

PERFORMANCE, POTENTIAL AND PROSPECTS OF FISHERIES SECTOR IN ERITREA

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ABSTRACT

Fish is important from the point of view of food and nutritional security, especially in developing countries. Most of the countries having sea gates and those having lakes are using different methods and techniques to exploit their fisheries sector to achieve their food security. Eritrea as one of the countries that has sea gate, also aims at using its fisheries resources to tackle the question of food security. It has a coastline that is more than 1,100 km long. The Red Sea is one of the underexploited potential fisheries resources in Eritrea. It is stated that Eritrea has the potential of maximum sustainable yield of 80,000 metric tons. But so far, research shows, the Eritrean fisheries sector is exploiting only 13% of this potential. So the Eritrean fishery is not yet optimally exploited. Therefore, it is an underutilized resource of the country. It does not yet contribute much towards food security of the country. This paper will examine the performance, potential and prospects of Eritrean fisheries and look at the main physical constraints in fish production such as the crafts and gear used in fishing. The paper also looks into the relationship of these factors to total fish landed in the country and the necessary steps that has to be taken to enhance fisheries production in the country.

Keywords: Fisheries development, artisanal fisheries, mechanized fisheries, Eritrea

INTRODUCTION

Eritrea occupies a key strategic position on the eastern side of the Red Sea, with an extensive sea area including approximately 355 islands. The length of its coastline is approximately 2,234 km in total, comprising 1,151 km of coast on the mainland and an additional 1,083 km of coastline to its Red Sea islands. Eritrea claims a 12 nm territorial sea limit although the exact borders of its territorial sea remain in dispute in some areas [1]. It is situated at the horn of Africa and has a rich history of links with and through the Red Sea. Eritrea as a newly developing country, has limited capacity to rebuild its war-devastated infrastructure. While the war on poverty has not been won, it has not been lost either. Nationally Eritrea is food insecure with the agricultural sector producing only 60% of food requirements even in good rainfall years. However, Eritrea possesses abundant and underexploited fish stocks, which have the potential to considerably contribute to and diversify national food security and reduce the incidence of poverty, particularly among coastal communities [2]. The prospects of Eritrean fisheries development is very high due to the availability of untapped potential of natural resources.

RESOURCE POTENTIAL OF ERITREAN FISHERIES SECTOR

The waters of the Red Sea are highly productive, supporting substantial population of diverse marine species, with around 1,000 known species of fish and 220 species of corals [3]. Eritrea owns more than 1,100 km coastline on the Red Sea. It has major marine resources that have barely been exploited due to the long war of independence. The maximum sustainable yield ranges from 40,000 to 80,000 metric tons per year, where currently only 13 % is utilized every year [2]. For instance the revenue received by the government from 15,000 metric tons of fish, based on a charge of 20% royalty on the overall value of the exported amount of fresh unprocessed fish, while 10% was charged for processed products was estimated on average about US \$ 2.5 million for the year 2000. Fully operational processing plants were projected to generate twice this amount of royalties, or US\$ 5.0 million. Therefore, US\$ 7.5 - 8.0 million was estimated to be a one-fifth (around 20%) of the capacity of Eritrea's upper limit MSY, which are the sustainable, renewable fisheries. Additional benefits could be earned from employment, taxes and the development of support services such as construction and transportation [4]. Thus in order to effectively exploit this potential, Eritrea has developed policies and programs that are aimed at improving the supply of protein-rich food products to both local and foreign markets, increasing its foreign exchange earnings and creating employment opportunities [5].

The Eritrean Red Sea is generally recognized as being highly favorable for the development of artisanal fisheries. Important coral reef areas, extensive surface of soft bottoms and numerous shelters of the Dahlak archipelago plateau and, to the north and south of this plateau, short distances to the continental shelf break, are all conditions conducive to such development. Diversified coral reef communities, extensive mangrove mud flats, sea grass or seaweed beds and standing kelps harbor are diversified commercially important fisheries resources. Outside the coralline zones its sedimentary floors, while not particularly attractive for artisanal demersal fishing activities, offer quite favorable conditions for trawling operations. Eritrea possesses a variety of fish resources as per their natural habitats: Soft bottom demersal fishes such as lizard fish, threadfin breams and catfishes, and shrimps are caught by trawlers. Hard bottom demersal & reef fishes (food and ornamental) such as snappers, emperors, grunts, job fishes, groupers, etc., found on rocky bottoms and caught by mechanized trawlers and by hook & line artisanal fishermen and long-liners. Small pelagic, such as sardines and anchovies that are targets for beach-seines and purse-seines. Large pelagic, usually caught by gill nets and occasionally as a by-catch in commercial trawlers mostly tunas and mackerels. Sharks that are caught for their highly valuable fins. Specialized fisheries such as sea cucumber, snail nail and Trochus. Unexploited species such as shellfish that includes crabs, sepia, lobsters, squids and octopus. No comprehensive quantitative surveys of the resources and the productivity of the Eritrean Red Sea have been carried out, although various short-term exploratory surveys for specific stocks were conducted between the mid-1950s and the late 1990s. Several attempts have been made to estimate the maximum sustainable yield (MSY) of the Eritrean marine fishery resources and they fluctuate between a high of 80,000 and a low of 40,000 metric tons per year [6].

FISHERIES SECTOR OF ERITREA

The coastal areas and islands of Eritrean Red Sea is highly conducive and as stated above patronize artisanal rather than mechanized fishery, the latter contributed a minimum of 80% of the total catch level [7]. Fish landings was generally characterized as very active in the past (1950s); catches of over 20,000 metric tons per year were reported in 1950-60, whereby 80% consisted of small pelagic, sardines and anchovy were processed into fishmeal or sun-dried for export to European and Far East markets. High production levels dropped significantly in late sixties, mainly due to the closure of the Suez Canal. Fish exports in 1966-67 only amounted to 5,700 metric tons of processed products. By 1972, growing internal war and subsequent instability, provoked a further decrease in fishing activity, and landings fell to 4,000 metric tons. During years that followed, majority of fishing fleets were destroyed and local fishermen increasingly turned to other activities, or fled to other countries and the fisheries sector collapsed [8].

Since the wake of independence, the Government of the State of Eritrea in collaboration with development partners (UNDP/FAO/ADB and UNCDF), intervened to revitalize the then devastated fisheries sector, to support coastal fishing communities; and realize the full potential of the sector's role in building the national economy. In effect, fish catch started to revive spontaneously, from an average of 280 metric tons/year in 1980s to the current levels of about 10,000 metric tons per year, which is still only about 13% of the possible potential harvest. Artisanal fish production has been increasing from about 300 metric tons per year in 1993 to 1,400 metric tons per year in 2000. The contribution of the fisheries sector to Eritrea's GDP went practically from nil to about 10% of the contribution of agricultural sector, the latter being 16% in 1994 [8].

In the management and development of fisheries in Eritrea, the status of any fish stock is legally required to be considered in the preparation of management and development plans for that fishery. However, because of scarce financial and technical resources, comprehensive assessments of the primary fish stocks are rare, with most studies having been undertaken in the 1960s-1980s. The last stock assessment survey of Eritrean waters was undertaken in 1996, in collaboration with French government scientists. However, stocks are monitored through the collection of catch and fishing effort data and these data provide the main source for ongoing assessment of fish stocks in Eritrea [1].

In the 1950s up to 1970s, Eritrean fisheries production was significantly greater than at present and the artisanal fishing industry was very active. Catches of over 25,000 metric tons per year were reported in 1954, prior to the withdrawal of Yemeni fishing units with over 80% of this production consisting of small coastal pelagics - sardines and anchovies - which were processed into fishmeal or sun-dried in Massawa for export to European and Far East markets. Reported harvests were in the order of 19,600 metric tons for fishmeal, 1,250 metric tons for processed

sharks, 150 metric tons for shells, and 1,300 metric tons for food fishes. Fisheries in those early days were essentially oriented towards exports [1].

Fish production of 21,000 metric tons in 1966, dropped to 14,000 metric tons in 1967. This was due not to any decline in the productivity of the fishing grounds but because of the closure of the Suez Canal. By 1972, growing internal warfare and subsequent instability provoked a further decrease in fishing activity and landings fell to 4,000 metric tons. This trend continued during the following years. Numerous fishing craft were destroyed and, without outlet for their production, local fishermen increasingly turned to other activities or migrated to other countries. As a result, by the end of the 1970s, the Eritrean fisheries had almost completely collapsed. According to various sources, total production only amounted to about 328 metric tons in 1980. With independence in 1993, the fisheries are being re-built and expanded to include a mechanized fishing sector [1].

Despite the long time periods between comprehensive assessments, the estimates of Maximum Sustainable Yield from the various studies are quite similar and are used (together with ongoing monitoring) by the Ministry of Marine Resources for planning fisheries development strategies. Small pelagic resources (mainly the sardine, *Harengula punctata*, and anchovy, *Thrissoles baleana* and *Amentum heteroboloum*, comprise the majority of the estimated total MSY for fisheries resources at around 50,000 metric tons per year [9]. MSY for demersal resources, mainly, in order of greatest abundance, lizardfish (*Saurida* spp.), threadfin breams (*Nemipterus* spp.), barracuda (*Sphyraena* spp.), snappers (*Lutjanus* spp.), and groupers (*Epinephelus* spp.) have been estimated at around 15,000-20,000 metric tons per year while large pelagic (including tunas) MSYs have been estimated at around 7,000 metric tons per year. The remainder of the estimated total MSY consists of shrimp (500 metric tons per year), lobster and other minor species. In total, the MSY for all fisheries resources in Eritrea has been variously reported in a range of 4,000 to 80,000 metric tons per year. Current landings for all major species are significantly less than the upper limit of the estimated MSY and therefore fisheries' planning in Eritrea in recent years has concentrated on development activities to increase landings in a sustainable way [1].

A summary of the characteristics of the major mechanized and artisanal fisheries in Eritrea in 2003 is as follows: there are only small recreational fisheries and no data are available although recreational fisheries needs to be licensed [1].

Table I: Characteristics of the major fisheries of Eritrea [1]

Category of fishery	Fishery	Volume (est. in metric tons)	Value US\$	% of Total volume caught	% of Total value caught	Covered by a management plan? (yes/no)	# of Participants (est.)	# of Vessels (est.)
Mechanized	Demersal trawl	6831	\$5.2 m	92.6%	68.4%	Yes	936	46
	Pelagic	210	Included in (1)	2.8%	Included in (1)	Yes	Included in (1)	Included in (1)
	Shrimp	337	\$2.4 m	4.6%	31.6%		Included in (1)	Included in (1)
Artisanal	Demersal& pelagic	1928	\$3.8 m	94.2%	82.6%	Yes	3000	600
	Shrimp	119	\$0.8 m	5.8%	17.4%	Yes	Included in (1)	Included in (1)

The majority of the fisheries resources of Eritrea are still underutilized (Table I). This can be concluded by comparing the MSY obtained by survey (1997 – 1998) undertaken by the French Marine Research Institute (IFREMER) and comparing with the actual fish caught in Table I. the result of survey which was reported by FAO shows that the total MSY of the above fishery (listed in table I) is 52,500metric tons, but the result of Table I shows that actual fish caught consists only 17.9% of the potential MSY. Therefore, even though these fisheries are covered by the management plan of the government of Eritrea but still they are operating below the estimated MSY. Hence, there is a need to further diagnose the problem and undertake more development efforts and initiatives towards the achievement of the MSY.

The Eritrean fisheries resources can be classified into two: Inland fisheries and marine fisheries.

Inland Fisheries

The inland fresh water reservoirs, which have been largely under-utilized for producing fish, are built in the high and lowlands of the country. They are strategically placed to collect water during rainy seasons for irrigation and supply of drinking water. But now these water bodies have a role to support subsistence fishery to supply the surrounding population and villages with fish protein [2]. An inland fisheries center is located in the central zone of Eritrea at an elevation of 1,800m with facilities such as experimental ponds. Species stocked or considered good candidates for further stocking include *Oreochromis niloticus*, *Tilapia zilli*, *Cyprinu caprio*, *Carassius carassius* and *Carassius auratus*. The total catch of inland fisheries including subsistence fishing was about 5 metric tons per year in 2002, but according to the Ministry of Marine Resources, has a potential of 100 metric tons per year [10]. The FAO "The world fisheries production" report of 2009 indicates the marine production to be 3,030 metric tons per year while aquaculture production was nil. Therefore; the inland fisheries are still under-exploited resources, producing only 5% of the estimated potential. It needs a careful strategic management for the exploitation and contribution to the food security objective of the country [11].

In 1993 FAO technical paper reported that possibilities for the development of aquaculture and inland fisheries are modest, at least in the short and medium term. Major constraints to development include the limited number of reservoirs that can be developed for reservoir fisheries, low consumption levels of fish in rural areas, poor water quality and productivity limitations, water supply problems (drought and drying), and lack of easy access to many reservoirs and rural localities where fish farming might be considered. As far as brackish water aquaculture is concerned, lack of basic infrastructure (roads, power supply, animal processing plants, etc.), the high salinity of the Red Sea, and the ready and comparatively cheap availability of underexploited marine fisheries resources all pose limitations upon or at least heavily qualify possibilities for development of inland brackish water aquaculture [12].

But, the government of the State of Eritrea has recognized the importance of aquaculture in its national development plan and strategy which is aimed at developing the sub-sector as part of the overall effort to achieve food security and alleviate poverty. At present there are 338 reservoirs and 324 dams constructed in the high and lowlands. Three hundred more earthen dams, which can all be stocked with fish, are under construction. This strategy of utilizing the existing water resource to develop culture-based fisheries is focusing on developing the rural areas. At present there are 70 reservoirs in three regions which have been stocked with introduced species mainly tilapia and carps. The stocked dams are monitored for production performance and general status of stocked fish. The general observation in respect of the status of all the species stocked in the reservoirs was that they established well. However, productivity is low and would need improvement for the resources to meet the future needs for food. Aquaculture in Eritrea is intended to contribute more to the social and economic objectives of the nation. The policy framework for a national aquaculture development strategy and plan is to improve nutrition, expand economic growth and protection of natural resources. This strategy is setup to be achieved by involving the community population and stakeholders as the main beneficiaries [2].

An integrated Seawater Farm located at Gurgusum beach in Massawa has been in operation since 1999. Still in the beginning phases, this project has four components: a shrimp production facility in concrete ponds, whose post-harvest waste water is first pumped into earthen ponds to grow brackish/saltwater tilapia, and then used to irrigate fields of the halophyte *Salicornia* (used for a variety of purposes ranging from oil production for the cosmetics industry to burning the chaff as fuel). Finally, the remaining wastewater is not put back into the sea, but used to irrigate mangrove trees and for other aesthetic planting purposes. The farm operates its own shrimp feed production plant and has its own hatchery to provide post larval shrimp that will go into the ponds [10]. The plant is also engaged in the production of fishmeal and animal feeds. These activities bring into scene the potential of the country in this sector.

However; Eritrea's location in the drought prone Sahel region has made the country more susceptible to water shortages, which could be mentioned as one of the causes of the low productivity in its agricultural output. The country has been affected by recurrent drought and famine in the past, which led to the deaths of both human beings and animals [13]. Thus, the inland fisheries could not be much dependable as it would be dependent on unreliable rainfall.

Marine Resources

As already mentioned in the above passages the waters of the Red Sea are highly productive, supporting substantial population of diverse marine species, with around 1000 known species of fish and 220 species of corals. All of these species are of commercial importance, thus, making the Red Sea rich in biological diversity which could be exploited judiciously. A relatively extensive continental shelf and coral reefs along the coastline and along the islands forms a compact and complex variety of interlacing ecosystems offering several ecological riches of marine organisms. Therefore; the Eritrean coastline offers a potential opportunity for expanding the fisheries sector [2].

Eritrea’s exclusive economic zone (EEZ) is approximately 120,000 sq.km out of which the continental shelf covers about 56,000 sq.km with a plateau containing 360 islands that define the Dahlak Archipelago. The latter add another 1,300 km of coastline. About 25% of the continental shelf is occupied by the plateau; 19% of the shelf is less than 30m deep and thus off limits to trawling activities. In the Eritrean Red Sea, there are at least 360 off shore islands greater than 50m wide or long. The total islands’ coastline is approximately 1,980 km long. The islands have a land area of around 1,300 sq.km. Its mainland coastline is about 1,900 km from the Sudan border to the Djibouti border. Eritrea has a continental shelf of 56,000 km [10]. The commercially important fish species of the Eritrean Red Sea can be categorized into five groups. These are Demersal, Pelagic, Ornamental, Crustacean, and Cephalopods. Based on this classification, there are 104 Demersal, 79 Ornamental, 26 Pelagic, 2 Crustacean, and 2 Cephalopod species both for local and export market utilization [3]. Of course this list is not exhaustive as it is short of the full number of the fish species.

Eritrea's coastline has several harbours, some with historical significance such as Adulis in Zula Bay and the harbour on Dahlak Kebir Island. The major harbours are those at Massawa and Assab with several others in between such as Wokiro, Gal'allo, Ti'o, 'Eddi, and Bar'asole. North of Massawa, at places such as Marsa Beritae, Marsa Ibrahim, Marsa Gulbub and Marsa Kubba. Fisheries harbours are either under construction or are presently being considered for feasibility. According to the Research and Statistics, Ministry of Marine Resources, Massawa, Eritrea, the waters of the southern part of the Red Sea are highly productive in part due to allochthonous advection of monsoon upwelled nutrient rich waters through Bab El Mandab [10]. Gal'allo, Ti'o, 'Eddi and Bar'asole have already been constructed and presently are actively being used for landing purposes. The following table II is the result of marine fish production from 1956 to 1998.

Table II: Estimation of MSY in Eritrean marine water expressed in metric tons [2]

Fishery resource	Atkins 1956	Ben Yami 1964	Atkins & Patners 1965	Grofit 1971	Atkins & Grofit 1965	Gaudet 1971	Guidecel li 1984	IFREME R/MoF 1998	Lowest estimate MSY	Highest estimate MSY
Demersal										
Soft-bottom demersal	10-15	10	-	-	10-15	8.5	18	-	8.5	18
Reef based demersal	-	-	-	3.5	-	-	5	17	3	5
Crustaceans										
Shrimps	0.5	-	-	-	0.5	0.5	-	-	0.5	0.5
Spiny lobster	0.5	-	-	-	0.5	-	0.5 - 1	-	0.5	1
Pelagic										
Ocean pelagic	-	-	-	-	-	-	5	-	5	5
Small pelagic	50	50	25-50	25-50	50	25	25-50	37	25	50
Sharks	5	5	-	5	5	2	5	-	2	5
Total									40	84.5

As indicated in table II, the MSY reveals that the number of large pelagic fishery is relatively small with estimates of MSY at about 5,000metric tons per year. This category includes valuable species such as Spanish mackerel, barracuda, tuna and jackfish. The estimation also shows that about 56% of the total estimated yield consists of small pelagics; which include anchovies and sardines. Demersal resources are commercially most valuable for exports, with an estimated MSY of 18,000metric tons per year. Fish species such as red snapper, grouper and emperor belong

to this category. The supply of crustaceans such as shrimp and lobster, which has a high commercial value in the EU market, has MSY of 500 and 1,000 metric tons respectively. In the case of shark, the annual sustainable yield is estimated between 2,000 and 5,000 metric tons [2]. No survey has been taken recently, thus MSY estimates remains to be the same till date.

CLASSIFICATION OF FISHERMEN IN ERITREA

Artisanal Fisheries

The artisanal fishery in Eritrea refers to fishing activities practiced by fishermen who possess small boats and usually supply limited amount of fish to the market. It is one of the most active sectors in Eritrea. Coastal people around Massawa and Asseb have been practicing it for a long time. Within this sector, fishermen are organized in cooperative associations all along the coast. The main fishing cooperatives can be categorized as Massawa, Dahlak, Gal'allo, Ti'o and Asseb in which 37 affiliate village cooperatives are included holding 1,174 member fishermen in the year of 2000 as per the report of Ministry of Fisheries. The artisanal sector is expanding as the government has built new landing facilities in Asseb and is undertaking a huge development project with a loan from the African Development Bank [14]. The aim of this project was to establish three new fishing harbours along the coast between Massawa and Asseb. The main commercially valuable fish species caught by this sector are reef fishes such as snappers, groupers and emperors. In addition, pelagic fishes of the families' trevallies, mackerels and tunas are common catches. Barracudas and shrimps are also caught in smaller proportions [15]. Currently the projects have completed building the harbours and are serving as landing centers for the artisanal fishermen.

Excluding the innumerable foot fisherman, part time operators, and fisherwomen who directly or indirectly engage themselves in fishery and fishery related activities to earn a living, the professional artisanal fishermen population is very small in size not exceeding 3,300 by number and sparsely scattered along the continental coast and islands, the Dahlak Archipelago in particular. However, only half of them are actually considered to be active or full time fishermen, even though it has ever been growing since 1993 and new fishermen were constantly attracted into the activity [2].

Artisanal fishing in Eritrea is mainly carried out using three types of fishing boats called Houries, Samboucks and Fiber-glasses. Houries are traditional, small outboard engine, wooden boats. They are 4-11 meters long with 40hp engine. Samboucks are bigger, 12-17 meters long and are traditional Red Sea vessels partly decked with inboard diesel engine. The average crew size for Houries ranges from 4-6 while Samboucks can carry up to 10 people [15,16]. The third type of boats, Fiber-glasses, some made in Yemen and some others in Japan are mostly used in the southern part of the country. Artisanal fishermen also use some newly introduced 11 and 18 meters Fiber-glass long liners and shrimp trawlers. As of the year of 2000, 188 Houries, 49 Samboucks and 30 Fiberglass are licensed to fish in the area [15]. And in May 2002 the Eritrea - National Fishery Sector Overview reported the number of artisanal fishermen to have 560 boats, but the number of the licensed artisanal fishermen remain the same as of 2000. Houries constitute 80%, Samboucks 9% and the Fiber-glasses form 11% of the fishing fleet. For the year 2001 the fish landings of the artisanal fleet were estimated to be 1,445 metric tons. In 2011 Ministry of Marine Resources Statistics Unit reported the artisanal fishermen fish landing to be 1,827 metric tons [17], showing 26.5% growth from the 2001. For the first decade after independence the policy of the Government of Eritrea was to rehabilitate the infrastructure of the fishing sector favouring the artisanal fishermen [10].

The main fishing gears used by artisanal fishermen are Gillnets and, Hook and Line. Fishermen use either one of these gears or both at the same time. Hook and Line are mainly used to catch demersal fishes while Gillnet is used for catching shark and pelagic fishes. All activities are manual since there are no hauling devices. In addition to these, land based collectors, traditionally called the 'foot-fishermen' number over 1000; they are mainly women and children who use hooks, nets and spears to fish for their daily food [14]. The following figure1 shows the Artisanal Fisheries catch and effort from 1992-2010. It shows that there is high variability of fish landing of the artisanal fishermen. Reaching its highest landing in 2002 and 2009, and contributing about 2.7% of the total MSY of the fisheries potential of the country.

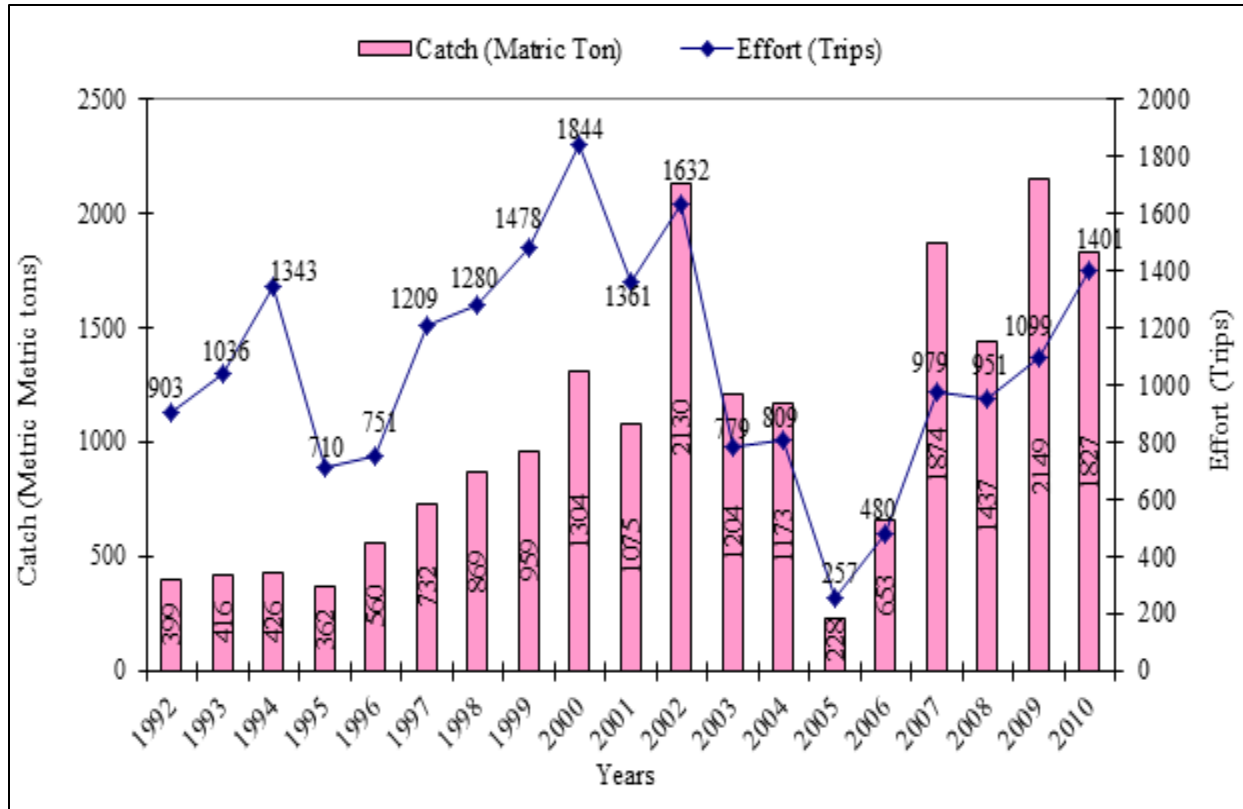


Figure 1: Artisanal fisheries catch and effort from 1992-2010 [17]

Mechanized Fisheries

The mechanized fishing fleet strength in the sixties involved up to 4 inshore trawlers (50–120 HP), 9 off-shore trawlers (150–400 HP) and about 3 hand-liners [18, 19]. The trawler fleet was mostly commanded by expatriates and crewed by Eritrean deck-hands. Its financial productivity was satisfactory for the well-operated units. For several years, the average catch of a properly run 240 HP trawler, using Mediterranean-type gear, was between 200 and 280 kg of commercial fish per trawling hour. Complementary catches of penaeid shrimp were also obtained in amounts averaging from 20 to 30 kg/trawling hour during the good shrimping season, approximately from November to April. In 1993, this fishery has totally disappeared. It remains the case, however, that about 35,000 km² of good trawling grounds are well known, with a probability that other trawlable areas exist [20]. For the year 2001, the reports of Eritrea - National Fishery Sector Overview indicated the landings of the mechanized fleet were 14,488 metric tons. In 2011 the Ministry of Marine Resources (Statistics Unit), reports has shown that the mechanized fleet landings were 1,461 metric tons which is only 10% of the 2001 landings. Thus, the mechanized fisheries exhibited a dramatic decline as low as 10% of the year 2001, while the artisanal fishermen landings were increased by 26.5% in the same year compared with that of 2001.

In 1960's about six fishmeal plants were working in Massawa during the sixties. These factories processed sardine and anchovy captured and sun-dried by about 2,000 -3,000 beach seining fishermen from October to April, all along the coast from Massawa to Assab, and transported by small 80–200 HP carriers. Average annual production of this activity was of 1,000 metric tons of fishmeal for European markets and about 3,000 metric tons of dried products for the Far East. In the Massawa port, an enterprise commercialized first quality fish on the national market, transporting an average of 200 metric tons/year by truck to Asmara and Addis Ababa. Two firms operating with five trawlers were also exporting about 1,500 metric tons/year of frozen table fish to Israel, and one enterprise traded shells abroad. All the fishing companies possessed their own facilities for ice, processing, freezing, storage and transport. In those years Massawa had a jetty, two boatyards, and a slipway. Assab had a modern refrigeration

storehouse totaling 1,300 m³ at -18 to -20 ° C. During the early 1990s all these activities had collapsed and nearly all the facilities have disappeared or have been destroyed due to the prolonged war for independence [21].

After a long period of inactivity, trawling operations in Eritrean Red Sea waters were restarted in 1992 on a provisional basis under an agreement between DMRIF (Department of Marine Resources and Inland Fisheries) and a Sudan registered firm. Two stern trawl units worked grounds around the Massawa area for a few months in late 1992. The DMRIF observers have kept track of these operations, and those records of catch locations, volumes, and species were furnished. Given the past successful performance of mechanized fishing activity at a modest scale, the existence of at least some 35,000 km² of good trawling grounds and perhaps more, and the presence of a considerable range of resources including high value species whose stocks do not seem to have been appreciably exploited for many years, it seemed reasonable to favour the resumption of mechanized trawling on a gradual basis. The activities were very carefully monitored during those three to five years (1990's) to determine performance levels and collect time series data on catch volumes, composition, by-catches, etc. This monitoring programme could be implemented in conjunction with the establishment of a proper catch assessment survey system and statistical unit within DMRIF, and of management plans for each fishery involved (e.g. regulation of effort through closed seasons for the shrimp fishery) [12]. As we can see from the following figure 2 (the time-series data of the mechanized trawler of fish catch and effort from 1992-2010) the results of the mechanized fisheries was encouraging compared to the artisanal fisheries displayed by Fig. 1 above, except for the years of 1992, 1997, 1998 where artisanal fish landing is more than mechanized. Thus, the policy of the government of Eritrea has shifted in favour of the mechanized sector. Regulations governing the mechanized trawl fleet include measures to protect the coastal biomass such as a minimum depth of 30 m and a minimum distance of 6.5 miles from the shore and 4 miles from any island. During the hot months of July through September, all mechanized fishing operations are prohibited in Eritrean waters [10]. But in the later stage (from 2008-2010) the artisanal fishermen show more growth in fish landings regardless of the policy shift made towards the mechanized fisheries. This is one of the reasons why government policy recently started favouring the artisanal fisheries also. This can be seen by the strategies and policies followed by Ministry of Marine Resources [2].

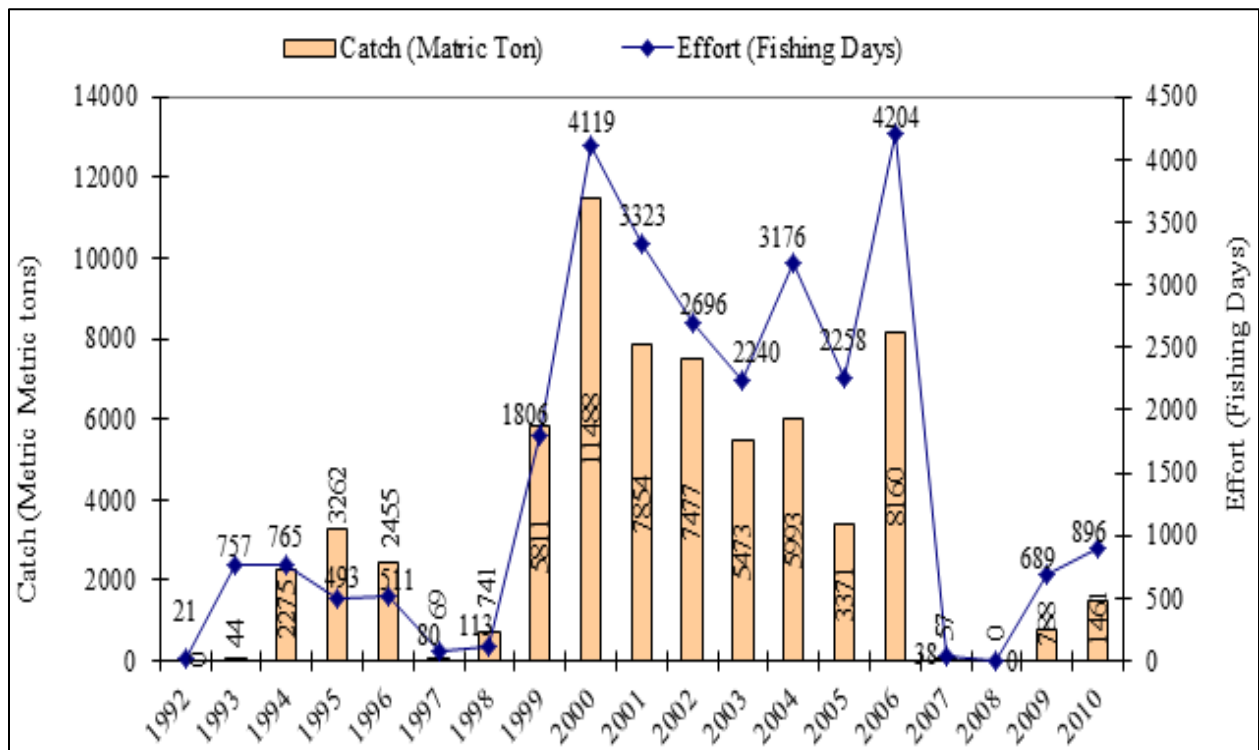


Figure 2: Mechanized (trawler) fish catch and effort from 1992-2010 [17]

Table III: Total Artisanal & Mechanized Fish Catch From 1992-2010 [17]

Years	Artisanal Catch (metric tons)	Mechanized Catch (metric tons)	Total
1992	398.549	0.000	398.549
1993	416.117	43.500	459.617
1994	425.913	2274.660	2700.573
1995	362.300	3261.520	3623.820
1996	560.293	2454.571	3014.864
1997	731.697	68.638	800.335
1998	868.651	740.836	1609.487
1999	958.957	5810.773	6769.730
2000	1304.396	11487.710	12792.106
2001	1075.323	7854.433	8929.756
2002	2129.554	7476.798	9606.352
2003	1204.124	5473.378	6677.502
2004	1172.560	5993.471	7166.031
2005	227.617	3370.834	3598.451
2006	652.857	8160.235	8813.092
2007	1874.113	56.691	1930.804
2008	1437.118	0.000	1437.118
2009	2149.436	787.530	2936.966
2010	1826.643	1460.880	3287.523
Total	19776.218	66776.458	86552.676

If we closely observe the data in the table III, it gives us some important information regarding the fish landings or production of both the artisanal and mechanized fisheries in Eritrea. From 1992 after the independence of the country there was a gradual growth in fish catch/landings. This was due to the initiatives taken by the government of Eritrea to rehabilitate the fisheries sector. But even though the growth is steady there are fluctuations in fish production. The rate of combined production ranges from 398.549 metric tons/year to 12,792.106 metric tons/year. When converted to percentile this will be 0.50% to 16% in comparison to the highest possible potential (MSY) of the sector. Thus, the fisheries sector is operating and performing below optimum level. We can also observe the total fish landing of the 19 years is only 8.2 % above the upper limit MSY of the estimated potential. On average (86,552.68 divided by the number of years, 19) the Eritrean fisheries is producing 4,555.40 metric tons per year which is 5.7% of the upper limit of the MSY and only 13.9% above the lower limit of the MSY. From the data in table III above we conclude that, even though the Eritrean fisheries has a huge potential for improving the food security and developmental aspects of the country, but in reality it is under-operated and its effect on the economy is very small. So far it has not been optimally exploited.

CONSTRAINTS AND DEVELOPMENT STRATEGIES

Although the fisheries sector of Eritrea has a huge potential for economic and social development of the country. But there are still some constraints that are causes behind the under-exploitation of the sector. Therefore we will examine some of the constraints of the Eritrean fisheries and possible solutions for the development of the sector. The constraints are classified into two categories. The first category is social and cultural factor and the second is economic factors. After listing the constraining factors on the second column of table IV, then the possible development strategies that should be pursued by the policy makers has been recommended on the third column of table IV below.

Table IV: Constraints and Developmental Strategies

Factors	Major operational constraints	Developmental strategies for improvement
Social and cultural factors	Lack of skill and knowledge among fishermen Shortage of manpower in the sector	-Training for skill up-gradation and operational knowledge to fishermen without loss of the traditional knowledge of the fishermen -Motivating children of fishermen community to go for primary education -Making the fishermen aware of the code of conduct for responsible fisheries -educating youth for strategic deployment in appropriate employment in the fisheries sector -Institutional building for the development of the fisheries sector and coastal communities -Training, consultancy and extension services to empower the fishing community -Creating avenues for occupational diversification – self-employment programs
	Low gender representation due to rigid religious and cultural background	-Empowering women for generating their livelihood, through formation of Self Help Groups (SHGs) and micro-finance which can be help women to run their own small businesses and make it self-sustaining. -Building awareness and mobilization of gender equality among the coastal communities to enhance women’s participation
Economic factors	Low living standards	- Involve organized fishing in housing, educational and health sectors. - Seek international cooperation in enabling better housing, education and health care including potable water and drainage. - Make education compulsory and accessible
	Low catch per trip, low productivity	- Introduction of efficient crafts and gears - Replacement of obsolete fishing gear and enabling working capital requirements. - Enabling an organized market structure to ensure fair prices to artisanal fishers.
	Inadequate harvest and post-harvest infrastructure	-building necessary infrastructure like ice plants, landing centers, transportation systems and roads. -Providing access to the infrastructure facilities for procurement pre-processing & marketing of fish and fishery products

	Low prices, marketing problems	<p>-Providing marketing & technical support for enhancing production and sale</p> <p>-marketing the output through organized cooperatives- this gives the fishermen a competitive edge vis-à-vis the traders and middlemen in the market</p> <p>-Ensuring forward & backward linkages in the sector</p>
	Poor information system and inefficient management system	<p>- Enabling minimization of cost per fishing trip through establishment of electronic fish finders/ GPS equipment and satellite information technology</p> <p>-introduce efficient management system for sustainable use of the resources and quality production, processing and marketing of the fish produce.</p> <p>-Introducing Total Quality Management (TQM) systems</p>
	Lack of cheap and timely credit	<p>-To liberate the fishermen from the clutches of middlemen by extending cheap credit and organizing them by providing a common platform for their direct involvement in decision-making process</p>

Therefore, the overall development of the fisheries sector with the total welfare of the fishing community (artisanal fishermen) taking top most priority should be the main policy of the ministry of marine resources for the efficient and optimal utilization of the fisheries resources.

CONCLUSION

The initiatives of the Eritrean government in collaboration with the UNDP is expected to ensure resource use management and efficient human resource deployment in the fisheries sector which could well lead the way to the overall development of the agricultural sector in general and the fisheries sector in particular in Eritrea. Simultaneously trans-boundary issues in fisheries need to be addressed in order to develop and sustain a cordial and healthy exploitation of the fisheries resources of the country. Efficient business models suitable to the ethos and lifestyles of the people need to be developed so that growth is balanced with sustainability which will enable poverty alleviation, improve rural livelihoods and contribute to the food and nutritional security of Eritrea.

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