small artisan activities (Hamel *et al*., 2001).

Poor management frameworks were also a problem in the past for other sea cucumber producing countries. For example, the government of Papua New Guinea imposed a partial moratorium to protect the endangered resource but, due to a lack of proper management frameworks, Lokani *et al.* (1995) indicated that the size limit of 15 cm and the gear restrictions did not prevent overfishing. The government of India imposed a ban on the export of small sea cucumbers in 1982, but this created a crisis in the Indian sea cucumber fishery industry (Silas *et al*., 1985). In the Solomon Islands the government banned the collection and sale of *Holothuria scabra* in 1997 (Battaglene, 1998), but illegal harvesting continued (Hamel *et al*., 2001).

An effective management framework for sea cucumbers has been achieved in some countries, e.g., by establishment of a sea cucumber fishery sector and association (ONET) in Madagascar (Conand *et al*., 1998), a Malaysian Network for Holothurians Conservation and Management (HCSM) (Baine and Choo, 1999) in Malaysia, PESCOM international in Mozambique (Dutton and Zolho, 1994; Costa and Montecino, 1990), and the Queensland East Coast Beche de mer Industry Association (QECBIA) in Australia (Schoppe, 2000). These sectors and organisations have clearly identified action plans for sustainable management that could be easily transferred to Tanzania.

Scientific orientation of funding agencies, research results and recommendations

Some funding agencies place emphasis on scientific content in the proposals at the expense of resource management and conservation. Emphasis should be placed on utilization of human resources within local communities which do not require skills beyond the capacity of the available personnel to monitor and implement recommendations. Most of the sea cucumber dealers surveyed (artisanal fishers) have a low level of education. Most of them are primary school leavers without any knowledge on fisheries biology and management. The findings from studies carried out in Tanzania have been difficult to understand by sea cucumber dealers who are unable to relate them to the everyday fishery practices.

Rewriting some research results and recommendations in simple language spoken or understood by sea cucumber dealers (possibly in Kiswahili) can fill this gap. This will raise understanding and ease implementation of shared management activities for sea cucumbers. In Madagascar, Conand *et al*. (1998) pointed out the shared management approach, involving the organised profession (exporters, harvesters), the fishery administration, the scientific research interests and local communities was established to reduce overexploitation of sea cucumbers.

Prospects for sea cucumber mariculture in Tanzania

The coastline of Tanzania consists of mangrove areas, seagrass meadows, fringing coral reefs, intertidal flats, estuarine lagoons and bays with high biodiversity and a relatively unspoiled environment (Ngoile and Francis, 2001) within which there are potential sites for mariculture (Muhando *et al*., 2001). The requirements for establishment of sea cucumber fishery management systems and mariculture include availability of information from fishery research (e.g. on its potential and standing stock). However, at a national level, the Division of Fisheries receives only limited funding for mariculture development while at the regional and district levels there is no budget for mariculture activities (Mafwenga, 1994).

One gap for Tanzania is the lack of understanding of the potential of sea cucumber mariculture as a supplementary economic activity. This is reflected by an overwhelming (86 %) number of respondents (including collectors,

processors and middlemen) who endorsed lack of awareness on sea cucumber mariculture. The traders (14 %) expressed awareness on the potential of sea cucumber mariculture as an economic activity due to direct contact with sea cucumber traders in other countries.

Sea cucumber mariculture skills developed in other countries can be transferred to Tanzania in the same way as seaweed farming technology. In some cases, sea cucumber mariculture and seaweed farming can be integrated. Although sea cucumber development, mariculture research and technical capacity do not exist in Tanzania, technical assistance can be obtained through training, study tours and workshops.

Technological capacity

Generally sea cucumber dealers lack sea cucumber fishery and mariculture technology. The information from the Tanzania /SWIOP (1985) workshop is fading away and it is likely to continue diminishing as old fishers retire and newcomers to the business have no knowledge of this fishery. This was observed in various levels of the fishery, for example, the skipping of some procedures in the handling, preparation and drying methods of beche-de-mer. Different species are mixed and prepared by the same methods and procedures. This results in a low price at the selling station and no actions have been taken to make information available to the newcomers so as to rectify this problem.

Conclusion

In Tanzania, marine resources are regarded as belonging to the community. Open access to unmanaged sea cucumber resource will likely lead to depletion of the stock. However, to prevent such consequences, the FAO World Fisheries Conference in Rome (1983) recommended that governments should seek to ensure that fishers have clearly defined fishing rights and that the allowable catches do not exceed the productivity of the resource (King, 1995). Fishing methods for sea cucumbers are less selective, and protecting small individuals seems to be difficult. Therefore since beche-de-mer from Tanzania is for export, monitoring of legal size limits can be done at the level of the middlemen, buyers and exporters.

In the case of conservation and aquaculture, technical and financial support is necessary to effect changes in dealers' behaviour and for the adoption of new technology and management measures for sea cucumber resource in Tanzania. Collaborative efforts (community-based associations, policy-makers, researchers, educators, NGOs, funding agencies) are needed to ensure large-scale changes and rapid knowledge adoption. Associations should (i) plan an organised fishery system, (ii) set action plans appropriate to local setting, and (iii) be involved in the transfer of technology.

Recommendations

1. Resource assessments should be carried out by surveying all shallow areas to estimate the population (stock size) of each species traded in Tanzania and a socio-economic analysis carried out of the sea cucumber fishing community. Both governmental and non-governmental organizations could team up to accomplish this task.
2. Capacity building programmes (e.g., training, study tours, participation in national and international meetings and workshops on sea cucumbers) should be conducted and supported by both governmental and non-governmental organizations.
3. Law and policy enforcement should be ensured through regulatory mechanisms and collaborative management by government, dealers and private sectors to protect the wild sea cucumber stocks.
4. A demonstration sea cucumber farm should be established with the help of government institutions. This is expected to stimulate sea cucumber mariculture activities in the country.

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