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# Issues of the ornamental fish farmers' community in Iran

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## ABSTRACT

Despite the global trade of over 2 billion ornamental fish, Iran, with a production of 291 million pieces and employing 12,100 people, accounts for only 0.07% of global fishery exports. Therefore, to provide an overview of the potential development and challenges, we conducted research using an electronic questionnaire. We used the Mann-Whitney test to compare the means of two independent groups and Friedman's test to rank these factors. More than 60 farmers from 18 provinces participated in the study, with over 67% of their farms covering less than 500 m². The primary challenges were disease, poor nutrition quality, larval mortality, maintaining and improving water quality, and a shortage of skilled labor. Farmers aged over 32 emphasized water resource limitations more than younger farmers, and they also highlighted the importance of quality control and the inadequacy of existing laws and guidelines. In contrast, farmers under 32 emphasized the importance of collaboration between universities and research centers in addressing production issues. Water resource limitations and quality control were deemed more critical in farms producing over 20,000 pieces. In contrast, in farms larger than 300 m², education, the lack of professional training centers, production area constraints, and the role of academic research in ornamental fish were considered less important than in smaller farms. The issue of education and support, particularly for small-scale farms lacking fishery education, should be taken seriously.

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## Introduction

The global ornamental fish industry is valued at US$15 billion, with over 2 billion ornamental fish traded (Satam *et al.*, 2018). The trade spans approximately 125 countries. Freshwater fish dominate this trade, accounting for 90%, and are primarily sourced from breeding facilities in developing nations, mainly in Asia and South America, as well as in the USA and Europe (Evers, 2019). The global aquarium fish industry thrives due to low operating costs and manageable systems. In major ornamental fish markets, retail value significantly exceeds commercial value, positively affecting the entire value chain (Monticini, 2010). This activity improves land-use efficiency as an income-generating activity (Weerasinghe *et al.*, 2024). For example, in 2019, ornamental fish production accounted for about 2% of Sri Lanka's total export value. The industry comprises fish breeders, fish growers, outgrowers, middlemen, collectors, and exporters. However, in this context, it is challenging to distinguish between fish breeders and growers, as they often perform both activities simultaneously. Therefore, these parties are commonly referred to as ornamental fish farmers (Weerasinghe *et al.*, 2024).

An overview of the ornamental fish production process and the university's role in advancing research revealed that academic research accounts for only a small fraction of advances in breeding marine ornamental fish in captivity (Pouil *et al.*, 2020). Significant progress has been achieved through private companies and enthusiasts. Nevertheless, academic research is crucial for conserving marine species, particularly for captive breeding programs for species that require it (Dee *et al.*, 2014). Unfortunately, despite progress, research in this field has remained costly and time-consuming. It is improbable that most marine ornamental fish, like freshwater ornamental fish, many of which are now domesticated, will be bred in captivity soon (Teletchea, 2016). Water quality is vital to the proper functioning of any aquaculture facility. In Florida, regulatory costs associated with water restrictions included implementing infrastructure such as aquaculture systems and reclamation facilities, labor to operate these facilities, and permitting fees for wells. The final two categories encompassed regulatory costs and lost production value, as well as interstate transportation costs and fish health (Boldt *et al.*, 2023).

Although most researchers have focused on biological aspects such as nutrition, breeding, and genetics, a significant challenge remains: trade and consumer preferences for keeping these fish. Ornamental fish farmers and business owners must thoroughly understand market conditions and export demand dynamics (Chitra and Krishnaveni, 2013). To remain competitive, they need to analyze market trends effectively and rapidly adapt their strategies to avoid falling behind. They must learn and innovate rapidly, or modify their business strategies in response to market conditions. For instance, many ornamental fish businesses faced losses during the COVID-19 pandemic because they were reluctant to change their business models (Nanayakkara *et al.*, 2021), yet many ultimately achieved greater profits than before (Ramadhan, 2021). Those who typically sell directly in the local market should be open to learning to sell online and to seeking information on exporting products to other countries through transshipment services (Tarihoran *et al.*, 2023). For example, in Sri Lanka, the ornamental fish export business made significant progress during the COVID-19 pandemic, increasing earnings in this sector. Commonly identified challenges fall into four groups: production issues, market/economic issues, technology adoption, and other concerns. The outlook heavily depends on market conditions and encourages producers to balance

environmental sustainability with optimal resource management (Weerasinghe *et al.,* 2024). Based on the analysis of the Jamaican ornamental fish industry, ornamental fish production is highly profitable and a worthwhile investment for individuals. For years, many small-scale producers have been urging the government to establish a swap room with staff dedicated to marketing ornamental fish internationally. These small-scale manufacturers could sell their products to this swap room. However, this plan was never realized (Gray *et al.,* 2011).

Numerous studies have been conducted in the field of aquaculture, including: Investigating obstacles and challenges in farmed shrimp production in Golestan Province of Iran (Adeli *et al.,* 2021), analysis of Iran's ornamental fish exports (Adeli and Taghani, 2023), effective factors in production and marketing of ornamental fish in Alborz Province of Iran (Barghi Lashkari *et al.,* 2017), a review of socio-economic conditions hindering the optimal development of ornamental aquatic production and trade in Iran (Rastiannasab and Karimi, 2020), the ornamental fish trade and fish conservation (Andrews, 1990), current status, challenges, and opportunities in the ornamental fish trade in India (Pandey and Mandal, 2017), Ornamental fish farming as a successful small-scale aqua business in India (Ghosh *et al.,* 2003), Opportunities and business challenges of marine ornamental fishes in Indonesia as a potential fisheries commodity (Sinansari and Priono, 2019), Biosecurity and the ornamental fish trade: A stakeholder perspective in England (Wood *et al.,* 2022), and Analysis of ornamental fish exports from the Amazon State, Brazil (Tribuzy-Neto *et al.,* 2020), among others.

The history of the ornamental fish industry in Iran spans approximately 50-60 years, with a production volume of about 291 million pieces in 2021 and an employment rate of 12.1 thousand people. This research also examined the challenges faced by Iran's aquarium fish breeders.

## Material and Methods

We began by reviewing existing literature on Iran's ornamental fish producers and conducting preliminary interviews to identify key production and market challenges. Based on these findings, we designed a structured questionnaire, which experts validated, and we tested for reliability using Cronbach's alpha. We distributed the finalized questionnaire electronically to all active ornamental fish producers across Iran and collected it upon completion. Using SPSS 22, we analyzed the raw data for both qualitative and quantitative variables. To compare means between two independent groups, we used the Mann-Whitney test, and we used Friedman's test to rank the significance of identified challenges from a sociological perspective.

## Results

Our survey captured responses from ornamental fish producers across 18 of Iran's 31 provinces, with the highest participation rates in Isfahan and Razavi Khorasan provinces (together accounting for 54% of respondents). The average age of producers was 37 years, and 72.3% were under 40. Education levels varied: 30.8% held diplomas, while the majority (69.2%) had higher education. Notably, over 70% of producers lacked formal education in agriculture or fisheries (Table 1).


**Figure 1.** Distribution of ornamental fish farms in Iran.

Over 76% of farms employed fewer than five workers, while only 5.6% had more than ten employees. Women's participation in the survey was low: only two women served as farm managers and entrepreneurs, and neither held a business license. In 76% of the farms, fewer than two female workers were present. The ratio of individuals with personal farms to those renting farms, as well as licensed to unlicensed farms, was 50%. Sixty-three percent of farms operate both breeding and production simultaneously, while only 10% of farms produce live food. More than half (50.8%) of the farms produced fewer than eight species of freshwater ornamental fish, while 87.7% did not produce any saltwater ornamental fish. Over 67% of aquaculture farms occupied less than 500 m² of land, while 27.5% had pools smaller than 100 m². Water supply sources and the volume of water entering the farm are the main factors limiting farm development. Only 3.6% of producers engaged with scientific centers and universities, while 81.5% and 98.5% have not received government support or land to develop or expand their businesses (Table 1). Table 2 highlights the primary challenges ornamental fish farms face: disease, nutritional quality, larval mortality, water quality management, and a shortage of skilled labor.

**Table 1 -** Socio-demographic characteristics of ornamental fish farmers and their production capacity.

| Variable | Status | Frequency% | Variable | Status | Frequency (%) |
|---|---|---|---|---|---|
| Age | <30 | 21.5 | Education Level | High school diploma | 30.8 |
| | 31–40 | 50.8 | | Associate Degree | 12.3 |
| | 41–50 | 18.5 | | Bachelor | 33.8 |
| | 51–60 | 7.7 | | Master's degree | 13.8 |
| | 60< | 1.5 | | PhD | 9.2 |
| Activity | reproduction | 7.7 | Field of Study (Manager) | Fishery | 21.5 |
| | breeding | 10.8 | | Agriculture | 2 |
| | Fish breeding& reproducing | 81 | | Veterinary | 6.2 |
| | Live food | 10.8 | | other fields | 70.8 |
| license | Licensed | 41.5 | Ownership Status | Owner | 51.6 |
| | unlicensed | 58.5 | | Renter | 48.4 |

| Variable | Status | Frequency% | Variable | Status | Frequency (%) |
|---|---|---|---|---|---|
| Farm area | <500 m² | 67.7 | Pool area | <100 m² | 27.7 |
| | 500–1000 m² | 12.3 | | <100 m² | 18.5 |
| | 1000–2000 m² | 6.2 | | 200–400 m² | 25.6 |
| | 2000 m²< | 13.8 | | 400–1000 m² | 12.4 |
| Total female staffing | Fewer than two women | 76 | | 1000 m²< | 13.8 |
| | 2–4 women | 12 | Total staffing | Less than 5 labors | 76.6 |
| | More than 4 women | 12 | | 6–10 labor | 21.8 |
| Number of marine species | 0 | 87.7 | | More than 10 labors | 5.6 |
| | 1–2 | 3.1 | Number of freshwater species | 0–8 | 50.8 |
| | 3–5 | 4.6 | | 9–16 | 24.6 |
| | <5 | 4.6 | | 17–25 | 13.8 |
| Production capacity (Nominal production) | Less than 100,000 pieces | 51.8 | | <25 | 10.8 |
| | 100,000–200,000 | 9.5 | production volume (pieces) | <20,000 | 60.7 |
| | 200,000–300,000 | 8.1 | | 20,000–40,000 | 10 |
| | 300,000–400,000 | 8.2 | | 40,000–60,000 | 14.7 |
| | 400,000< | 22.4 | | 60,000–80,000 | 4.3 |
| Production scale | Home scale | 29.2 | | >80,000 pieces | 10.3 |
| | Semi industrial | 41.5 | | | |
| | Industrial | 29.2 | | | |

**Table 2.** Production problems in ornamental fish farms.

| Factor | Frequency of priorities (%) | | | | | | Average rank | Score | Degree of Freedom | Friedman test | *P*-value |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | | | | | |
| Disease | 50.8 | 1.23 | 10.8 | 9.3 | 4.6 | 15 | 1.99 | 1 | 5 | 170.439 | <0.001 |
| Nutrition | 27.7 | 50.8 | 15.4 | 4.6 | 1.5 | 0 | 2.02 | 2 | | | |
| Survival of larvae | 3.1 | 9.2 | 58.8 | 13.8 | 9.2 | 6.2 | 3.33 | 3 | | | |
| Water quality | 12.3 | 4.6 | 4.6 | 58.5 | 12.3 | 7.7 | 3.77 | 4 | | | |
| Lack of skilled labor | 4.6 | 4.6 | 10.8 | 6.2 | 66.2 | 7.7 | 4.48 | 5 | | | |
| other challenges | 4.6 | 3.1 | 0 | 9.2 | 4.6 | 78.5 | 5.41 | 6 | | | |

Table 3 shows that individuals under 32 years old regard the interaction between universities and research centers in addressing production issues as a more significant concern than those over 32. Producers over 32 prioritize limitations in water resources, quality control, and the deficiencies of laws and guidelines. Water resource limitations and quality control have a more substantial impact on farms producing over 20,000 ornamental fish than on those with lower production levels. Furthermore, farms with production areas under 240 m² face greater

challenges due to space constraints. In farms larger than 300 m², the significance of education, the lack of skilled institutions, and the role of academic research in ornamental fish production were less pronounced than in smaller farms .

Table 3 also indicates that in farms producing more than two viviparous species, inadequate rules and guidelines were viewed as a more critical issue, while in farms producing over four oviparous species, market competition was intense and competitors were highly professional. Additionally, in farms producing fewer than four oviparous species, challenges in education and a lack of competent educational institutions were evident. Producers with unrelated education perceived the rise in currency and input prices as more impactful on their business, whereas those with fisheries and agriculture education placed greater value on support from the Fisheries Organization, the Ministry of Agriculture, and related expert services.

**Table 3.** The relationship between farmers' sociological characteristics and production problems.

| Mix | dependent factor | independent factor | Average rank | Mann –Whitney | *P*-value |
|---|---|---|---|---|---|
| Age | The significance of the limitations and quality of water resources in farms | <32 | 32.6 | 357 | 0.02 |
| | | >32 | 33.44 | | |
| | The role of academia in research progress and solving production problems | 32< | 36.82 | 397 | 0.042 |
| | | >32 | 28.81 | | |
| | The challenge of Inefficient rules and guidelines | 32< | 28.49 | 273.5 | 0.037 |
| | | >32 | 37.95 | | |
| manager (major) | The level of government support and its expert services | A graduate of fisheries or related majors | 42.47 | 257 | 0.002 |
| | | other majors | 29.09 | | |
| | The impact of the increase in the price of currency and production inputs | A graduate of fisheries or related majors | 26.79 | 319 | 0.045 |
| | | other majors | 35.57 | | |
| Production | The importance of limitation and quality of water resources in the farm | 20,000< | 27.32 | 308 | 0.038 |
| | | 20,000> | 36.67 | | |
| farm area | education and the lack of The issue of competent educational institutions | 300 m²< | 37.67 | 354 | 0.022 |
| | | 300 m²> | 27.21 | | |
| | Limitation of the production area | 300m²< | 38.28 | 332 | 0.007 |
| | | 300 m²> | 26.45 | | |
| | The role of academia in research progress in ornamental fish | 300m²< | 37.11 | 374 | 0.026 |
| | | 300 m²> | 27.9 | | |
| pool area | Limitations of the production area | <240m² | 37.52 | 379 | 0.037 |
| | | 240m²> | 28.34 | | |
| Vivaparous spieces(VS) | The challenge of Inefficient rules and guidelines | Less than 2 VS | 28.5 | 374 | 0.038 |
| | | more than 2 VS | 37.94 | | |
| Ovaprous species (OS) | The market conditions are very competitive, and competitors behave professionally. | Less than 4 OS | 28.24 | 358.5 | 0.019 |
| | | more than 4 OS | 38.55 | | |
| | | Less than 4 OS | 37.73 | | |

## Discussion

Respondents averaged 37 years of age, with a significant majority (72.3%) under 40—a trend also observed by Barghi Lashkari et al. (2017) in Alborz Province, Iran. Similar trends were noted in Indonesia, where 63% of saltwater pool farmers were under 50 years old (Kamaruddin and Baharuddin, 2015; Samah and Kamaruddin, 2015). In Malaysia, the average age of aquaculture farmers ranges from 38 to 50 years (Ng *et al.,* 2013). This age group represents the

most productive period for capital and energy in optimal operations (Langy and Mekura, 2005). As Kumar et al. (2018) note, aquaculture producers with advanced education are more likely to adopt technologies efficiently. This finding contrasts with Ogbonna (2014), who argues that elderly fish farmers are in their economic prime, and this stage affects their decisions about adopting technology. According to Langy and Mekura (2005), experienced farmers often possess greater financial readiness and communicate more effectively with development agencies, making them more receptive to adopting new technologies.

The results indicate that 30.8% of the activists possessed a high school diploma, while the rest had higher education. Over 70% of activists and entrepreneurs in this sector had an education unrelated to agriculture and fisheries. Producers with unrelated education saw rising currency and input prices as more significant to their business, while those educated in fisheries and agriculture placed greater value on support from the Fisheries Organization, the Ministry of Agriculture, and related expert services. This contrasts with the survey of the Indonesian aquaculture community, which reveals that aquaculture farmers generally have low educational attainment, with most achieving only secondary education and a small percentage being uneducated (Samah and Kamaruddin, 2015).

Education can facilitate the modernization of fish farming by enabling producers to access and understand emerging technologies (Adesoji and Kerere, 2013). Highly educated aquaculturists are likely to make efficient adoption decisions, and technology adoption is expected to be high (Atanu *et al.,* 1994). Conversely, formal education may impede technology adoption by enhancing human capital and providing greater incentives for off-farm employment (Uematsu and Mishra, 2010) .

A study on social and demographic factors affecting GAqP (Good Aquaculture Practices) in Malaysia found that approximately 84% of saltwater pond farmers adopted GAqP, with an average compliance rate of 71.9%. In contrast, freshwater pond farmers had an average GAqP compliance rate of 50.3%. Notably, saltwater farmers' education level negatively influenced GAqP adoption (Samah and Kamaruddin, 2015). Age and technical knowledge in aquaculture are the primary factors affecting GAqP levels among these farmers. Therefore, aquaculture development plans should incorporate initiatives to enhance producers' technical knowledge to support sustainable growth in Malaysia's aquaculture sector (Samah and Kamaruddin, 2015). Findings revealed that disease control, nutrition optimization, larval survival rates, reliable water sources, and trained labor were the main hurdles, paralleling earlier observations by Pandey and Mandal (2017). The ornamental fish sector in India faces numerous issues, encompassing both technical and economic aspects. The main limitations include a lack of technical knowledge and scientific information on breeding, feed types and nutrition, and health management. Additionally, the primary challenges for ornamental fish farmers in Sri Lanka include feed and additives, fish survival, maintaining fish quality, difficulties in executing natural and artificial breeding activities correctly, low-quality breeders, unavailability of chemical drugs for disease treatment, cross infections, and significant operational issues such as tank cleaning and water exchange, which correspond with the research findings of Malkanthi *et al.,* (2021).

Fish farming in China also adopts a stringent approach to testing and quarantining larvae before introducing them to the farm. This scrutiny extends to feed selection, with a strong

emphasis on nutritional content, thereby enhancing the production of higher-quality aquatic products (Yan *et al.,* 2023). Furthermore, the questionnaire results indicated that 73.8% of farmers are not members of trade unions; however, they did not identify this as a challenge. In contrast, fisheries graduates highlighted the lack of government support as an obstacle to production. This aligns with Yan et al. (2023) in China, which shows a significant positive relationship between organizational support and the adoption of good aquaculture practices among fish farmers.

Strengthening entrepreneurship centers, creating support structures through unions, cooperatives, and large companies, and granting small loans, along with tax exemptions and the allocation of land and facilities for establishing production lines in knowledge-based fisheries entrepreneurial centers, are essential mechanisms to address the challenges facing Iran's shrimp market and enhance entrepreneurship in this sector (Samsampour et al., 2021)). Business development is closely tied to the government's role, including improving fish breeders' skills, providing necessary facilities and infrastructure, investigating obstacles in digital marketing, and addressing inconsistencies between government programs to facilitate development (Natsir and Ilham, 2023). In Sri Lanka, support issues include: non-participation of government and organizations (96.6%), lack of loan facilities (86.2%), inadequate insurance options (72.4%), labor issues (25.9%), and challenges in loan repayment (25.9%) (Malkanthi *et al.,* 2021).

Reports indicate that the impact of water resource limitations and quality control was more pronounced in farms producing over 20,000 ornamental fish than in those with lower production levels, and in farms with production halls smaller than 240 m². The lack of production space posed a significant challenge. In farms larger than 300 m², the need for training, the absence of competent educational institutions, limited production space, and the influence of academic research and literature were more critical than in smaller farms. Despite the potential for ornamental fish production in Jamaica, the industry remains small-scale, with fewer than a hundred farmers. Most farmers struggle to meet market demand and export due to limited resources and capital, which aligns with research findings (Gray *et al.,* 2011).

The research indicates that 41.2% of farmers in Iran operate semi-industrially, with 35.2% holding licenses for nominal production of 100,000 pieces. Additionally, 34.2% of licenses are for production exceeding 400,000 pieces. Currently, 60.7% of producers generate fewer than 20,000 pieces, while only 10.3% produce more than 80,000 pieces. A survey of ornamental fish farms in Florida revealed that, on average, farmers hold three licenses per farm, including the commonly held FDACS (Florida Department of Agriculture and Consumer Services) aquaculture certificate, which requires annual renewal following an on-farm inspection. Primary compliance requirements encompass runoff control devices, runaway emissions control, and environmental monitoring (FDACS, 2016). Ornamental fish producers in Florida, USA, reported that competing with imported products is the most significant challenge for their business, as these products are often cheaper and have a higher production value because they are produced in countries that do not comply with regulations (Boldt *et al.,* 2023).

Research in Iran shows that 81% of farmers engage in both reproduction and breeding, 7.7% focus solely on reproduction, 10.8% focus solely on breeding, and another 10.8% produce live food. These findings align with those of Weerasinghe et al. (2024). Ornamental fish farmers in

Sri Lanka engage in 6.7% reproduction, 8.3% breeding, 3.3% live food production, and 78.3% simultaneous reproduction and breeding. In Sri Lanka, market challenges primarily include: inadequate transportation facilities, the absence of fixed pricing, and a lack of export inventory due to weight issues, among others (Malkanthi *et al.,* 2021). The ornamental fish trade is an emerging sector in Bangladesh's fisheries. *As noted by Fagun et al. (2020), the ornamental fish trade in Bangladesh faces challenges such as ineffective policies* to promote business expansion, limited knowledge regarding the diagnosis and treatment of sick fish, subpar feeding and rearing technologies, lack of integration with other businesses, inadequate participation of skilled workers, and the identification of strict quarantine methods as key issues.

In conclusion, we must prioritize education and support, particularly for small producers lacking fishery-related training. Although Iran's share of the global ornamental fish trade remains minimal, our study explored production challenges and barriers to business development, as well as interactions among farms, the government, and universities. Understanding market demand and government support is crucial for enhancing resource management in the ornamental fish trade. Training in disease control, food supply management, larval survival, water quality improvement, and guideline formulation, along with promoting internal and external marketing collaboration through research and academic institutions, can significantly advance this industry's development in Iran.

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