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REVIEW

The Present Situation of the Fisheries Sector in Iraq: A Critical Review

Muzaffer Mustafa Harlıoğlu*, Shokri Omar Mustafa, Zahra Batool

Fisheries Faculty, Fırat University, 23119 Elazığ, Türkiye https://orcid.org/0000-0001-8288-0571
Fisheries Faculty, Fırat University, 23119 Elazığ, Türkiye https://orcid.org/0000-0003-3290-1092
Fisheries Faculty, Fırat University, 23119 Elazığ, Türkiye https://orcid.org/0000-0002-4393-3527

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Trout

Abstract: In this review, the status of fisheries in Iraq is described. Iraq has two main water resources, the Tigris and Euphrates Rivers, forming a water area of approximately 700,000 hectares. Surface waters are distributed as natural lakes (39%), dam lakes (13.3%), and rivers and their tributaries (3.7%). On the other hand, marshes constitute 44% of the water sources in Iraq. The Iraqi government began recording fish production from wild and aquaculture in 1986. Total fish production from freshwaters in Iraq in 1991 and 1998 were 18,800 and 30,000 tons, respectively. In 2020, the total fish production in Iraq reached to 241,848 tons (Anonymous, 2022a). The bulk of fish production belonged to carps followed by barbs (genus Barbus) and trouts. With respect to capture fishing in Iraq, a variety of trawl nets (single-bag and multi-bag) and gillnets have commonly been used. The 1970s and 1980s were characterized by low consumption of fish meat (i.e., 4.3 kg in 1979), but it has gradually increased over the last years and has reached a remarkable 10 kg per capita in 2020. In this review, freshwater and marine fish species, aquaculture production and wild catch, institutions and centers specialized in researching and developing fisheries, fish meat consumption, problems of the fishing industry and potential solutions to develop the fishing industry in Iraq are outlined. This is the first study on the present status of fisheries in Iraq.

Anahtar kelimeler:

Akuakültür
Barbus
Sazan
Balık tüketimi
Balık üretimi
Deniz balığı
Alabalık

Irak'ta Balıkçılık Sektörünün Günümüzdeki Durumu: Eleştirel Bir Derleme

Öz: Bu derlemede Irak'taki balıkçılığın günümüzdeki durumu anlatılmaktadır. Irak, yaklaşık 700 000 hektarlık bir su alanı oluşturan Dicle ve Fırat Nehirleri olmak üzere iki ana su kaynağına sahiptir. Bu su kaynaklarının %39'unu doğal göller, %13,3'ünü baraj gölleri ve %3,7'sini akarsular ve kolları oluşturmaktadır. Öte yandan, Irak'taki su kaynaklarının %44'ünü bataklıklar teşkil etmektedir. Irak hükümeti, 1986'da (4000 ton) doğal ve su ürünleri yetiştiriciliğinden elde edilen balık üretimini kaydetmeye başlanıştır. Irak'ta tatlı sulardan elde edilen toplam balık üretimi 1991 ve 1998 yıllarında sırasıyla 18 800 ve 30 000 ton olmuştur. Ayrıca, 2020 yılında Irak'ta toplam balık üretimi 241 848 tona ulaşmıştır. Balık üretiminin büyük bir kısmı sazandan elde edilir. Bunu Barbus ailesi ve alabalık takip etmektedir. Irak'ta balık avlamak için farklı tipte trol ağları (tek torbalı ve çoklu torbalı) ve uzatma ağları yaygın olarak kullanılmaktadır. 1970'ler ve 1980'ler düşük balık eti tüketiminin olduğu yıllar olmuştur (örneğin, 1979'da 4,3 kg), ancak son yıllarda balık tüketimi kademeli olarak artmış ve 2020'de 10 kg'a ulaşmıştır. Bu derlemede, Irak'ta tatlı su ve deniz balıkları türleri, su ürünleri üretimi ve doğadan avlanma, su ürünleri araştırma ve geliştirme konusunda uzmanlaşmış kurum ve merkezler, balık eti tüketimi, balıkçılık endüstrisinin sorunları ve Irak'ta balıkçılık endüstrisinin geliştirilmesi için olası çözümler ana hatlarıyla belirtilmiştir. Bu derleme Irak'ta balıkçılığın durumuna ilişkin ilk çalışmadır.

Introduction

Although Iraq is an oil-rich country and has an arid climate, fisheries played an active role in the country's economy until 1980. However, the aquaculture sector was adversely affected as consequence of the Iran–Iraq war in the 1980s and Kuwait operations. Environmental impacts from oil pollution also significantly diminished aquaculture production in Iraq (Jaradat, 2002; Maaruf and Akbay, 2020). Moreover, natural fish production in Iraq has also been adversely affected by climate changes (i.e., increase in water temperature and drought) and by the presence of *Carassius gibelio*, a non-native cyprinid fish species, in some freshwaters of Iraq since 2012;i.e, it is more abundant in the Tigris River in recent years (Anonymous, 2022a, b). Therefore, prospects for national food security in Iraq in the short or long-term by

*Corresponding author: mharlioglu1@hotmail.com

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international food aid and agricultural technology are unpromising (Maaruf and Akbay, 2020).

In Iraq, fish species cultured under controlled conditions are carp (93%) and trout (7%) (Anonymous, 2022a, b). There were two main official fishery research centers in Iraq (the Fish Research Center in Zaafaraniyah and the Marine Science Center in Basra) supplying fingerlings and feed to fish farmers in the 2000s (Grafton, 2010), but in recent years, only one hatchery is operational (Swera in Baghdad).

In Iraq, approximately 40% of the total fish products sold in markets are imported from abroad (Anonymous, 2022a, b). However, the share of local fishing is limited to 20-40% and the share of aquaculture is at 40%. It is thought that the decrease in harvest from natural resources has resulted in an increase in the rate of fish importation from other countries. Therefore, it is necessary to investigate the reasons for the decrease in natural populations in Iraq.

Currently in Iraq, the fisheries and aquaculture sectors have more potential for development than that of other meat producing sectors such as poultry and ruminants, as they only account for 4% of the total investment. For example, in recent years, fish production has improved in Northern Iraq and especially in Erbil province, but it is necessary to follow scientific and technological developments for higher economic returns at the lowest possible cost. In addition, despite the high importance of fish production in Iraq, the sector is faced with many problems with respect to production and investment, such as bureaucratic difficulties (i.e. difficulties in obtaining official permits), limited use of scientific, technological an innovative developments in fish farming and high fish production costs in recent years (FAO, 2019).

Freshwater fish species

Although there are 24 freshwater fish species recorded in the freshwaters of Iraq (Figure 1) (Al-Jubour and Mohamed, 2019) only *Cyprinus carpio and Hypophthalmichthys molitrix* are harvested for economic trade. The other freshwater fish species are: *Arabibarbus grypus, Acanthobrama marmid, Asalus eorase, Barbus lutebis, Barbus sharpi, Barbus grypus, Barbus xanthopterus, Capoeta damascina, Cyprinion kais, Capoeta umbla, Cterophary godon, Calliotropis delli, Carassius auratus, Carassius gibelio, Luciobarbus vorax, Luciobarbus xanthopterus, Mastacembelus mastacembelus, Mesopotamichthys sharpeyi, Mystus pelusius, Planiliza abu, Silurus triostegus* (Anonymous, 2022a, b). According to (Al- Jubour and Mohamed, 2019), these species belong to ten families, of which 17 are native and 7 are non-native.

Freshwater fish are caught from the Tigris and Euphrates rivers. In addition, some fishermen catch fish in the dam of Mosul, Dokan, Darbandikhan and Habaniya. For example, there are more than 1500 fishermen catching fish in the Mosul dam which is the biggest dam in Iraq (Anonymous, 2022b).

There are approximately 15,340 fishing boats in Iraq. Most of these boats (85%) are non-powered and the rest are equipped with engines of with horsepower 40 and below (Anonymous, 2022b).

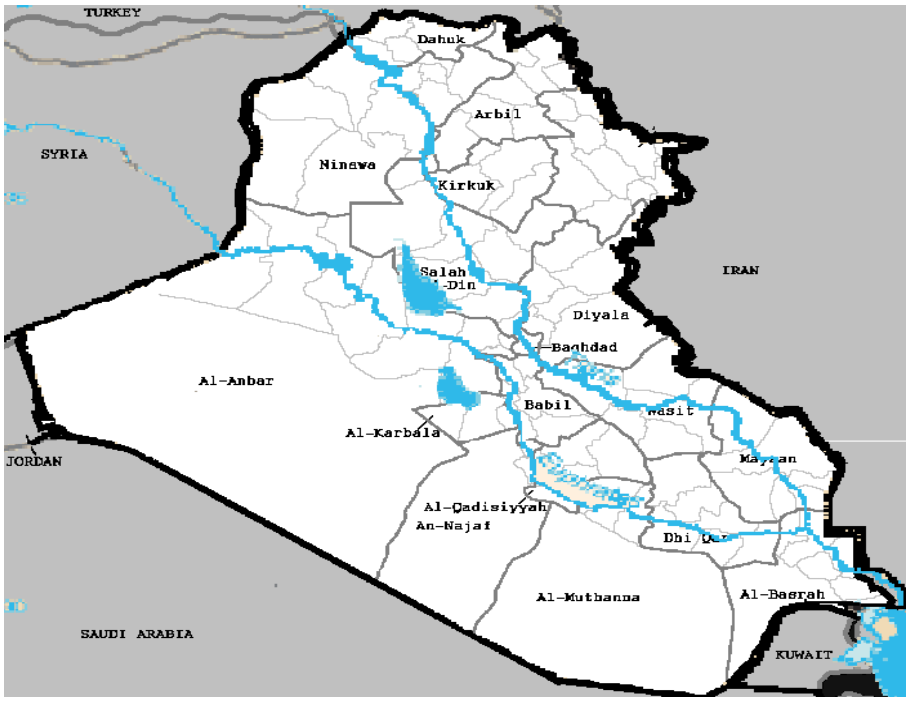

Figure 1. Freshwater resources and catchments area of rivers Tigris and Euphrates in Iraq (Wikimedia Commons, 2023)

Marine fish species

The coastal area of Iraq is very limited. Although Iraq has a coastline of only 100 kilometers in the Persian Gulf, it has two large ports that can serve all kinds of sea vehicles. These are the ports of Ümm-ül-Kasr on the shore of the Gulf of Basra and on the shore of the Şattülarap waterway. On the other hand, as for marine fisheries, Iraq has limited water borders (2 km). Basra is the only city that borders the waters of the Arabian Gulf, with 70% of the fishermen living in this city and some private companies also fish in this area.

The most important marine species are *Tenualosa ilisha*, *Lethrlrus nebulous*, *Pampus argenteus and Sparus aurata* (Al-Helli *et al*., 2019). The government controlled the marine fish catches between 1980-1986, but the control was not carried out after 1986 because of political reasons (Anonymous, 2022a). The annual fish production of marine fish was estimated at 1300 tons until the end of 1997. However, fish production increased remarkably to 13,400 tons in 1998 (Anonymous, 2022a).

Extensively used fishing gears and equipment for marine fish are trawls and ocean nets such as pelagic gillnets, bottom gillnets and other means of equipments such as shovels. The number of boats used in marine fishing is estimated as 1600, with only 3% of these boats are of relatively large size having an engine power of 200 horse power (HP). The rest are equipped with less powerful engines (Anonymous, 2022a).

Fish production in Iraq

Aquaculture production

Aquaculture production in Iraq is carried out in an area of approximately 7,500 hectares, and the main fish species produced are the common carp, grass car, and silver carp. Trout species are also reared in concrete ponds in the mountainous regions (Anonymous, 2022a).

The mean estimated aquaculture production between the period 1986- 1997 was approximately 4000 tons per year. However, it reached 7500 tons in 1998. On the other hand, after 2011, aquaculture production methods in Iraq has improved. For example, fish farmers began to use cages instead of earthen ponds for carp production and concrete ponds for trout production. As a result of this, an increase in fish production has been observed between 2011 - 2014. For example, the total fish production in Iraq reached approximately 80,000 and 85,000 tons in 2012 and 2014, respectively. On the other hand, the Koi herpes virus (Ababneh *et al*., 2020) and the decrease in the water level of the Tigris and Euphrates rivers (Anonymous, 2022a) caused a gradual reduction in fish production in Iraq after 2014. The production was reduced to approximately 51,000 tons in 2015 (Anonymous, 2022a). Moreover, as indicated in Figure 2, total fisheries production in Iraq was reported to be 62,673 tons in 2018 (World Bank, 2020). It reached 241,848 tons (150,000 tons from aquaculture and 91.848 tons from wild catch) in 2020.

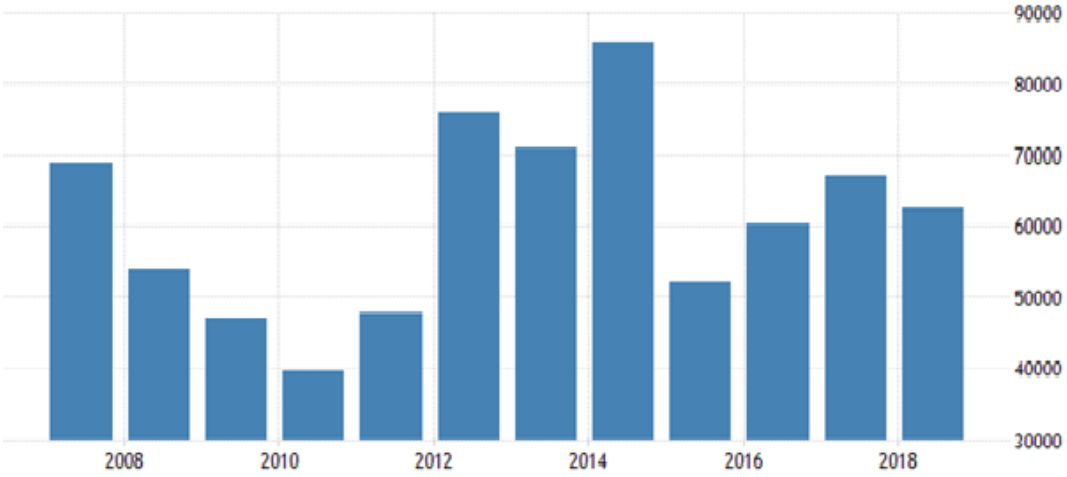

Figure 2. Total fisheries production (tons) in Iraq between 2008 and 2018 (World Bank, 2020)

The number of privately owned, registered fish farms is about 1983, of which only ten have an area of 1000 hectares and the rest are smaller than 4 hectares. These farms use freshwaters (rivers, streams) and well waters. In Iraq, there is no marine fish farming operation (Anonymous, 2022a).

The number of fish farms in Iraq has been increasing rapidly, especially after 2012. Currently, there are more than 1742 earthen ponds with a capacity of 61,110,000 m^2, more than 1,330 cages with a capacity of 227,289 m^2 and 33 RAS (Recirculating Aquaculture System) farms with a capacity of 31,535 m^2 in the whole of Iraq. In addition, 16 trout salmon farms with a capacity of 30000 m^2 are present in the north of Iraq **(**Anonymous, 2022a**).**

There are only 25 carp hatcheries producing fingerlings in Iraq.

Wild catches

In 2020, there were 7,654 registered fishermen in Iraq and the production totaled 91,848 tons**.** In local markets, 82% of the fish produced was consumed as fresh, 14% as alive and 4% as frozen. On the other hand, there are

currently no fish processing factories established in Iraq (Anonymous, 2022a, b)**.**

The data for the amount of local catches for some years is limited (Taher, 2011; Nasir and Khalid, 2013), and there is no information in the literature for wild catches for all of Iraq (Anonymous, 2022a, b)**.**

Institutions and centers specialized in researching and developing fisheries in Iraq

The Fisheries Research Center in the city of Al-Zafaraniya was the biggest fisheries research center in Iraq. It contained three departments: education, nutrition and diseases. The center published research studies and assisted graduate students in completing their research. The center contained ponds and small hatchery units for experimental investigations. However, it was closed during the previous regime and merged with Ebaa in 1990. Ebaa Center for Agricultural Research included a department for fish research and focused on improving fisheries in Iraq**.** Ebaa Center is still closed. The Marine Sciences Center, located in the city of Basra, focuses on specialized scientific studies in marine sciences (Anonymous, 2022a).

The General Authority for Fisheries Development with expertise in the fields of breeding, multiplication and development of fisheries.was reconstituted in 2014

The central hatchery in Essaouira's city is involved in the production of fingerlings of three types of carp (common, herbivorous and silver) to meet the needs of fingerlings for fish farms. The hatchery also aimed to produce fingerlings for stock enhancement of Iraqi local fish species such as brown (Spangled emperor; *Lethrinus nebulosus*) and kattan (Yellowfin barbell; *Luciobarbus xanthopterus*) into inland waters.

There is only a single department at the College of the Agriculture/University of Basra and it is the only department that specializes in studying fish, where students are awarded a bachelor's degree. Also, all science colleges in Baghdad, Mosul, Salah al-Din, Al-Mustansiriya and the city of Erbil (Salah al-din University) have recently opened departments on fish studies.

The fish resources directorate belongs to the general directorate of animal resources under the Ministry of Agriculture and Water Resources in Northern Iraq.

Fish meat consumption in Iraq

Historically, fish consumption in Iraq reached an all-time high of 4.30 kg per capita in 1979 and an all-time low of 0.770 kg in 2003. Therefore, Iraq ranked 135th among 158 countries in terms of fish consumption in 2003. However, fish consumption reached 2.90 kg in 2013. Moreover, the consumption of fish meat in Iraq has increased gradually in recent years. For example, Iraq's population was about 42 million in 2020 and annual fish meat consumption per capita was approximately 10 kg (Anonymous 2022a).

Apparent fish consumption in Iraq was estimated at 2.6 kg/capita in 2016. In 2017, imports of fish and fishery products were estimated at USD 148 million and exports at USD 80,000 (FAO, 2022).

Table 1. Type (ground soil pond, cages, RAS and trout) and number of farms, their surface area and production in Iraq (Anonymous, 2022a, b)

	Type of farm	No. of farm	Capacity (m^2)	Production (ton)
1	Ground soil pond farm	1,742	61,110,000	12,063
2	Cages	1,330	227,289	9,101
3	RAS farm	33	31,535	1,650
4	Trout farm	16	30,000	1,238

Problems of the fishing industry in Iraq

The lack of fisheries framework and database

The General Authority for the Development of Fish Resources was closed in 1989 by an arbitrary decision that led to the dissolution of its specialists. Therefore, currently, there is still no adequate reestablished organizational structure for the Development of Fish Resources in the Iraqi Ministry of Agriculture.

Increase in fish production expenditures

Due to the lack of fish feed manufacturing facilities productivity and food conversion ratio are negatively affected and use of by-products in feed formulations are limited. Consequently, cost of feed can sometimes reaches up to 70% of the total production costs, reducing revenue and profit. .

Limitation of the optimal use of the ingredients in forming fish rations

Optimal limits of raw materials are generally not considered when rations are formulated. For example, the use of wheat, corn or soybean and other feed additives above the optimal ratios at a given fish age may result in decreases in digestion efficiency and lower feed conversion ratio.

Genetic deterioration in carp

Carps were first imported from Hungary in 1955 for aquaculture purposes. In 1982, new breeders were also transferred from the same country. They have since been used for breeding and farming. The absence of new genetically engineered incubators has caused degradation in some reproductive features of the introduced carp. On the other hand, these strains indicated by low growth rates, low feed conversion rate, elongation of the body and less tolerance to diseases, led to the need to transfer new genetically raised carp breeders.

The negative impact of climate changes

The negative effects of climate changes on aquaculture and fisheries have been observed since 2012. The high-water temperatures resulted in favorable conditions for newly introduced fish species, such as *Crassious gibelio* (Shikhat, local name) in the Tigris River in the North of Iraq. This species has had a negative impact on carp and barb populations.

Adverse effects on water resources due to increased drought: Due to the increase in drought in recent years, the amount of natural water resources has decreased and the habitat of fish has disappeared in many water resources in Iraq. For example, the Al-Hawizeh marsh is one of the largest wetlands in southern Iraq. In the last two decades, 65% of a permanent marsh has been drained, resulting in a significant loss of native aquatic flora and fauna. The marsh was flooded again in April 2003 (Mohamed *et al*., 2008).

Other Problems

Fish cultivation in Iraq is mainly carried out in ground soil ponds, which require substantial land area and large amounts of water. Modern fish farming technologies such as cages and recirculating aquaculture systems (RAS) are not used. Since there are no fishmeal and soybean meal production facilities in Iraq, these ingredients are imported. Therefore, the cost of feed is quite high. Fish processing and canning plants have not been established yet in the country. There is also limited research on intensification of local and commercial fish culture and reducing feed costs. In addition, there are only a few fish markets available for customers (Anonymous, 2022b)**.** Although annual fish consumption per capita in the world reached 20.3 kg in 2018 (FAO, 2020), this value is lower than half of the world average for Iraq. In fishing, problems such as use of illegal fishing gear, extensive catch of undersized fish, and overfishing are major problems. There are limited efforts focused on fisheries research, water quality and disease diagnosis. Iraq, for example, faced a major Koi herpes virus disease problem in 2018. Because the samples were sent abroad for diagnosis and a valid result could not be obtained, the disease could not be diagnosed quickly, causing the disease to spread to other populations and spread out of control. The recent ban on marine fishing activities and privatization of the fishing fleet has led to a decline in marine fish production in Iraq (Anonymous, 2022a). Extensive bureaucracy in the country is also discouraging for investors who are willing to invest in the field of fisheries. Laws regulating fishing, exploitation and protection of aquatic life were enacted in 1976 (Legislation number: 48) so there is an urgent need for new regulations in fisheries.

Potential solutions to develop the fishing industry in Iraq

Creating a new fisheries framework

One of the most important point is to create a new fishing framework by creating an updated organizational structure. Preferably, the General Directorate should include not only fish but also other aquatic animals. This action will potentially cause an increase in fish production. Laws regulating fishing, exploitation and protection of aquatic life are more than 40 years old. Therefore, regulations and laws need to be updated. For example, the regulation on the prevention and activation of poaching in Iraq needs to be renewed, penalties for violators and illegal fishermen should be increased and investment should be encouraged by reducing bureaucracy. Updating the laws will cause investors to implement large fish and other aquaculture projects to increase production in Iraq. Similarly, Abood and Mohamed (2020), also stated that some management measures need to be taken in Basrah inland fisheries, including the implementation of fish regulations, in particular, the prevention of illegal fishing methods and increasing fish production by releasing fingerlings of cyprinid species to preserve them and protect them from extinction and overfishing.

Fish-feed producing factories should be established to reduce feed costs and increase the efficiency of the feed conversion rate. Fish meal and fish oil constitute approximately 70% of the cost of fish pellet feed. Therefore, fish meal and fish oil factories should also be established to reduce the production cost of fish pellet feed. Consideration should be given to the use of high-value additives of by-products such as fish meal and oil, corn gluten meal, distillers' dried grain with solubles (DDGS) and others when rationing.

New carp breeders should be imported to Iraq to improve the genetic characteristics of carp, increase their production and resistance to disease and climate change, and also reduce production cost. For these reasons new carp breeders were imported from Hungry in 2009 (Al-Humairi *et al*., 2020). If necessary, the import should be repeated. To increase fish production, present production techniques should be transformed into semi-intensive systems such as recirculating aquaculture systems (RAS), hydroponics and aquaponics. Use of equipment for mass culture of aquatic organisms such as automatic feeders and blowers should be expanded. In this regard, in coordination with the relevant authorities and developed countries, it is necessary to participate in scientific projects on increasing productivity per unit area, reducing water use and decreasing costs.

The number of markets for fishery products are very limited in Iraq. This is a major problem for local anglers. Therefore, the number of fishery markets should be increased. In order to reduce competition between local and imported fish, it is necessary to limit fish imports from other countries during the local production period, especially for carp. In order to increase the consumption of fish to levels comparable to that of global consumption, the importance of dietary seafood should be communicated more effectively with the public. In Iraq, laboratories focusing on feed, water and soil analysis and diagnosis of fish diseases should be established.

Carp and barb populations have been adversely affected by climate changes, especially in northern Iraq. The state, therefore, needs to produce large numbers of fry and stock them in rivers and dams to compensate for losses and increase carp and barb populations. A preliminary study was initiated by the Duhok Governorate of Northern Iraq with the stocking of approximately 200,000 carp fry in the Tigris River (Anonymous, 2022b).

Conclusion

It can be concluded that aquaculture, wild catch, and fish meat consumption have increased recently in Iraq, but the fisheries sector needs more government support to increase production. The implementation of scientific and technological modernization can improve commercially viable local fisheries, as well as increase aquaculture production. In addition, strict management practices are needed to increase the consumption of fisheries production and to ensure the sustainable harvest of fisheries resources.

Conflict of Interest

The authors have no conflict of interest.

Author Contributions

Conceptualization: MMH; investigation: SOMM: data collection: SOMM; data curation: SOMM, ZB and MMH; writing original draft preparation: SOMM, ZB and MMH; writing-review and editing: ZB and MMH; supervision: MMH. All authors have read and agreed to the published version of the manuscript.

Ethics Approval

Ethics committee approval is not required for this study.

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