



Sustainability of the hookah diving fishery in Turkey


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Abstract

Hookah diving is a traditional fishing method based on the hand collection of commercial benthic organisms. Fishers continue their profession without paying attention to their physical health and psychophysical fitness. Ignoring the diving safety and decompression rules underwater, using improvised diving systems, and economic concerns carry risks that can result in death. The long-term sustainability of work depends on nations' ability to control fishing practices and promote good management. This study discusses the current situation of hookah divers in Turkey based on official statistics from the ministry and face-to-face interviews with hookah divers. The data were subjected to strengths, weaknesses, opportunities, and threats (SWOT) analysis and synthesised with the literature for strategic analysis. The sector's contribution to the national economy, economic satisfaction of divers, and supporting rural employment were evaluated as strengths. Lack of expertise in the professional career and complex laws were identified as threats that require urgent solutions. Multidirectional national efforts are needed for sustainable fishing, including stakeholder networking, diving safety, hookah equipment, underwater fishing strategies, training curricula and professional career development. Our findings offer strategic and planning approaches for the sustainable development of hookah diving in Turkey.

Keywords: compressor diving; fisheries management; small-scale fisheries, sustainability development; SWOT

1 | INTRODUCTION

Humanity has been diving underwater since ancient times for both sportive and commercial reasons. Hookah diving is a commercial fishing method based on gathering commercial benthic organisms from the seabed and passed down from generation to generation in small-scale fisheries (Barbosa-Filho *et al.* 2020). The target species are shellfish and various invertebrates, usually found in coastal and shallow waters (Huchim-Lara *et al.* 2016). Fishers use various tools (hooks, spatula, wedges, knives, etc.) and techniques to collect the target species underwater (Pet-Soede and Erdmann 1998). Hookah diving makes important contributions to ecosystem-based sustainable fisheries. It has a much lower ecosystem impact

than some fishing methods (trawls and gill nets), which are significantly responsible for bycatch and destructive benthic impact (Aydın *et al.* 2016). Traps and lift nets tried as alternatives were not satisfactory in terms of catch efficiency (Altınağaç *et al.* 2004; Şahin 2004; Sağlam *et al.* 2017). Divers display gathering behavior focused solely on the target species and tend to collect large size individuals of high economic value (Aydın *et al.* 2016). Due to its high economic benefits, hookah diving is a growing activity in many regions in Asia, Africa, Latin America, the Pacific and the Caribbean (Buonfiglio and Lovatelli 2023).

Hookah diving, which started with sponge harvesting in Turkey, dates back more than 5000 years in the

Aegean and Mediterranean Sea (Pronzato and Manconi 2008). Continuous fishing pressure on natural marine sources has caused overexploitation of stocks, and with the reductions, fishers have started to turn to different fisheries methods (Demirel *et al.* 2020). With its versatile advantages and strengths, hookah diving has become a traditional fishing method that has been passed down for generations. Fisheries are primarily performed with hookah systems, and small-scale fishers have developed boats and diving systems based on this method. Fishery is concentrated on clams, aquadis, various mussels, whelk, sea cucumbers, sponges, and sea urchins (Aydın *et al.* 2016; Kinacıgil *et al.* 2017; Çekiç *et al.* 2020). Although most of the gathered products are not consumed in Turkey, they are consumed lovingly in Far East countries. Therefore, it constitutes a vital export item and provides a significant inflow of foreign currency to Turkey (Dereli and Aydın 2021). The sector has also created employment opportunities for thousands of people, including fishers, processors, transporters, marketers and exporters (Çekiç *et al.* 2020). Because of its economic benefits and shallow water coverage, hookah diving has attracted the interest of local fishers with little or no underwater diving experience. Generally poorly equipped, the fishers made the transition to the profession without any concern for the state of their physical health and psychophysical suitability (Parvez *et al.* 2017). Hookah diving carries risks that can result in death due to greater depths and bottom time underwater, ignoring safety rules and decompression tables, use of an unsuitable compressor and improvised diving systems, and economic anxiety (Çekiç *et al.* 2020; Karadurmuş and Alkan 2022; Buonfiglio and Lovatelli 2023). Understanding fishers in the profession, fishing practices, and catch performance is an important part of fisheries management (Muallil *et al.* 2013). The long-term sustainability of the world's fisheries depends on the ability of nations to control their fishing efforts and promote well management effectively. The literature is limited to studies on the historical development of hookah diving (Kabasakal 2022) in Turkey, the socio-economic status of divers (Aydın *et al.* 2016; Çekiç *et al.* 2020), diving risks and medical consequences (Toklu and Cimşit 2009), professional problems and solutions (Karadurmuş 2021). This study aims to strategically analyse the barriers and solutions for the sustainable development of the profession by discussing the current situation of hookah diving in Turkey. This paper is intended for fishers who harvest organisms from the seabed using hookah systems and for fishery policymakers.

2 | METHODOLOGY

2.1 Data collection

The dataset used in this study is based on official ministry records and interviews with existing divers. The official data were collated from the official records obtained

from the General Directorate of Fisheries and Aquaculture under the Ministry of Agriculture and Forestry of the Republic of Türkiye. Official records contain numerical data on boats (after this, referred to as “hookah boats”) that have a license to gather commercial benthic organisms with hookah systems. All official records from 2016 to 2022 were included in the data set without undergoing any statistical analysis before the procedure. Turkey's export statistics and details were compiled from the official records of the Turkish Statistical Institute. Export data includes target species exported as processed or fresh to various countries, such as whelks, sea cucumbers, sea urchins, mussels and clams collect in hookah diving. The export data were extracted according to the coding list based on the Trade Data categorised by Harmonized System Codes (HS) developed by the World Customs Organization (WCO) to enable a systematic description of detailed analyses.

2.2 Evaluation of data

Interviews were held with 28 hookah divers, whose professional experience ranges from 13 to 32 years, who are actively practicing the profession. The interviews were conducted face to face, and questions included their professional careers, diving profiles, satisfaction levels, problems and suggestions. Their answers and statements were noted during the interview without interfering with the narrative. With an objectivist approach, the information given by the interviewee was accepted as a one-to-one representation of professional reality. The data were synthesised with the literature for strategic analysis and subjected to SWOT analysis. SWOT analysis derives its name from the words strengths (S), weaknesses (W), opportunities (O), and threats (T). The result of the SWOT analysis is a list of factors that can be used for further analysis and for selecting the decision criteria in the multicriteria analysis of fisheries management of hookah diving. SWOT analysis is commonly used as a strategic planning technique in various areas of fisheries such as conservation strategies (Cowx *et al.* 2010), socioeconomic status (Glass *et al.* 2015), marketing (Khanal *et al.* 2020) and sustainable development (Rahman *et al.* 2020), including the current study subject. In this study, SWOT was used to identify strategic options, linking internal and external factors affecting fisheries management.

3 | RESULTS AND DISCUSSION

3.1 Hookah diving with strengths

Regarding natural stocks, Turkish seas are quite diverse, especially whelk, sea urchins, sea cucumbers and various shellfish (Aydın *et al.* 2016) and this presents wide opportunities for local fishermen. Hookah diving is still preferred by small-scale fishermen nowadays and they are making investments in this fishing method. Traditional hookah diving, which has a strong fishing fleet, has been

transferred from generation to generation. Although the number of hookah boats increased slightly from 2016 to 2020, the trend was volatile. The number of hookah boats, around 500 in 2016, increased significantly to over 750 in 2019 and 2020. The number of hookah boats, which had increased rapidly in the previous period, declined sharply to 467. In the last case, the number of hookah boats in 2022 was recorded as 685. A significant trend was observed in sea urchin fishing in 2022, starting with the first legal catch. Approximately 46% of the boats were licensed to collect whelk, 43% sea urchins and very few (11%) sea cucumbers (Figure 1).

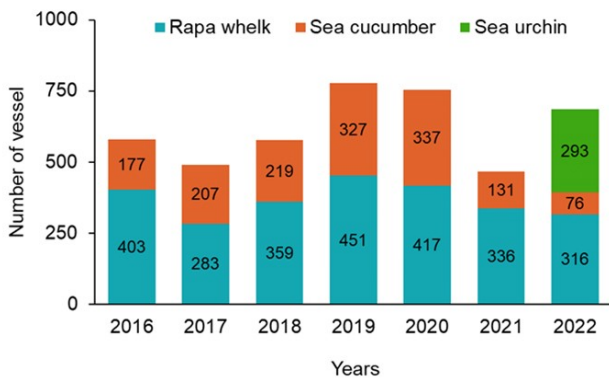


FIGURE 1 Distribution of hookah diving fishing fleet in Turkey by target species and years.

The low cost and ease of installation of hookah systems are among the reasons why hookah fishing is preferred by divers worldwide, including Turkey (Bene and Tevfik 2001; Huchim-Lara *et al.* 2015). Occupational and economic satisfaction levels of hookah divers in Turkey are quite high (González-Wangüemert *et al.* 2014; Aydın *et al.* 2016; Çekiç *et al.* 2020). The sector has created job

opportunities for thousands of people, including divers, processors, intermediaries and local traders. The dominant species and fishing fleet vary by region depending on the abundance of marine resources. According to the distribution of the fishing fleet extracted from the official records, rapa whelk fishing is mainly concentrated in the Black Sea (Istanbul, Zonguldak and Samsun), sea cucumber (Izmir, Istanbul and Balıkesir) and sea urchin fishing (Izmir, Balıkesir and Çanakkale) are pre-dominated in the Aegean Sea and the Marmara Sea (Figure 2). The number of hookah boats with the highest number of diving licenses from 2016 to 2022 was recorded in İzmir. İstanbul was in second place with 657 diving licenses followed by Balıkesir ($n = 439$), Zonguldak ($n = 398$) and Samsun ($n = 290$) (Figure 2). The least number of licenses were recorded in Hatay, Antalya and Artvin.

Most of the harvested organisms are luxury food items and have commercial importance due to its rich nutritional content (Aydın *et al.* 2011). However, Turkey does not consume products such as whelk, aquivades, sponges, sea cucumbers and sea urchins. For this reason, it has created an essential export item and provides a significant foreign exchange inflow to Turkey (Aydın 2017; Çekiç *et al.* 2020). The adverse effects of various fisheries methods targeting similar species (bottom trawl, beam trawl, beach seine, gill nets etc.) on the ecosystem are well documented (Bjorndal 2002, Zengin *et al.* 2022). In this direction, alternative fishing methods have been proposed for the sustainable use of benthic resources and the protection of the marine ecosystem with an ecosystem-based holistic approach. Some scientists, including fishers, agree that hookah diving is an environmentally safe method of fishing (Altınağaç *et al.* 2004; Aydın *et al.* 2016).



FIGURE 2 Distribution of hookah diving fishing fleet in Turkey by regions and target species.

3.2 Hookah diving with weakness

Poor cooperation and coordination with official institutions were also considered essential shortcomings. Although economic satisfaction is high, fishing costs must be reduced to increase profitability. Diving equipment, fuel, labour and vessel maintenance constitute essential expense items of fisheries. Although the government has created a financial support fund to support small-scale fisheries, the existing incentives, capital and infrastructure are still insufficient. With the increase in global inflation in recent years, fishermen need help meeting the costs.

When the stocks are exposed to overfishing for years, export sizes gradually decrease and the demand of foreign markets may not be adequately met at the desired time due to irregular catches (Purcell *et al.* 2013). Therefore, a consensus is that marine stocks should be well-managed (Samoilys *et al.* 2017). In order to keep the catchable stocks in balance, it is necessary to know the growth, development, mortality, breeding periods, stock biomass and recruitment amounts of the marine organisms. The current status of inventories is usually derived from export data (Dereli and Aydın 2021) and legal limitations are created accordingly. There are gaps in the legal framework due to the lack of knowledge of stocks and lack of data. Current situation analysis and future stock forecasts should be made with new scientific studies of stocks, and fisheries management strategies should be determined.

3.3 Threats versus opportunities

The fishing industry's expansion and growth are very important to the economic development of countries. International trade in fishery products is also an important source of foreign exchange for countries (FAO 2020). As a matter of fact, together with Turkey's rapidly developing fishing industry, a record export of 1.4 billion US\$ was realized in 2021. The total export of aquatic products subject to hookah diving was 36,163,611 US\$ in 2022. Whelk had the highest share (41.4%) in total exports, with an export value of 14,960,774 US\$. The sea cucumber was in second place with 11,308,664 US\$ in export followed by sea urchin (8,754,579 US\$), mussels (1,138,912 US\$) and clams (682 US\$) (Figure 3). It is worth remembering that it would be misleading to attribute all exports to hookah divers and that these products are caught in different fisheries methods (especially beam trawling), albeit limited. Nevertheless, the data provide evidence for demonstrating the sector's economic potential. Many of the products harvested by hookah divers are also exported (Aydın *et al.* 2011). The export potential of these seafood products in the international market and the demand for the products have increased globally in recent years (Dereli and Aydın 2021). Adapting invasive species such as Rapa whelk (*Rapana venosa*) and long spined sea urchin

(*Diadema setosum*) to Turkish seas offers significant opportunities for hookah divers. Crowded population, intense agricultural and industrial activities, pollution and changes due to the global climate crisis put constant pressure on the earth, especially on ecosystems. In addition to pressures, overfishing, bycatch, illegal fishing, and deterioration in the marine ecosystem and benthic habitat structure are prominent problems in world fisheries (Link and Watson 2019). Despite increasing global concerns, the global transition trend towards a green economy has come to the fore in recent years. Intense efforts are made for renewable energy, green buildings, sustainable transportation, water and land management, and sustainable fisheries. In the face of all these efforts, hookah diving serves ecosystem-based fisheries (Aydın *et al.* 2016) and is considered a critical opportunity for the sector's sustainability. Despite its strengths and versatile opportunities, there are significant threats to the sustainability of hookah diving (Figure 4).

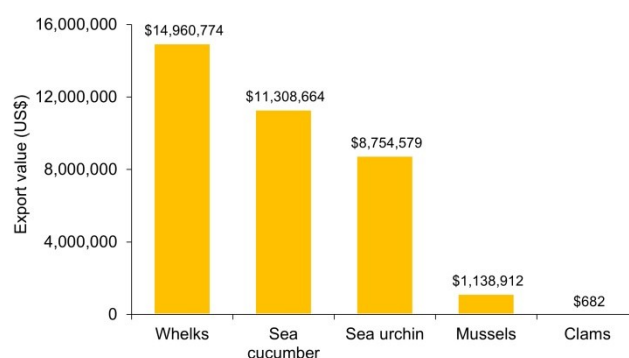


FIGURE 3 Export values of products subject to hookah diving in Turkey for 2022.

3.4 Threats across the sustainable development and management strategies

Diving activities pose a significant health risk to divers. These include decompression sickness, carbon monoxide poisoning, interruption of the air supply and entanglement. The diver's underwater behaviour, fishing strategy, history of illness and psychological factors affect the risk (Huchim-Lara 2010; Buonfiglio and Lovatelli 2023). Lack of training and ignoring safety procedures are other factors that increase the risk of decompression (Long *et al.* 2002; Toklu and Cimşit 2009; Smart 2010). As in all commercial diving, trained people should be employed in hookah diving (Buonfiglio and Lovatelli 2023). As a result of the evaluations, the lack of career enhancement and dive safety consciousness comes to the fore as significant threats. Transfer of advanced knowledge and skills is recommended for developing occupational career skills in hookah diving, where human life is at stake. For this, it is recommended to establish educational collaborations, conduct a comprehensive training needs analysis, develop a specifically designed learning curriculum and integrate it

into existing vocational training. Diving safety should be emphasised in addition to the curriculum covering occupational health, diving theories and decompression methods. Fishermen in Turkey are subject to general health insurance. Most divers are reluctant to get health

insurance and work without any health insurance (Aydın *et al.* 2016; Çekiç *et al.* 2020). Although health insurance health insurance is compulsory for all citizens in Turkey, policies such as private health insurance, early retirement and depreciation should be developed for divers.



FIGURE 4 Overview of the SWOT analysis about the hookah diving fishery in Turkey.

Hookah systems consist of an average 5 – 6 horsepower gasoline engine, a single-stage air compressor that can compress air, an air tank with sufficient volume and pressure for the diver to dive to depths of 20-30 meters, a hose group and a regulator (Aydın *et al.* 2016). The whole system is mounted on wooden planks on the deck of the fishing boat (Figure 5a; Chin *et al.* 2015). Equipment problems, exhaustion of air/breathing gas, poisoning, entanglement, and on-board fire are the leading known causes of death in hookah diving (Smart 2010; US Navy 2016; Acencio-Lane *et al.* 2019; Buonfiglio and Lovatelli 2023). Poor technology and design flaws in hookah (Figure 5b – 5c) and boat systems are mainly responsible for these deaths (Lippmann 2010; Karadurmuş and Alkan 2022). Unfortunately, hookah systems are not subject to inspection in Turkey. The gasoline engine, air hose and pressure tanks used in existing hookah systems pose a risk. In general, untrained and inexperienced surface support personnel also invite diving accidents (Figure 5d). There are cases of compressor running out of fuel, broken air hose or even fire on the deck caused by surface support personnel. For this reason, it is necessary to review all hookah, diving and deck equipment regarding occupational health and safety and establish the necessary legal framework. Divers resist accepting new technologies due to economic conditions and high inflation. Extensive government support is needed for the acquisition and transfer of advanced technology, integration into existing systems and training of divers. Production efforts and research and development activity initiatives in line with domestic resources for developing existing designs and

hookah equipment are essential for sustainability.

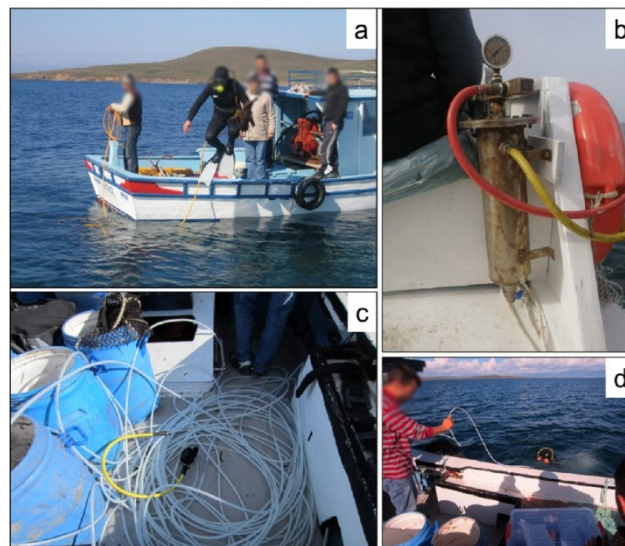


FIGURE 5 A hookah diver and boat (a), filter system of hookah (b), hose assembly (c) and surface support personnel (d).

Economic satisfaction and complex legal framework lead fishermen to illegal fishing. Illegal, unreported and unregulated fishing (IUU fishing) is one of the main threats to the sustainable use and conservation of fisheries resources (Pramod *et al.* 2014). Irregular fishing practices and inefficiency in monitoring and inspection are the main reasons for the continuation of IUU fisheries (Miller *et al.* 2014). It is recommended that lack of concrete regu-

latory measures, ineffective policy implementation, and insufficient supervision and control are the main impediments to eliminating the ongoing IUU problem. The current legal framework should be broadly regulated, economic and environmental conditions should be improved, and control and supervision mechanisms should be developed. The role of fisheries inspectors and effective community involvement is necessary to ensure the optimum and sustainable management of marine resources.

All kinds of commercial diving activities in Turkey are carried out within the framework of the "Professional Underwatermen Regulation" numbered 23098 published in the Official Gazette dated September 2, 1997. Current decisions mainly cover advanced diving jobs, including industrial jobs. Enforcing fishery regulations, including bans, minimum catch sizes, the type of fishing gear allowed, and monitoring to avoid activities such as poaching in restricted areas or catching threatened species, are the issues that require attention to reduce the impacts on biodiversity arising from the overfishing, bycatch, and degradation of habitat. In the framework mentioned above, hookah diving should be considered separately from other commercial diving activities. It should be organized in all processes, from entering the profession to its execution.

An ideal and sustainable economy produces the most significant general welfare with the least resource use and environmental damage. The fishing income of hookah divers is satisfactory, but high operating costs, inflation and fluctuations in exchange rates negatively affect profitability. Public support, low-interest loans and tax exemption are recommended to ensure sustainable fisheries and income stability. All these supports should be organized to cover fuel, labour, diving equipment, training and ship maintenance, especially the transfer of advanced technology.

The fishing industry faces various risks in the process, from production to marketing, due to its importance in the economy and the reasons arising from its nature. In order to minimise these risks, the necessity of agricultural organisation arises. In order to minimise these risks, the necessity of agricultural organisation emerges (Tan and Demir 2015) and is reported as an essential deficiency in Turkish fisheries (Doğan 2017). Poor communication between divers and official institutions has also been identified as an important obstacle in hookah fishing. It can contribute to economic and social development by improving communication/cooperation with fisheries cooperatives and regional unions, to which the fishing fleets of fishers are legally bound. Moreover, integrating fishery policies with other socioeconomic policies and interdepartmental cooperation is needed to achieve policy consistency across local related.

Factors such as job satisfaction, economic anxiety, market demand and scarcity of marine resources signifi-

cantly affect fishing behaviour and strategies (Castillo 2011; Salas *et al.* 2011). Diving strategies allow hookah divers to meet their daily catch efficiency target. However, divers are willing to change their strategy at all risks to maximise catch and generate more income (Laloe and Samba 1991; Buonfiglio and Lovatelli 2023). Decompression tables and dive time limits are often ignored (Bene and Tefvik 2001; Çekiç *et al.* 2020; Karadurmuş 2021). As a result of all these risks, it is stated that divers experience high rates of decompression sickness, barotraumas, arterial gas embolisms and many clinical ailments related to diving (Denoble *et al.* 2011; Vann *et al.* 2011). National efforts should be initiated to improve working conditions and create a decent working environment for hookah divers. Recent observations in many coastal communities have shown that fishers are ageing and young people are not entering the industry. One of the main problems of ageing and work is the mismatch between the employee's functional capacity and the job requirements. The job demands usually do not increase over time, but workability, physical work capacity, functional mental capacity and employability typically decline with age. Dynamic social influences and changing fisheries management are important factors influencing youth labour force participation. National policies aimed at maintaining older workers in a socially and economically meaningful role should be adopted by governments and supported by appropriate legislation. For sustainable development, it is recommended to create skills, knowledge and confidence, transfer knowledge about careers and current paths and create job opportunities to encourage the young population to the profession.

The export size of the stocks exposed to overfishing gradually decreases and the demand of foreign markets is not adequately met due to irregular fishing (Purcell *et al.* 2013). Therefore, fisheries stocks must be well managed (Samoilys *et al.* 2017). Hookah diving has the potential to affect particularly vulnerable or threatened populations seriously. There is varying evidence of the diver's underwater behaviour's negative impact on their target populations (Indra *et al.* 2019) and their habitats (Friedman *et al.* 2011). Lack of awareness/knowledge about sustainable fishing is one of the main threats to the sustainable use and conservation of fisheries resources and can cause severe damage to stocks. For this reason, further scientific studies, including increased public awareness of fisheries management, catch quality, marine ecology and biodiversity, and diver behaviour are recommended.

4 | FINAL REMARKS AND CONCLUSIONS

Our study provides in-depth data on current trends in hookah diving and offers management strategies for the sustainability of the industry. The international demand for benthic organisms has increased in recent years, contributing to the development of hookah diving in Turkey

(Dereli and Aydın 2021). Turkey is in an advantageous position due to stocks that haven't exploited yet, which creates enormous employment for hookah divers. Hookah divers hope to keep their profitability at a stable level and to work in sustainable work conditions. This paper highlights the need for comprehensive national efforts, including professional qualification, learning curriculum, certification, health conditions, employment, diving equipment and hookah systems, to address barriers to sustainability. Our findings form the basis for further studies and policies on hookah diving to serve the UN sustainable development goals.

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CONFLICT OF INTEREST

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

AUTHORS' CONTRIBUTION

All authors contributed to the study conception and design. Material preparation, data collection and analysis were performed by UK & MA. Both authors read and approved the final manuscript.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available on a reasonable request from the corresponding author.

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