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AQUACULTURE IN TURKEY

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Abstract
The world's resources dedicated to fisheries and aquaculture are predicted to remain stable at their maximum utilization rate. Many intensive fish farms with recirculation production systems are needed in order to achieve sustainable output. Combined or integrated production projects are needed for sustainable production and to meet the high demand for food supplies. However, due to a substantial migration problem from rural areas to metropolitan centers, labor may be a concern in the aquaculture business. Turkey is still improving technology in order to maximize resource utilization while minimizing disruption to aquatic systems. With the growth of aquaculture, some environmental issues have been identified. Based on the present study, it was predicted that Tukey will produce 700,000 tons of fish by 2050. The purpose of this paper is to provide an overview of the current situation, as well as studies on sustainability and future developments in the field.

Keywords: aquaculture production, fish farming, sustainability in aquaculture, Turkey.

1. INTRODUCTION

Fishing may be a very old tradition in Anatolia, extending back to mythological Romanian times. Fish farming became popular in the 1970s. It commenced with a rainbow trout farm (*Oncorhynchus mykiss*). Gilthead sea bream (*Sparus aurata*) and sea bass (*Dicentrarchus labrax*) farms were established in the 1980s. Tuna farming began in the early 2000s (Memis et al., 2002). Common carp (*Cyprinus carpio*) and tilapia (*Oreochromis niloticus*) have been raised also in small quantities. Trout has been raised in cages in both inland and coastal waters, in addition to land-based farms. Marine and freshwater fish species like sturgeons (*Acipenser* spp.), black sea trout (*Salmo trutta*), and turbot (*Psetta maxima*) have been raised in off-shore cages, earthen ponds, and fiberglass tanks in modern facilities in the Black Sea region. In various parts of Turkey, bluefin tuna (*Thunnus thynnus*) and Mediterranean mussels (*Mytilus galloprovincialis*) has been farmed. Technological research has been conducted to increase productivity in fish diets by experimenting with novel feed ingredients or replacing alternative feed ingredients (Yanik and Aras, 1999).

Aquaculture has a negative impact on water supplies as well. Due to sea bream and sea bass aquaculture, Sasi et al. (2017) found a high degree of contamination in Bafa Lake. After observing sea bream and sea bass production areas in cages in Ildir Bay, Basaran et al. (2007) suggested employing offshore cages to lessen environmental impact. Precautions or laws are needed to overcome environmental problems (Yucel-Gier et al. 2009).

As a result, the goal of this article was to outline the current situation of Turkish aquaculture and its long-term sustainability.

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2. TURKEY'S AQUACULTURE SITUATION

Freshwater fish species in Turkey include 236 species, subspecies, and 26 families (FAO, 2018). Turkey's caught species include mainly anchovy (*Engraulis encrasicholus*), Van Lake pearl mullet (*Chalcalburnus tarichii*), and common carp (Harlioglu, 2011). In many aspects, Turkey is self-sufficient, especially when it comes to food. Along with cage culture and land-based production, aquaculture is Turkey's fourth largest industry. Inland, recreational, and aquaculture fishing are the three categories of fishing. In 2017, the Mediterranean Sea tuna quota was 22.695 tons, with plans to increase it to 28.000, 32.000, and 36.000 tons in 2018, 2019, and 2020, respectively (Yanik, 2018). The United Nations decided to halt overfishing by 2020 and effectively control fishing activities on the basis of science, in accordance with Sustainable Development Goal 14 (SDG 14) of the 2030 Agenda for Sustainable Development.

Turkey is the sixth largest producer of fish in Europe and the third largest in the Caucasus. Fisheries are one of four sub-sectors of agricultural output, accounting for 0.3 percent of GNP (Gross National Product), after plant production, animal husbandry, and forestry (OECD, 2008). In 2020, compared to the previous year, fisheries production fell by 6.1 percent to 785 thousand 811 tons. Catched sea fish accounted for 37.1 percent of total fishing production, followed by catched other sea products at 5%, catched inland water products at 4.2 percent, and aquaculture products at 53.6 percent.

There are 434 active marine aquaculture facilities, producing mainly gilthead seabream (*Sparus aurata*) and European seabass (*Dicentrarchus labrax*). In terms of seabass, seabream, and rainbow trout output, Turkey came in second to Norway in the EU. Production of rainbow trout, sea bass, and sea bream increased from 79,031 tons in 2000 to 235,133 tons in 2014. (Baki and Yucel, 2016). Turkey produced 0.6 million tonnes of fish, including mollusks and crustaceans, worth USD 1481 million in 2018. Aquaculture contributed 76% of the total value, while fisheries contributed 24%. The quantity generated declined by 2% between 2008 and 2018, while the value climbed by 5%. Aquaculture production climbed by 12.9 percent in 2020, reaching 293 thousand 175 tonnes at sea and 128 thousand 236 tonnes in inland waters. According to studies, sea-based fish farms account for 18% of all fish farms and 60 percent of total aquaculture production (MoFAL, 2018).

3. RESULTS AND DISCUSSIONS

SUSTAINABILITY STUDIES AND FUTURE CONCERNS

It is well understood that technological advancements are required for sustainability, and research on breeding and genetics methods, disease control using a combination of new technologies, such as a system that can diagnose and vaccine at the same time, feeding techniques, feed quality, and environmentally friendly products from healthy systems must continue (Waite et al., 2014). Processing aquatic products is necessary also to boost overall revenue.

Research was primarily focused on introducing new fish species with economic value or on using alternative species such as seabream (*Pagrus pagrus*), white grouper (*Epinephelus aeneus*), sharpsnout seabream *(Puntazzo puntazzo*), common dentex (Dentex dentex), corb (Umbrina cirrosa), common pandora (*Pagellus erythrinus*), striped seabream (*Lithognathus mormmyrus*), meagre (*Argyyrosomus regius*), brown meagre (*Sciena umbra*), two-banded seabream (*Diplodus vulgaris*), white seabream (*Diplodus sargus*) and greater amberjack (*Seriola dumerili*) (FAO, 2018). Koksal et al. (2000) hypothesized that rainbow trout fish farms may successfully rear siberian sturgeon (Acipenser baeri) in concrete ponds. Cakli et al. (2005) reared sea bass and sea bream alongside common dentex (*Dentex dentex* L.). Turkmen (2007) investigated shrimp culture

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(*Penaeus semisulcatus*) in the Aegean Sea. Coban et al. (2009) studied red porgy (*Pagrus pagrus*) growth stages. Bulut et al. (2014) conducted a feeding study on the introduction of two-banded seabream (*Diplodus vulgaris*) into aquaculture and found positive results. Figure 1 represents improvements in aquaculture (Bodur, 2016).

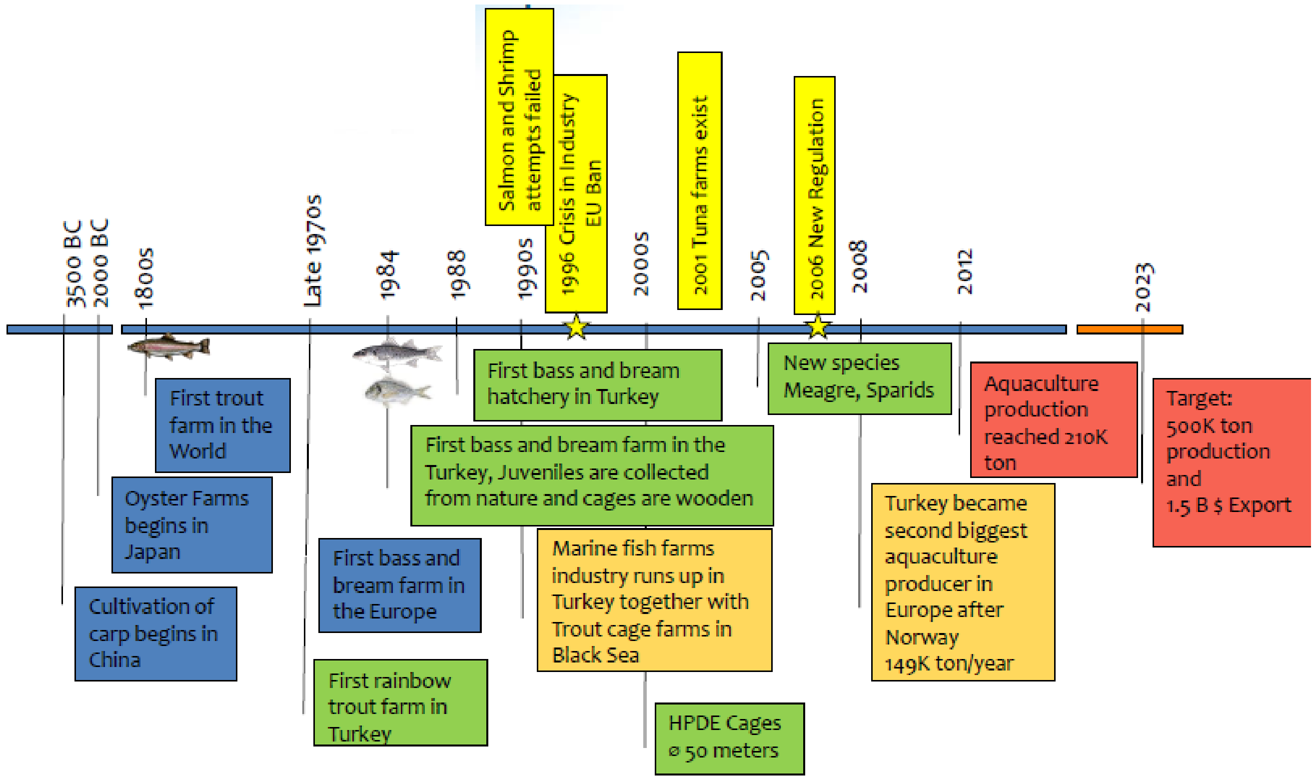

Figure 1. Chronological development of the aquaculture in Turkey (Bodur, 2016)

According to Yanik and Aras (1999), 50 percent of slaughterhouse by products can be used in rainbow trout diets (*Oncorhyncus mykiss*). Aydin and Gumus (2013) found the same percentage of Nile tilapia fry, *Oreochromis niloticus*, after replacing the chicken by-product mean. Gumus et al. (2009) reported that tuna liver meal may replace 20% of the protein in carp fry diets.
Eroldogan et al. (2006) studied some feeding regimens in sea bream, *Sparus aurata*, in order to improve feed conversion ratio. Merrifield et al. (2010) looked at the feasibility of utilizing *Chlorogloeopsis* in Nile tilapia diets to boost productivity. Gultepe et al. (2011) employed Bio-Mos in diets to boost gilthead sea bream growth. Korkmaz et al. (2011) discovered a 30% replacement rate in koi fish using dried baker's yeast for the same reason. There has been research with positive outcomes in mirror carp to boost productivity (Yigit et al., 2013). Koprucu (2012) investigated protein and energy digestibility in grass carp utilizing local feed stuffs.
Karahan et al. (2013) proposed employing genetic diagnosis of abnormalities at an early stage to boost production of European sea bass. Ercan et al. (2015) investigated the impact of effluent salinity levels on the growth of European sea bass. The effects of zeolite on the detrimental effects of environmental circumstances in Nile tilapia and common carp were explored by Cogun and Sahin (2012) and Mutlu et al. (2016). Some feed additives have been employed in the development

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of technology. For rainbow trout, adding 100 grams of kefir per kilogram of meat is recommended (Gumus et al., 2017). Turkmen et al. (2017) employed micro meals to boost gilthead seabream larval development and survival. Mannan-oligosaccharide (MOS) was used in meals to help gilthead sea bream grow faster (Gultepe et al., 2011 and 2015; Gelibolu et al., 2018).
Aquaculture is predicted to grow greatly by 2050, with a focus on continuing research to replace fishmeal and fish oil with alternative and unique materials such as animal wastes, seaweed, and plant-based or insect sources. Turkey's aquaculture growth rate was reported to be 4.2 percent, lower than the global average (Yanik, 2018). Aquaculture production is expected to reach 700,000 tonnes by 2050 with $y = 12740x + 38868$, $R^2 = 0.9741$) equation. Figure 2 shows future trend for aquaculture (Yanik, 2018).

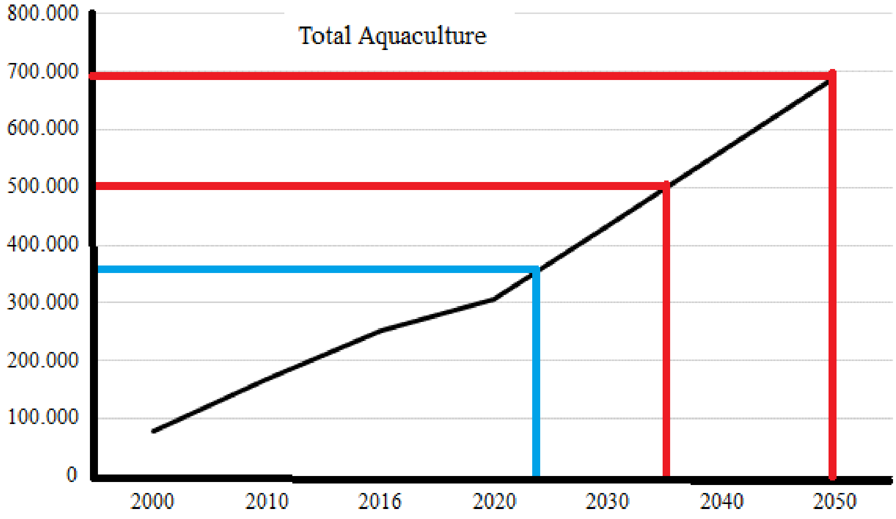

Figure 2. Future prediction for Turkey's Aquaculture

Considering aquaculture-suitable resources, Turkey looks to utilize less than half of its capacity. Therefore, it is anticipated that aquaculture production may be increased by using available places or developing technology to create feed with a low pollutant rate, as well as using disease-free certified brood stocks (Yanik, 2018). Continuous monitoring and measures are necessary when it comes to sustainability (Deniz and Benli, 2009). Technological breakthroughs may help achieve high production by offering information on how to create disease-resistant and high-growth-rate strains via genetic techniques (Karahan et al., 2013).

4. CONCLUSIONS

As a result, Turkey is expected to have a substantial chance to increase its long-term output. Other than recirculating systems, there has been no action in Turkey's aquaculture. Targeted aquaculture production is expected to be attained either by the application of new technologies (Deb et al., 2017) or the introduction of new species (FAO, 2018).

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