Small scale tuna fisheries profiles in the Indonesia archipelagic waters

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Abstract. Indonesia is one of the largest tuna producers in the world, which contributes 16% to world tuna production. The dominant tuna species caught in Indonesia are Albacore Tuna (Thunnus alalunga), Madidihang/Yellowfin Tuna (T. albacares), Big Eye Tuna (T. obesus) and Southern Bluefin Tuna (T. maccocyii). The tuna fisheries have contributed significant jobs or livelihood to the coastal communities. Profit and revenue sharing is a common remuneration system found on tuna fisheries though out Indonesia. However, these fishers are vulnerable given their economic and welfare conditions and of usually limited options of others livelihood. Small fishers have limited access to livelihoods, access to finance and access to skills or fishing technology. Therefore, the inclusion of socio-economic performance or indicators into the tuna fisheries management is crucial in Indonesia.

1. Introduction
Fisheries is an important sector in the Indonesian economy. Data from USAID [1] shows that in 2015 fisheries contributed 8.28% to Indonesian Gross Domestic Product, with more than 643,105 households dependent on fishing activities in coastal areas. On the other hand, data from MMAF, 2020 [2] shows that tuna is an essential part of the fisheries sector because it contributes up to 13% of the total production and 14% of the total value of Indonesia's fisheries exports. We can conclude that tuna has an essential role in the Indonesian fisheries sector. Tuna in our research consisting of (Thunnus albacares), bigeye tuna (Thunnus obesus), albakora (Thunnus alalunga), southern bluefin tuna (Thunnus maccocyii) and skipjack tuna (Katsuwormisus pelamis). The average growth for tuna production from 2014 to 2019 was about 1.62% and 2.24% from 2014 until 2019 [2].

The average Indonesia's tuna and skipjack production from 2014 to 2019 based on Figure 1 reached 791,866 tons/year or about 8% of the world's tuna and skipjack production [3] and about 13% of the national capture fisheries production. Currently, the government of Indonesia is developing the harvest strategy for skipjack and yellowfin tuna in the inter archipelagic waters in Indonesia. The development of a harvest strategy is considered to be an important step toward ensuring the sustainability of Indonesia's tuna stocks, and the development of methods to systematically incorporate social and economic considerations into this HS is an important piece of the national and regional tuna fisheries management puzzle. Specifically, incorporating social and economic considerations into fisheries planning can assist in identifying realistic and implementable strategies, in forecasting the likely impacts of resource allocation decisions, and in identifying clear objectives that management can be assessed against over the long term [4-6].
However, the profiles of tuna fisheries are lacking, moreover on the small-scale fishers. Many vessels sizes < 30 GT are operating on the FMA 713, 714 and 715, the Inter Pelagic Waters In Indonesia. These tuna fisheries has provided lots of number of jobs for fishers. This paper aims to provide an overview of profiles of small scale tuna fisheries in Indonesia. The next session will describe the tuna fleets structure at national level including those part of IOTC and WCPFC, then followed by the tuna fleet structure operating at the IAW, followed by distribution of tuna fishing gear numbers and their associated number of crews based on vessel’s sizes. Lastly, the paper described the production and values of tuna landed in the IAW based on vessel’s sizes. Several socio-economic conditions of the small scale tuna fisheries were discussed in the paper based on other studies or field observation. This paper uses secondary tuna data from MMAF, and published literature on tuna socio economics of tuna fishers.

![Figure 1. Production trend of tunas in Indonesia from 2014-2019 [2]](image)

2. National Tuna Profile

PIPP is the governmental regular data collection on vessels that land their catches on the fishing port. The data covers about 30% of total fishing vessels in Indonesia (Personal interview with Sonny Koeshendrajana, March, 2021). Based on the landing data from fishing ports in Indonesia [7], the paper analysed the tuna landings for five tuna commodities based on gear types, vessel’s sized, the volume of landings, the values of landing, and tuna prices.

In terms of landings, skipjack is the one mostly caught and it is evidenced by the largest number of vessels capturing skipjack tuna. It is then followed by yellow fin tuna showed in Figure 2. This is in a good accordance with the development of the Harvest Strategy for tuna in the Inter Archipelagic Waters in Indonesia for skipjack and yellow fin tuna.

Among those 5 species, the Southern Bluefin Tuna has the highest value per kg followed by the Albacore and big eye tunas. Southern blue fin tuna is a fresh tuna commodity and exclusive for Japanese market for sashimi and sushi, mostly they are on grade A. Indonesia exports tuna in fresh, frozen and processed forms, with the main markets for Indonesian tuna exports being Japan and the USA, as evidenced by various previous studies [8-10].

Table 1 shows that the vessels < 30 GT contribute about 73 % of total tuna vessels. This shows that tuna fisheries are dominated by medium and small vessels. Furthermore, among those vessels, the small vessels (< 10 GT) are about 18% and the vessels (10-30 GTs) are about 54%. This shows that tuna is a lucrative fish that needs to be sold immediately or kept frozen. Therefore, this fishing needs an adequate space for proper handling on the boat and optimal vessels’ size and volume to be able to navigate the vessels and hold the catch that meet economic return.
Figure 2. Volume and price per kg tuna by species [7]

Table 1. Structure of tuna fleets based on the commodity being caught and the size of vessels

| Vessel's size | Albacore | Skipjack | Yellowfin Tuna | Bigeye | Bluefin | Total |
|--------------|----------|----------|----------------|--------|---------|-------|
| < 5 GT       | 13       | 332      | 419            | 75     | 13      | 852   |
| 5-10 GT      | 40       | 472      | 578            | 156    | 6       | 1.252 |
| 11-30 GT     | 418      | 2.270    | 2.151          | 1.189  | 57      | 6.085 |
| 31-60 GT     | 121      | 437      | 342            | 125    | 36      | 1.061 |
| 61-100 GT    | 69       | 206      | 213            | 82     | 44      | 614   |
| 101-150 GT   | 58       | 221      | 228            | 135    | 35      | 677   |
| > 150 GT     | 12       | 216      | 191            | 134    | 10      | 563   |
| Total        | 731      | 4.154    | 4.122          | 1.896  | 201     |

Source: MMAF, 2020 calculated [7]

The structure of tuna fleets based on the commodity being caught and the size of vessels as displayed in Table 1, the most vessels capturing skipjack tuna are those on the group size 11-30 GT. It is then followed by those vessels size of 5-10 GT and the vessel size of 30-60 GT. One prevailing motivation could be registration fees and ex-ante tax for vessels < 50 GT is much lower than those above 30GT. The vessels < 30 GT are being managed by the provincial government and are required to apply for permits from the provincial government. This arrangement was mandated by the Local Government Autonomy Law Number 23/2014.

Figure 3 shows that the most vessels landed tuna is the vessels group of 11-30 GT. This group of vessels contributed more than 60% of total tuna landing in Indonesia compared to other vessel’s group sizes. This might be due to highest contribution of skipjack landings as displayed in Figure 2.

3. Tuna Fisheris Profile in Inter Pelagic Waters (FMA 713, 714 and 715)

The following tables will describe the tuna fleet structures operating in those three FMAs (Fisheries Management Areas), namely FMA 713, WPP 714 and 715. The profiles consist of composition of number of vessels and the associated crews by vessel’s size groups, then followed by volume and value of landed tuna in from these areas.

Purse Seine and Long line Vessels size are >10 GTs whereas the Pole and Liners are > 5 GTs. Small Purse Seiners and Hand Liners, Troll liners are varied in the vessel sizes starting from < 5 GTs vessels and as large as 100 GTs. The massive populations of vessels in the range of 11-30 GTs might be due to
subsidized fuels. By law, only those < 10 GTs can access the subsidized fuel since 2015. However, those vessels > 10 GT and < 30 GTs are still accessing or receiving the subsidized fuels in reality. This is due to the fact that smaller boats might not have access or information where and how to access the subsidized fuels. For example, to be eligible for subsidized fuels, fishers need to have a group of fishers and receive recommendations from fisheries local offices. These requirements are sometimes hard to get for very small fishers.

Table 2 shows that small-scale fishermen (under 30 GT) prefer to use the Troll line, Hand Line and Small Purse Seine types of fishing gear. Troll line is a traditional fishing Gear and is still widely used by fishers in Indonesia. While large-scale Fishermen (over 30 GT) are more likely to use Purse Seiner and Long Line.

The total crews for tuna vessels are about 237,789 crews on board [7]. This is about 30% of total tuna fleets in Indonesia. It shows that Purse seiners have more crews than other tuna vessels in total, followed by pole and line and handline. This is in accordance with the numbers of fishing vessels based on the total number of vessels by vessel size groups. Moreover, Purse seiners provided more jobs for fishers as the vessels need more men on boat during fishing. Table 3 shows the small purse seiners of size 11-30 GTs employed the most crews at about 72,000 crews on board [7]. In reality, the number could reach as many as 240,000 crews on board for small purse seiners (Own calculation).

The income level of the poor community is also influenced by the shared-profit system they implement, which is based on an agreement. The shared-profit system has various mechanisms and calculations, according to the agreement of each fisherman group. Profit sharing system in the fishery is a system applied by the ship / boat owner or skipper to the crew. The shared-profit system has an important role influencing the fisher’s welfare.

Figure 3. Tuna Landings (Kg) based on vessels size groups [7]

| Vessel's size | Type of Fishing Gear |
|--------------|----------------------|
|              | Large Purse Seine    | Small Purse Seine  | Hand Line | Long line | Troll Line (Tonda) | Pole and Line |
| < 5 GT       | Unit | Number of crew | Unit | Number of crew | Unit | Number of crew | Unit | Number of crew | Unit | Number of crew | Unit | Number of crew | Unit | Number of crew | Unit | Number of crew |
| 5-10 GT      | -    | -                    | 7    | 2,978        | 246   | 293           | -    | -                | 1    | 4                | -    | -                |
| 11-30 GT     | 3    | 188                   | 34   | 1,314        | 265   | 1043          | -    | -                | 4    | 52               | 17   | 2,869            |
| 31-60 GT     | 47   | 14                    | 390  | 71,981       | 133   | 6,618         | 6    | 473              | 575  | 46,505           | 73   | 10,665           |
| 61-100 GT    | 41   | 28,703                | 14   | 21,438       | 10    | 920           | 457  |                   | 34   | 5,638            |
| 101-150 GT   | 2    | 84                    | 41   | 28,703       | 1     | 60            | 60   | 25,231           |

Source: MMAF, 2020 calculated [7]
Profit sharing system is a common practice for Indonesian fishermen, for example in PPN Brondong Lamongan, the shared-profit system is called *umanan* (percentage). The income is divided by 40 to 50 people (percent) for the skipper and the rest is divided for crew. If the crew members are concurrently or occupying a certain position or position, for example as a captain or scout, then he will get another additional service, for example: crew who is also the scout, he gets 1 uman for the CREW and 1 for the position as a guide [11].

Widihastuti and Rosyidah [12] studied the profit sharing for tuna fishing vessel in the Aru Islands. The profit sharing system for drifting gill net users for skipjack uses a percentage of 50% for net income. Net income is obtained from the sale of fish commodities less operating costs. Meanwhile, 50% will be distributed to the captain of 51.5% and crew of 48.5% (number of crew).

Profits in small-scale tuna fishing business can be improved through a partnership strategy and an agreed profit sharing scheme. The implementation of a partnership strategy must be more professional with firms banded by an agreement and fulfil the principles of proportionality, justice, benefit and sustainability. The profit-sharing scheme must be able to fulfil the needs of both parties proportionally, fairly, profitably and sustainably. The formula for the optimal profit sharing pattern is 48.52, for fishermen and capital owners respectively [13].

In most fisheries, crew are paid through different shared remuneration systems rather than a fixed wage. In shared remuneration systems, wages can significantly increase when the economic performance of vessels improve, and consequently provide incentives to workers. Purwasih *et al.* [14] studies the difference of the income of purse seine and troll line fishermen in PPP Tamperan Pacitan Fishing Port, East Java. The difference in income in a month and a year from each business is caused by the difference in the number of trips in a month and a year. Purse seine fishing business has more trips than troll line fishing business. The average income of labor fishermen in a purse seine is Rp. 2,375,400, - / trip, Rp. 7,126,200, - / month and Rp. 64,135,800, - / year. While the average income of labor fishermen in the troll line fishing business is Rp. 2,330,000, - / trip, Rp. 4,660,000, - and Rp. 46.6 million, - / year.

Fisherman social structure is dominated by poor fishermen that own boats with one outboard motor type 1, size 0-5 GT which can be categorized as limited ownership of traditional fishing boats with a simple machine technology that is a major contributor to the quantity of fisheries production. However, they remain marginal in social positions in unequal and exploitative technologies. So as producers, the fishermen did not receive a large share of revenues [15]. This condition is worse when the market is dominated by middlemen or bakul; they are actually becoming the ruler of the economy in the fishing community.

Limited access of finance to any formal finance institutions make them highly dependent on informal loan sources, such as money lenders which will have impacts to their fish production marketing. The dependence of fishermen and owners is something to be worried about if it continues. The fisherman became attached to the owner. Profit sharing system is important. The profit sharing system, which has a major role in determining the amount of income, especially for crew members, can reduce the problem of crew members as small fishermen, especially if there are additional policy options from the government [12].

The government had issued a policy written in UU no. 16 tahun 1964 regarding the fishery sharing system, to create order and regulations in the implementation of profit sharing and to protect low-income fishermen from those with high (strong) incomes. However, in reality the law should provide protection has not been optimal yet. The study on Indonesian Fishermen in the Vortex of Structural Poverty by Retnowati [11] concluded that from an economic point of view, the income of fishermen is still very low, so they are poor, this is due to: limited capital, skills, pressure from the owners of capital (an unfair fishery sharing system), a trading system or fish auction that is not transparent (there are no regulations appropriate and weak authority or government), a work culture that is still traditional or conventional.

The poverty experienced by Indonesian fishermen makes them weak both in the social and political sectors. The law that should provide an umbrella of protection for fishermen has not been able to fully protect it. The conditions of poverty which are experienced by fishermen led to their conflict and only to be the object.
Table 3. Distribution of tuna commodity production volume and their values based on vessel’s size

| Production by Vessel’s Size | Albacore | Skipjack | Yellowfin | Bigeye | Bluefin | Total |
|-----------------------------|----------|----------|-----------|--------|---------|-------|
| < 5 GT<br>Volume (Kg)        | 600      | 341.369  | 775.284   | 120.354| 3.071   | 1.240.678 |
| Value (IDR)                 | 16.800   | 6.088.568| 29.835.148| 4.625.461| 85.966 | 40.651.943 |
| 5-10 GT<br>Volume (Kg)      | 1.200    | 848.673  | 1.131.269 | 62.667 | 1.905   | 2.045.714 |
| Value (IDR)                 | 43.979   | 11.638.974| 41.822.972| 2.221.407| 49.939 | 55.777.271 |
| 11-30 GT<br>Volume (Kg)     | 267.889  | 10.024.415| 3.537.565 | 903.452| 8.631   | 14.741.951 |
| Value (IDR)                 | 8.701.162| 120.617.906| 71.219.214| 24.744.368| 413.453| 225.696.103 |
| 31-60 GT<br>Volume (Kg)     | 45.400   | 2.038.540| 950.619   | 21.557 | -       | 3.056.116 |
| Value (IDR)                 | 2.270.000| 30.004.262| 28.012.693| 877.705 | -       | 61.164.660 |
| 61-100 GT<br>Volume (Kg)    | 9.174.413| 4.188.763| 64.598    | 1.000  | 13.428.774 |
| Value (IDR)                 | 174.629.807| 78.549.727| 3.430.505| 20.000 | 256.630.039 |
| 101-150 GT<br>Volume (Kg)   | 27.750   | 2.850    | -         | -      | 30.600  |
| Value (IDR)                 | 499.500  | 54.150   | -         | -      | 553.650 |

Source: MMAF, 2020 calculated [7]

Skipjack is a tuna commodity that has the highest production value, followed by Yellow Fin and Big Eye (Table 3). This indicates that there is a relationship between the vessel’s size and the catches, where the increase or decrease in the production of tuna is influenced by other production factors such as the vessel’s capacity, number of fishing gears, natural factors and others. Skipjack is commonly used in Indonesian cuisine also known as cakalang.

Table 3 shows that the 11-30 GT vessels have the highest total production, which is around 14.7 million kg. This can be due to the 11-30 GT vessels being the most widely used tuna vessels and also Tuna fishermen in Indonesia are dominated by traditional fishermen. Then the second highest production came from 61-100 GT vessels which is around 13.4 million kg. Overall both are dominated by Skipjack, this is because this tuna species can be easily found in many Indonesian seas. Skipjack tuna is a tropical species of economic importance for fisheries around the world.

Furthermore, the vessel size of 61-100 GTs contributed more landings than those of 31-60 GTs. The technical capacities of larger vessels might enable the vessels to go fishing further offshore and hold more tunas into their vessels. In other words, cost per kg could be lower for 61-100 GTs vessels than those 31-60 GTs [16].

Proper handling of fish after being caught needs to be done before it reaches consumers. According to Widhyasari [17] activities on board tuna fishing vessels are divided into several parts, namely preparation, operation, post operation and rest. Preparation activities consist of: preparation for fishing ground and preparation of tools. The fishing operation starts from setting, drifting and hauling. Postoperative activities are carried out by handling fish by killing the fish and cleaning them so that they can be stored immediately.

The study conducted by Wiratama [18] has provided information on how fishermen in Sadeng Yogyakarta handle tuna catches. Handling the quality of fish on board must be done hygienically, quickly, precisely and precisely, supported by adequate facilities. However, based on the results of the study, damage to the fish was found, most of which were slimy gills, red eyes, and a slightly cloudy cornea with a proportion of 70.07%. The cause of the decline in the quality of tuna comes from the fishermen’s aspect of the fishermen’s knowledge in handling fish handling is still lacking. The handling aspect is the arrangement of fish in the hold is simply placed, not washed with clean water, and not using bulk ice. Technological aspects are not yet supported by adequate technology such as fish beaters and ice cube crushers on boats. The same happened with Trolling Line Fishery at the Nusantara Palabuhanratu Fishing Port. According to Ngamel and Taniwut [19], unloading the catch of trolling line is done simply without using technology that simplifies the unloading process of tuna. Demolition does not consider the right time and is still exposed to sunlight. During the lifting process, fishermen do not do it carefully which will have an impact on the quality of the tuna (stepping on the tuna).
Ma’arif’s [20] research results on Troll line Fishery Activities in Pacitan show that tuna catches weighing more than 10 kg are marketed directly to the area, while tuna weighing less than 10 kg are distributed through the local market. The handling of the tuna catch on board the trolley boat does not support maintaining the quality of the tuna catch and this also makes it difficult for fishermen to market their catch to a wider market because there is no company for exporting tuna in Pacitan.

Small-scale fishers do not want to improve their handling because they receive the same and low prices for tuna that they captured. The tuna prices at fisher’s level are determined by the middleman. There is no bargaining or fair auction mechanism between sellers and buyers on the small scale tuna Fishers. In some occasions tuna prices determination based on the tuna qualities between the fishers and the buyer's or the company that buys the tuna. This issue can be solved by having a common agreement on hiring a third party that is neutral in determining the tuna prices with respect to their qualities.

Small scale fishers usually suffer a low fishing technology and skills due to low access to technology. Fishers usually learn from other fishermen who gained experiences from other places. For example, in Tulehu (Ambon), there were migrated fishers from teh Philippines who married with Ambonese women. He had some more sophisticated skills on fishing technology such as large purse seine. Through diffusion of his social life among fishers in Ambon, local fishers learned the technology of tuna fishing. We observed that fishers face hindrance in accessing high technology, they tried on their own and not many fisher’s empowerment programs provided by the government for upgrading fisher’s skill.

4. Gender Roles in Tuna Fisheries in Indonesia

Gender roles were determined by the economic, political, and cultural attributes and opportunities associated with being male or female. Gender refers to the array of socially constructed roles and relationships, personality traits, attitudes, behaviors, values, and relative power and influence that society ascribes to the two sexes on a differential basis (USAID Gender Equality and Female Empowerment Policy). Study on gender in Tuna fisheries in Indonesia is still limited and only in a certain location except the USAID report in 2016.

Study gender on tuna fisheries was conducted by The Oceans and Fisheries Partnership - USAID Oceans [1]; Gude, Pangemanan & Lumenta [21] in Bitung studied the gender roles in tuna fisheries in Bitung. Those studies analyzed the relationship between men and women in the tuna value chain in Bitung. Both studies described that men and women have an important role in the tuna value chain. Report from USAID study elaborates that men have the power to control access to resources (vessels, fishing gears, and larger processing units, while women in Bitung have more access to control small processing units and local marketing facilities. In a small household/business operation, control for the source of financial and information is on the women.

The study conducted by Gude, Pangemanan & Lumenta [21] found that men have more control on the decision of financial credit from financial institutions as well as the use of the income. On the other hand, women play roles in domestic, public, and social activities. The decision on the volume of fish to be sold, how and where to sell is determined by women.

Wurarah, Andaki & Suhaeni [22] analysed gender roles on tuna value chain fisheries from fishing until processing in Bitung, particularly in PT Sari Tuna Makmur. The analysis covered access and control of men and women regarding the responsibilities and job description in capturing fish, unloading fish on the fishing port, transporting to the fish collector and to the processing companies.

The comprehensive analysis of gender was conducted by Fitriana [23] on pole and line tuna value chain business. This research proposes a six-gender dimension framework to accelerate gender mainstreaming in pole and line tuna fisheries, i.e., access to assets and resources, Beliefs and Perceptions, Practices, Time and Space, Rights, Power for the availability of input, production, trading, and processing. Along the pole and line tuna value chain in Indonesia, she applied the six genders dimension to analyse the achievement of Indonesia tuna pole and line on the fishery global development: target species, Secondary and Endangered, Threatened and Protected Species, Habitats and ecosystems, Enforcement (MCS), Management and governance.

The gender study on tuna fishing communities using the Troll line hand line in two villages in Leihiitu by Fitriyani et.al [24] They found that the decision in the household and public activities was mostly
dominated by women because of the husband (fishermen)’s average allocation of time in the fishing activities on the sea 13 hours a day. This research did not elaborate on the value chain analysis of the Troll line and handline in those villages.

Jumadi, Pangemanan & Tamba [25] in Bitung used disaggregated gender data of PT. Delta Pacific tuna canning industry to elaborate the role of men and women in company Business activities. This study discusses the gender relation amongst the workforce in PT Delta Pacific. This study shows that 80% of the labor is occupied by women and 20% men. The women in PT Delta Pacific Tuna mostly work in the processing line and many as the lead of department and supervisor. Around 45% of women in the processing line have the skill of beheading, skinning and loaning. The role of women is very crucial in this canning company's activities.

Barclay et al [26] conducted research on women and gender on the tuna value chain in the fishing community in Bitung and Maluku. In Maluku, the analysis considers the role of women and gender of the tuna value chain of tuna hand line fishing vessels with the tonnage of <2 GT and 5 – 8 GT. Men occupy most roles associated with fishing, lifting heavy loads, the most lucrative export-oriented trade commodities, and positions associated with authority, such as managerial and executive roles in fishing industries. In Tuna Exporting companies based in Ambon, men and women were dominated by different gender relations. Women make up the majority of workers in processing and administrative roles and are also involved in middle management. In one exporting company in Maluku, women were reported as being 60% of the workforce on the floor, where their skill in cleaning and grading fish loins was seen as particularly valuable. However, in the management side of the business, women made up only 30% of the workforce and were engaged in mostly administrative and middle management roles. Men tended to undertake heavy lifting and transporting roles, as well as some processing roles. Village-based traders for export tuna market domination by men; and men and women dominated for the traders in the local market. Meanwhile, family traders are mostly dominated by women. The role of women in skipjack fisheries Bitung shows in managerial of canneries industry 98% by men and canneries worker mostly women; supply skipjack to canneries and export trade mostly dominated by women, family smoked fish dominated by men and women; retailer in Bitung market involved men and women and retailer associated with tibo tibo for trading fish in the rural and urban market in Bitung and Manado dominated by women.

5. Conclusion
The tuna fisheries were dominated by small scale fishing boats such as 11-30 GTs operating in The Inter Pelagic Waters Indonesia. The most dominated tuna species caught in IAW is skipjack using the purse seine gear on the fishing vessels. The tuna fisheries has contributed significant jobs or livelihood to the coastal communities. Profit and revenue sharing is a common remuneration system found on tuna fisheries though out Indonesia. However, these fishers are vulnerable given their economic and welfare conditions and of usually limited options of other livelihood. Small fishers has limited access to livelihoods, access to finance and access to skills or fishing technology. Therefore, the inclusion of socio economic performance or indicators into the tuna fisheries management is crucial in Indonesia.

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