Opportunity and business challenge of marine ornamental fishes in Indonesia as a potential commodity of fisheries

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Abstract. The business opportunity of marine ornamental fishes is very big and promises high profits, although the challenges faced are quite great. The high interest in Indonesia's marine ornamental fishes currently leads to the growth of fish farmers or market actors who involves in ornamental fish business as its primary commodity. This study aims to analysis the opportunities and challenges faced in marine ornamental fish business in Indonesia. The research methodology used is descriptive analysis, which describes the data obtained for further analyzed and interpreted according to existing conditions, does not evaluate and examine the hypothesis but only describe the existing information in accordance to the variables studied. The results showed that the challenge in marine ornamental fish development business is the community behaviour in marine ornamental fish catching that damage habitat and coral reef as strategic habitat of various types of consumption fish and ornamental fish. The use of explosives, toxins and other illegal fishing that requires appropriate solutions to solve it. Therefore, the socialization of the importance of environmentally friendly ornamental fish catching must be immediately delivered to the community, including rehabilitation efforts of coral reefs which are the main habitat of marine ornamental fish.

1. Introduction

Marine ornamental fish is one of the coral reef ecosystems source, marine ornamental fish is a type of marine fish that can be utilized its visual beauty, both physical form, behaviour, as well as its colour and shade, usually maintained in an aquarium. Habitat of marine ornamental fish is coral reef, where there are healthy coral reefs there ornamental fish gathered. Indonesia's marine areas have many reefs which famous in its diversity, beauty and vastness, which make Indonesia has high diversity of coral fish compared to other countries. The centres of Indonesia's ornamental fish are found in various water areas of eastern Indonesia belonging to the Coral Triangle zone, such as water areas of Southeast Sulawesi, North Sulawesi, Maluku and Papua [1, 2]. Marine ornamental fishes are also known as reef fishes, because the habitat cannot be far from the coral reefs. If the coral reefs are damaged, then the reef fishes inside will be extinguished as well. Most of the reef fishes are not migratory fish type, they will always be around the herd or...
around the coral reefs. Not all reef fishes are made into ornamental fish, usually only the ones with length of less than 30 cm and have an attractive colour [3].

Around 1,471 species of ornamental fish are traded in the world, with an estimated number of 20 to 24 million tails. Jae-jae fish type (*Pomacentrus viridis*) and clown fish (*Amphiprion ocellaris*) are the most traded fishes [4]. World marine ornamental fish trade began in the 1930s, and had risen sharply since the 1950s with the addition of fishing sites, such as Hawaii and Philippines [4]. In Indonesia marine ornamental fish trade began in the 1960s, with the first catching ground location was Seribu Islands. The value of ornamental fish trade from marine ornamental fish is about 20% while freshwater fish reaches 80%, whereas marine ornamental fish potency is very big which supported by coral reefs vastness that we have [3]. In contrast, almost 95% of marine ornamental fishes are traded from natural catches and very little is produced from cultivation (its function only growing the seeds caught by fishermen).

In general, it was noted that the value of the world's marine ornamental fish trade from year to year continues to increase and Indonesia’s rank as one of the exporting countries of ornamental fish increases as well [5]. Meanwhile, demand of marine ornamental fish, particularly from United States and Europe tends to increase every year. Data on imports of US marine ornamental fish from various parts of the world reached 24.5% while the Europe countries have reached more than 35% [6, 7].

The high economic value of marine ornamental fishes has prompted the community to uncontrollably catch large quantities of fish using fishing gear that destroys coral ecosystems, such as bombing and cyanide poisoning. The use of cyanide as fishing gear, either on ornamental fishes or consumption fishes, began to widespread and massively used in the 1980s until the 1990s. The use of cyanide as an ornamental fishing gear was considered quite effective and cheap in its time. Ornamental fishing with cyanide causes damage to the coral reef ecosystem [8]. Massive fishing activities can lead to an imbalance of food cycles in coral ecosystems. We need to realize that marine ornamental fish potency will experience overfishing when used inefficiently, not managed wisely and eventually the stock plummeted (collapse) or the extinct of species. For example, the case with Banggai cardinal fish in the water area of Banggai Islands, Central Sulawesi [9].

In the future, excessive exploitation of marine ornamental fish will result in overexploited, should be prevented and its management should be done wisely, thus the fear of extinction can be avoided. Therefore, it is necessary for the active role of research and development institutions within the Ministry of Marine Affairs and Fisheries to synergize with various stakeholders (NGOs, exporting companies and other community stakeholders) to utilize marine ornamental fish properly and sustainably [10]. Efforts to hatch and cultivate marine ornamental fish require serious attention in order to be the basis of its development in the future. The existence of ornamental fish market regulation in Europe requiring export of ornamental fish must be from cultivation, this becomes opportunity and challenge that is really needed to penetrate the said market, thus all fishing activity which currently be made livelihood of fisherman has to switch to cultivation. Thus, it is necessary to develop marine ornamental fish cultivation using seedlings from breeding seeds (hatcheries), hence will be able to reduce seeds or ornamental parent fish catching from its nature which environmentally unfriendly activity. At some work units in the scope of the Ministry of Marine Affairs and Fisheries, such as in Ambon, Lampung, Depok,
Gondol, and Bali have succeeded in developing certain types of marine ornamental fish, although its parent is mostly still a natural catch.

Currently, Indonesia has successfully hatching several types of marine ornamental fish that have high economical potency, such as clown fish, cardinal fish, and sea horses. This achievement deserves high appreciation considering the utilization in the future is very big. Thus, later as an exporting country of marine ornamental fish, Indonesia does not only rely on marine ornamental fish catching, but also can be fulfilled from the cultivation. Therefore, several efforts by research and development institutions within the Ministry of Marine Affairs and Fisheries to cultivate marine ornamental fish deserve serious attention in order to be the basis of its development in the future [11]. This study aims to analysis the opportunities and challenges faced in marine ornamental fish business in Indonesia.

2. Materials and Method
Materials and research tool was done by collecting secondary data. Secondary data was needed to support the primary data obtained from literature studies, institutions or related agencies, fisheries agencies, which supported this research. Entire data collected were analysed by desk study using descriptive analysis method. The methodology used was intended to create and described the data obtained for further analysis and interpretation in accordance with the conditions that exist. This study did not evaluate and examine hypotheses but only described the exist information in accordance with the variables studied. Primary data were obtained from interviews and questionnaires in the form of information about the development of marine ornamental fish business, used as a complement in the analysis.

3. Results and Discussion
According to the Directorate General of Aquaculture, the Ministry of Marine Affairs and Fisheries (KKP) [12], the prospects and business opportunities of marine ornamental fish is really great and promises high profits. Moreover, Indonesia’s marine ornamental fish has good diversity of body shapes and beautiful colours which are believed to reduce stress by ornamental fish lover. The high interest in Indonesia’s ornamental fish (freshwater and marine) this day, leads to the growth of fish farmers or market actors involve in ornamental fish business as its primary commodity.

As a country with the highest biodiversity in the world after Brazil, Indonesia has many types of ornamental fish species. This ornamental fish source comes from marine waters and freshwaters. Until now in Indonesia there are 700 species of marine ornamental fish, only about 480 species have been identified, and 200 of them have been traded. Its global market share reaches 20 percent. Of that amount, 95 percent are still captured from the high seas and only 5 percent are cultivated. Some famous ones include clown fish and cardinal fish [12].

More than 280 types of marine ornamental fish are traded for export purposes, the trade gate is centralized at Jakarta and Bali. Probably because both places have access to US and Europe, thus becoming shelters center for exporters. In some other places, there is also export trade in small quantities such as in Makassar, Solo and Medan. Exports from Makassar usually transit at Bali first, while for Solo and Medan transit at Singapore.
3.1. Opportunities and challenges of export

According to the Ministry of Marine Affairs and Fisheries, in 2012 the export value of ornamental fishes reached 600 billion rupiah, or in other words the potency of Indonesian ornamental fishes export is estimated at USD 60 million – USD 65 million or Rp 600 billion approximately [13]. This number puts Indonesia into the top five exporting countries of ornamental fishes, under Czech Republic, Thailand, Japan, and Singapore. Especially for Singapore, most of the ornamental fishes originated from this country are supplied from Indonesia [6].

Indonesia's ornamental fish market export opportunities in Europe region are quite large because as one of favoured exporting countries of tropical ornamental fish products by ornamental fish lovers in Europe. Based on Table 1, the delivery of marine ornamental fish conducted by PT. Aneka Surya, there are about 44 genuses (89 species) of marine ornamental fishes exported to Europe, in one shipment. The amount (volume) can be higher if accumulated from several times delivery in a monthly or annually conducted by all exporters in Indonesia. The shipment data indicate that there are species of ornamental fishes that have been successfully cultivated, *Amphiprion ocellaris* fish, *Dascyllus trimaculatus* and *Synchiropus splendidus* fish, but it is unknown whether the fishes exported come from cultivation or from the catch.

| No | Latin Name                  | Common Name                  |
|----|-----------------------------|------------------------------|
| 1  | *Abudefduf saxatilis*       | Sergeant Major               |
| 2  | *Acanthurus* spp (6 type)   | Wheeler’s Shrimp Goby        |
| 3  | *Amphiprion* spp (4 type)   |                              |
| 4  | *Apogon compressus*         | Split-Banded Cadinalfish     |
| 5  | *Centropuge* spp (5 type)   |                              |
| 6  | *Chaetodon* spp (7 type)    |                              |
| 7  | *Chelmon rostratus*         | Copperband butterfly         |
| 8  | *Chromis* spp (2 type)      |                              |
| 9  | *Chrysiptera* spp (3 type)  |                              |
| 10 | *Chirrhilabrus* spp (3 type)|                              |
| 11 | *Cirripectes variolosus*    | Balck Blenny                 |
| 12 | *Coris pictoides*           | Yellowlined wrasses          |
| 13 | *Cryptocentrus cinctus*     | Yellow Watchman Goby         |
| 14 | *Ctenochaetus striatus*     | Lined Bristletooth           |
| 15 | *Dasyllus* spp (3 type)     |                              |
| 16 | *Doryrhamphus dactyliophorus| Banded Pipefish              |
| 17 | *Ecsenius bicolor*          | Bicolor Blenny               |
| 18 | *Exallias brevis*           | Leopard Blenny               |
| 19 | *Gobiodon* spp (2 type)     |                              |
| 20 | *Glyphidodontops cyaneus*   | Blue Devil                   |
| 21 | *Labroides dimidiatus*      | Blue Cleaner Wrasse          |
| 22 | *Macropharyngodon negrosensis* | Yellowspotted wrasses     |
| 23 | *Myripristis* sp            | Asst Soldierfish             |
| 24 | *Naso* spp (2 type)         |                              |
| 25 | *Ostracion meleagris*       | Spotted Boxfish              |
| No. | Species                        | Common Name                        |
|-----|--------------------------------|------------------------------------|
| 29  | Paracheilinis carpenter        | Carpenter’s Flasher Wrasse         |
| 30  | Pervagor melanocephalus        | Blackheaded Filefish               |
| 31  | Plectorhinchus chaetodonoides   | Spotted Sweeplips                  |
| 32  | Pomacanthus spp (7 type)       |                                    |
| 33  | Premnas spp (2 type)           |                                    |
| 34  | Psedocheilus hexataenia        | Sixlined Wrasse                    |
| 35  | Pseudanthias spp (5 type)      |                                    |
| 36  | Pseudochromis paccagnellae     | Royal Dottyback                    |
| 37  | Pterois volitans               | Volitan Lionfish                   |
| 38  | Pygoplites diacanthus          | Regal Empress Angelfish            |
| 39  | Siganus spp (3 type)           |                                    |
| 40  | Sphaeramia nematoptera         | Coral Cardinalfish                 |
| 41  | Synchiropus splendidus         | Green Mandarinfish                 |
| 42  | Taenura lymma                  | Blue Spotted Rays                  |
| 43  | Walenciennea spp (2 type)      |                                    |
| 44  | Zebrasoma spp (2 type)         |                                    |

Source: PT. Aneka Tirta Surya, observation result at Soekarno-Hatta Airport Quarantine

Existing marine ornamental fishes export data continues to increase, such as documented export value from Indonesia to Hungary as one of Europe countries which became export destination from 2007 to 2011 (Figure 1). Some competing countries from Southeast Asia who also ship ornamental fish products to Europe are Malaysia, Singapore, Vietnam, Philippines and Thailand [7, 6, 14].

![Figure 1. Data comparing the development of freshwater ornamental fish products and marine ornamental fish value with export destinations to Hungary in Euro currency [14].](image-url)

Based on Figure 1, the value of marine ornamental fish (Euro) in 2008 increased sharply to EUR 28,611, but then decreased sharply in 2009 as well at the lowest value from the data obtained which was EUR 15,410, then increased again until 2011 to EUR 18,690. Similarly, the
value of freshwater ornamental fish exports also fluctuated, but in 2011 was the peak of export value with EUR 38163 as the highest value compared to ornamental fish products. The fluctuation of export value is due to competition of ornamental fish market entering Hungary from other tropical countries. Data of ornamental fish entering Hungary from Southeast Asia countries can be seen in Table 2.

| Rank | Freshwater Ornamental Fish | Marine Ornamental Fish |
|------|---------------------------|------------------------|
| 1    | Thailand                  | Indonesia              |
| 2    | Malaysia                  | Filipina               |
| 3    | Singapura                 | Singapura              |
| 4    | Indonesia                 | Vietnam                |
| 5    | Vietnam                   | Thailand               |

Source: Anonymous [14]

From Table 2, it can be seen that Indonesia was the highest exporting country for marine ornamental fish to Hungary (Europe), based on trade value data from 2007 to 2011. In contrast to freshwater ornamental fish data where Indonesia was in the 4th position and the highest ranking which sent its products was Thailand. Marine ornamental fish products sent to Hungary are derived from natural catch, because until now the cultivation business (hatcheries) of marine ornamental fish is in the early stages of testing and only a few species can be hatched.

Based on Figure 2, the main export destination of marine ornamental fish is United States followed by Japan and Singapore with export value of USD 1849000, USD 741600 and USD 330400, respectively. Then, based on the data of exporting countries of ornamental fish in 2004, Indonesia was ranked fourth after Singapore, Malaysia and Czech Republic [15]. For 2012,
Indonesia's ornamental fish export destination was Hongkong (17.7%) followed by United States (12.8%) and Japan (12.5%) and other countries (Figure 3).

![Figure 3](image_url)

**Figure 3.** Composition of Indonesia's ornamental fish export destination in the world in 2012 [6].

3.2. Challenges of Cultivation, Conservation and Ecotourism

Some marine ornamental fishes can be cultivated, among them is clown fish (*Amphiprion ocellaris*), being known as “Nemo” in a cartoon on one of private television stations. Currently, Lampung Sea Aquaculture Development Centre [16], Ambon Sea Aquaculture Development Centre [9] and Gondol Marine Research Centre [17] are actively developing cultivation techniques for ornamental fish. Cultivating clown fish is far more economically advantageous than catching it in the wild, because besides its quality is more guaranteed, it can also be provided in large quantities in faster time. The success factor in cultivating marine ornamental fish efforts, is a series of development efforts toward sustainable marine ornamental fish cultivation. Several types of marine ornamental fish have been successfully cultivated in an aquarium or container / tank in the household scale can be seen in the following table:

| No  | Local Name        | Scientific Name         |
|-----|-------------------|-------------------------|
| 1   | Clownfish biasa   | *Amphiprion ocellaris*  |
| 2   | Clownfish Biak    | *A. percula*            |
| 3   | Giro Pasir        | *A. clarkia*            |
| 4   | Clownfish Pink    | *A. perideroion*        |
| 5   | Clownfish Orange  | *A. sandaracinos*       |
| 6   | Balong            | *Premnas biaculeatus*   |
| 7   | Mandarin Fish     | *Sychiropus splendidus* |
| 8   | Banggai Cardinalfish | *Pterapogon kauderni*   |
| 9   | Blue Devil        | *Chrysiptera cyanea*    |

Source: Gani [18]
In addition to marine ornamental fish cultivation, conservation efforts will optimize the preservation of the environment around the water areas. A sustainable and beautiful area can attract domestic and foreign tourists to visit, therefore increasing local revenue. Clear waters, coral reefs that spawned fish, and beautiful ornamental fish become the main attraction of the area and invite many tourists to come. Coral reef ecosystem with a variety of ornamental fish and biota in it, in addition to producing goods and services that can be consumed both directly and indirectly, also produce environmental services that can be utilized such as ecotourism [19]. Due to the importance of ecological and economical functions of coral reefs and ornamental fish resources, the challenge faced by policy makers is how to provide a comprehensive value of reef fish resources, both in terms of market value and ecological value.

Utilization of marine ornamental fish resources through ecotourism can provide positive and negative effects. Both of these effects often interact in a complex way. It is the responsibility of people in charge to maximize the benefits and minimize the impact. The potential benefits of ornamental fish utilization in coral reefs through ecotourism can be in the form of increased economic opportunities, protection of natural resources and cultural values, and life quality improvement [19, 20]. Increased economic opportunities benefits, include:

1. Increasing employment for local communities or local residents,
2. Increasing revenue, developing new business and developing local economy including developing local handicraft,
3. Widespread marketing and increasing foreign exchange earnings,
4. Improving people's living standards and increasing local taxes,
5. Encouraging employees and communities to learn new skills,
6. Increasing sources of funding for the protection of nature and local communities.

While the benefits of protection of natural resources and cultural values include:

1. Protecting ecological processes and sustainable biodiversity
2. Increased economic value of ornamental fish resources that had been only consumed or conventionally marketed
3. Increased local facilities, transportation and communication
4. Assisting independent financial management mechanism in ecotourism management
5. Protect and preserve local cultural values
6. Assisting communication and interpretation of the importance of nature conservation to tourists and local communities, thus create more responsible new generations
7. Supporting research and development activities that assist people in charge and travellers in improving systems and practices of environmental and business management.

Meanwhile, the benefits of improved life quality that can be obtained include:

1. Improved aesthetic, spiritual and other values related to welfare
2. Supporting the development of environmental education for tourists and local communities
3. Increased intercultural understanding including the language and culture of foreign tourists
4. Encouraging the development of culture, craft and art
5. Increased level of education of local communities
6. Encouraging local communities to protect environment and appreciate local culture.
3.3 Opportunity towards aquaculture industry

One that is still not well developed is an ornamental fish industry that includes freshwater and marine ornamental fish. The existence of ornamental fish industry is still running in place, because it is constrained by various factors including regulation and infrastructure. The aquaculture industrialization is a process of change in which the direction of management policy (fishery resources, infrastructure development, investment system development, science and technology and human resources) is conducted in an integrated, industry-based manner to increase value added, efficiency and competitive scale of production. In these activities, each stage of fish farming should be interconnected, resource management must be paired with the application of environmentally friendly technologies (fishing gear, packaging tools, other facilities and infrastructure). Even infrastructure development, such as hatcheries development, should also take account of the environmental conditions, application of science and technology, as well as available human resource skills.

Currently, the government is preparing the National Action Plan (NAP) for Development of Ornamental Fish Industry 2017-2021, it is expected that NAP of Ornamental Fish Industry can be one of the guides in the effort to develop ornamental fish cultivation in Indonesia. The National Action Plan (NAP) of ornamental fish development initiated by the Ministry of Marine Affairs and Fisheries through the Marine and Fisheries Resources Research Agency, enables Indonesia to become the largest exporting country in the world by 2019 [21]. It can be due to the potency of ornamental fish existing, either freshwater or marine ornamental fish is very large and should be utilized for the benefit of public economy. Currently, the export of ornamental fish from Indonesia is still lower than Singapore, whereas the ornamental fish resources of the country is far below Indonesia. It is required to do research on the causes of Indonesia backwardness compared to Singapore, particularly ornamental fish exports. In connection with these constraints then ornamental fish traders in Indonesia should learn international fish trade correctly and thoroughly. By studying it, then Indonesia should be able to determine what and how much ornamental fish needs of other countries. Furthermore, it is necessary to recognize the factors and have the understanding of most needed and sought ornamental fish by other countries and where the specific location is. In addition to trade, it is also necessary to review the current regulations in Indonesia. If indeed the existing regulation is considered to be inhibiting, then shrinkage should be done to achieve better efficiency. Review of regulations, carried out on the various regulations that must be executed by ornamental fish business actors. The regulations, covering domestic and foreign trade (export). Another thing that needs to be improved immediately is the right strategy, thus there should be action plan, roadmap, business plan and others.

Some cultivation aquaculture policies that can be done to support industrial policy, among others is establishing research and development activities with the basis of implementation in communities. Certainly, with technological accompaniment that is not only conducted ceremonially, but also to ensure that technology applied in society can give positive impact to its prosperity. This activity can be in the form of application of Science and Technology for Society such as technology dissemination or socialization of environmentally friendly technology, both at central level and research centres in the region.
4. Conclusion
The business opportunity of marine ornamental fish is very big and promises high profits, although the challenges faced are quite large. Currently, the high interest in Indonesia's marine ornamental fish leads to the growth of fish farmers or market actors involve in ornamental fish business as its primary commodity. One that is still not well developed, is the ornamental fish industry. The existence of the ornamental fish industry is still running in place, because constrained by various factors including regulation and infrastructure. The industrialization of aquaculture is a process of change in which the direction of management policy (fishery resources, infrastructure development, investment system development, science and technology and human resources) is conducted in an integrated, industry-based manner to increase value added, efficiency and competitive scale of production. Even infrastructure development, such as hatcheries development, should also take account of the environmental conditions, application of science and technology, as well as available human resource skills.

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