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A review on the influence of fish size on price in the global fish market

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Abstract

Fresh fish and fish products are critical sources of protein rich diets, healthy nutritional food for the ever increasing world population. Fish can be captured through capture fisheries from the wild water bodies oceans, rivers, lakes, dams and all naturally occurring water bodies in the world. Another source of fish is aquaculture which involves intensive fish production from different production systems entailing intensive feeding of fish using commercially available fish feeds from the market. Fish from the wild can attain breathtaking sizes and weights since live fish feed from the wild waters is not limited. In aquaculture production units, fish feed is one of the most expensive inputs limiting the production of fish. Professionally, fish is reared in aquaculture systems until it attains a certain table or plate-size for the market. Continued feeding of the fish after attaining this optimal size is uneconomical. This paper examines the influence of fish size on its price both from capture fisheries and aquaculture with a view of a deep dive into other factors determining price of fish. The relationship between fish plate-size and price, small fish versus large fish dynamics is also explored. Documented information of this complex metadata relationship of optimal size and market price of fish vis-à-vis other underlying parameters is scanty. In terms of size, quality and aesthetic value of fish, Bluefin Tuna fish tops the top ten list of most expensive fish followed by Koi fish then Flowerhorn cichlid. Results also revealed that higher demand for plate-sized fish increased the relative abundance of the smallest (recruit size class) and largest (most fecund) fish in Mexico. This may be a market mechanism to increase stocks and fishermen's revenues. The study recommends that, Fisheries management may capitalize on these conditional effects by implementing size-based regulations when economic and institutional incentives will enhance compliance or additionally by creating compliance enhancing conditions for existing regulations.

Keywords: Fish size, fish price, market price, global fish market, capture fishers, aquaculture

1. Introduction

Commercial global fish market price per piece is determined by a variety of factors, key being fish size as the most influential, species, freshness, flavour and origin ^[1]. Fish prices usually increase with increasing size of fish with bigger fish fetching higher prices since they provide more meat and therefore higher incomes ^[34]. Additionally larger fish fetches premium prices too due to unique flavours and consumer perception. However, this relationship varies across different global markets and species of fish ^[1].

Fish prices at the global fish market generally reflect a number of other factors, including the quality of fish, availability of catch and supplies from alternative sources, fuel prices, retail demand conditions and aggregate volumes of fish in the global market ^[29].

Therefore, studies on global fish market data regarding size of fish versus prices and landings create unique platform information on social trends dependent on the interface between fishmongers, fishermen and consumers, as well as critical information on fisheries catch weights, lengths, percentage of total sales and market value ^[14].

Other studies have revealed that the fish size/fish price relationship encourages overfishing since the largest fish is removed first before the smaller fish ^[29]; [36]. Some studies also have revealed the alteration of marine food webs by the removal of higher trophic level fish species to attain the

highest fish prices ^[7]. The global fish trade is therefore an essential contributor to incomes, food security and economic livelihoods.

The current review therefore evaluates the role of fish size in global price of fish determination, with a focus on the common commercial species globally and regional, national trade dynamics.

2. Materials and Methods

Methodology employed in the study was narrative review method involving literature review of several peer research journals, scholarly articles from digital science platform, Research Gate, Science Direct among many. The review mainly centered on the influence of fresh fish size on the price of fish and fish products globally. In order to capture as much information as possible in the narrative review, most expensive top ten fish in the world were examined including the factors leading to their premium prices, global fresh fish market insights including SkyQuest analysis, evidence of market-driven size-selective fishing and aquaculture economics. Prices of different fish sizes and species sold from fish farms and the optimal economical fish plate-size (optimal harvest size) attracting desirable returns in the global market were also reviewed. Economics of small fish and large fish against other background bioeconomic characteristics were reviewed. The narrative

literature review comprised of 44 research publications in the study. The narrative review process is summarized in Figure 1.0

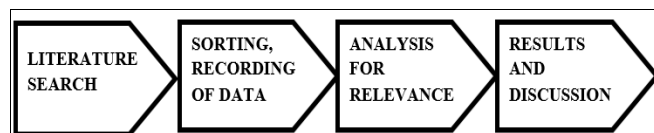


Fig 1.0: The narrative review process

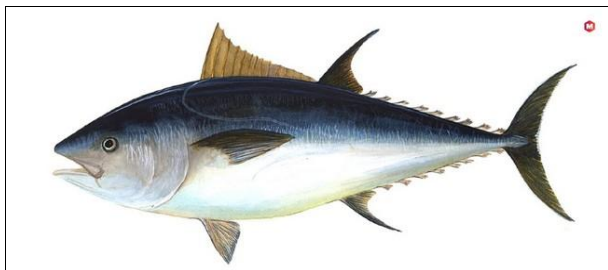
3. Results and Discussion

3.1 Top 10 Most Expensive Fish in the world in 2024

During the year under review depending on fish size, consumer perception, fantastic fish shapes, colours, flavour among others, the following fish topped the top ten list of the most expensive fish in 2024 globally; 1.bluefin tuna, 2.koi fish, 3.flowerhorn cichlid, 4.platinum arowana, 5.freshwater polka dot stingray, 6.peppermint angel fish, 7.masked angel fish, 8.bladefin basslet, 9.golden basslet and 10.platinum alligator Gar ^[19]. The Bluefin Tuna, which sushi fans love, and the colorful Koi fish that stands for friendship, can cost a fortune, up to millions of dollars! ^[19]. Additionally, some fish are so expensive because people think some of the unique can bring luck.

The most expensive fish

1. Bluefin Tuna



Bluefin Tuna in Japan is the most expensive fish species costing as much as USD3.1 million. It can up to 1,000 pounds and an astonishing length of 10 feet long. Bluefin Tuna are famous for their power and amazing speed. They are a pinnacle of high-end seafood, sashimi, sushi and famous for their rich protein meat and best flavoured meat ^[19]. Overfishing is causing their numbers to reduce drastically in the sea ^[23].

2. Koi fish



Koi fish is the second most expensive fish in Japan costing USD1.8 million. With meticulous care and professional blend of genetic manipulation, a golden trout with special

aesthetic features has been generated making Koi quite a luxurious fish in the world. Koi is considered a symbol of friendship and love in Japan due to its enormous size and beautiful mesmerizing colours with some having reached the age of over 200 years ^[19].

3. Flowerhorn cichlid



Due to the rarity and difficulty in breeding this fish, value of one Flowerhorn fish skyrockets to about USD600, 000. The fish originated in Malaysia in the late 1990s. They are an artificial hybrid strain of fish known for their aggression, and unique hump with mesmerizing colours often interpreted as symbols of prosperity and luck ^[19].

4. Platinum Arowana



One Platinum Arowana fish can cost up to USD400, 000 in the market due to their rare platinum colour, perceived superstitions of bringing good luck, and their renowned resistance to common fish diseases. The fish is easily recognized due to its unique body structure, characterized by sleek metallic sheen. The fish are called “living fossils” due to the fact that, they have a lineage dating back to over 100 million years ^[19].

5. Freshwater polka dot stingray



The market value of this fish is USD100, 000 since it's an endangered species and breeding it is therefore quite challenging due to its requirements for specific water conditions, its rarity, contrasting colours which all contribute to the high premium price of the fish. The Polka

fish is native to the Amazon River basin, has a flat body spotted with contrasting colours and an undeniable allure. The Freshwater Polka Dot Stingrays have unique shape and movements which provide an immensely satisfying spectacle for underwater enthusiasts ^[19].

6. Peppermint angelfish



The fish fetches a premium price of USD30, 000 in the market due to its striking colours, scarcity and the difficulty of capturing them from their deep-water habitats since they are quite elusive. Peppermint angelfish is, famous for its vibrant white and red stripes that make it look like a peppermint candy and the fish is a petite jewel of other fish of the deep waters. These fish are quite elusive contributing to their mystique. The fish is often found in the deep waters of the Rapa Iti in French Polynesia ^[19].

7. Masked angelfish



The Masked angelfish is the most expensive saltwater fish fetching a price of USD20, 000 in the global market due to their rarity, as they inhabit only a specific region in the world. Their habit of thriving in isolated deep waters, and mesmerizing appearance increases their premium price in the global market. Masked angelfish is native to the Northwestern Hawaiian Islands and is known for its bright white body with a distinctive black “mask” over its face. Males and females have different appearances, hence this small-sized fish displays sexual dimorphism ^[19].

8. Bladefin basslet



This fish in the global market goes for USD10, 000 due to difficulties associated with catching the fish since they live at extreme depths of deep waters. Additionally, their vivacious colours and unique physical characteristics increase their premium price value. The Bladefin basslet fish has unique razor-sharp first dorsal fin, striking red colour on top, white body and is an exotic fish generally found in the deep waters of the Caribbean. It has a maximum size of just 1.5 inches long ^[19].

9. Golden basslet



The price of golden basslet in the global market is USD8, 000 due to its scarcity and mesmerizing aesthetic beauty. It has a beautiful bright golden body with rich iridescent pigmentations. The golden basslet is generally small in size with breathtaking aesthetic beauty combined with a certain classic elegance, fancy gentle demeanor. Its unique golden hue makes it a highly sort executive aquarium fish species ^[19].

10. Platinum alligator Gar



This fish is an exotic silvery-white pet fish with a torpedo-shaped body. ^[30] platinum alligator gar fetches up to USD7, 000 in the global market primarily due to its unique appearance, rare platinum colour and its scarcity hence difficult catch effort. It has a substantial size extending up to ten feet with a fascinating primitive look resembling alligators due to their long bodies and similar shaped alligator jaws ^[19].

4. Global fresh fish market insights and SkyQuest analysis

Due to the high demand for fresh and healthy sea food products, North America has been dominating global fresh fish market for a couple of decades. United States of America forms the largest fresh fish global market segment in the North American market and has been witnessing steady growth in the demand for fresh sea food products mainly fish products, propelled by the increasing health consciousness of healthy sea foods among most consumers. Among the factors influencing demand of fish, size, fish

species, flavour and quality were cited as some of the parameters of key fish demand in the global market. [35] while studying bio-economic indicators of fisheries on impact of variations in landings and fish size on market prices in Istanbul Fish Market found that fish prices increased from small pelagic to medium pelagic to demersal fish. GAM model results for inter-species tests showed a strong positive effect of local maximum length ($p<0.01$) and a weaker positive effect of trophic level and vulnerability ($p<0.1$) on fish market price, but that landings amounts have no significant effect as a single predictor. Government efforts and strategies to promote healthy sea food recipes among the population have further enhanced the demand of fresh sea food products [35]

Asia-Pacific (APAC) region is the fastest-growing market for fresh sea food products due to rising individual incomes, increase in population and demand of protein based diets. The largest market in APAC is China due to its huge population and expanding urbanization leading to rapidly increasing consumption of fresh sea foods products. The rapid growth of fish products market in APAC is due to the government strategies of modernizing and promoting aquaculture, improving infrastructure for the transportation of fish products and its production [35].

According to the worldwide fresh sea foods market analysis, the market is determined by rising demand from both developing and developed world economies, due to increasing awareness of the nutritional benefits of fresh sea

products consumption and advancements in distribution channels and cold chain infrastructure. The increasing demand for proteinous diets as a better option to high-calorific food items is additionally catalyzing market growth [35].

However, overfishing, pollution, environmental impact of commercial fishing and aquaculture practices are some of the concerns impeding faster growth of the fresh fish global market. Going forward, emphasis should be on green fresh fish market focusing on traceability and sustainability of fish and fish products ensuring needs of current and future generations are met without harming the environment. Companies in the sea food sector should therefore adopt green responsible fishing practices and investment technologies which ensure safety and quality all sea food mainly fresh fish and fish products [35].

Fresh fish market trends - From 2024 projected to 2031

Global fresh fish market size in \$

\$235.31 billion

Biggest Segment

Salmon 1, 000

Fastest Growing

Tuna 900

Growth rate

3.5 percent CAGR

Worldwide fresh fish market in (\$ Bn) From 2024 Projected to 2031

Year	North America	Asia Pacific	Europe	Latin America	Middle East & Africa
2024	8	7	6	5	4
2025	9	8	7	6	5
2026	10	9	8	7	6
2027	11	10	9	8	7
2028	12	11	10	9	8
2029	13	12	11	10	9
2030	14	13	12	11	10
2031	15	14	13	12	11

Source: ResearchGate 2023

5. Evidence of market-driven size-selective fishing and aquaculture economics

While researching on the evidence of market-driven size-selective fishing and the mediating effects of biological and institutional factors, [31] by examining the Pacific red snapper (*Lutjanus peru*) fishery around La Paz, Mexico,

where medium or “plate-sized” fish are sold to restaurants at a premium price deduced the follow; if higher demand for plate-sized fish increases the relative abundance of the smallest (recruit size class) and largest (most fecund) fish, this may be a market mechanism to increase stocks and fishermen’s revenues.

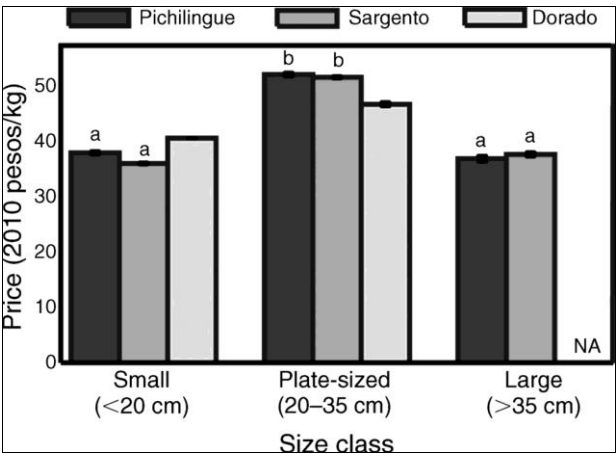
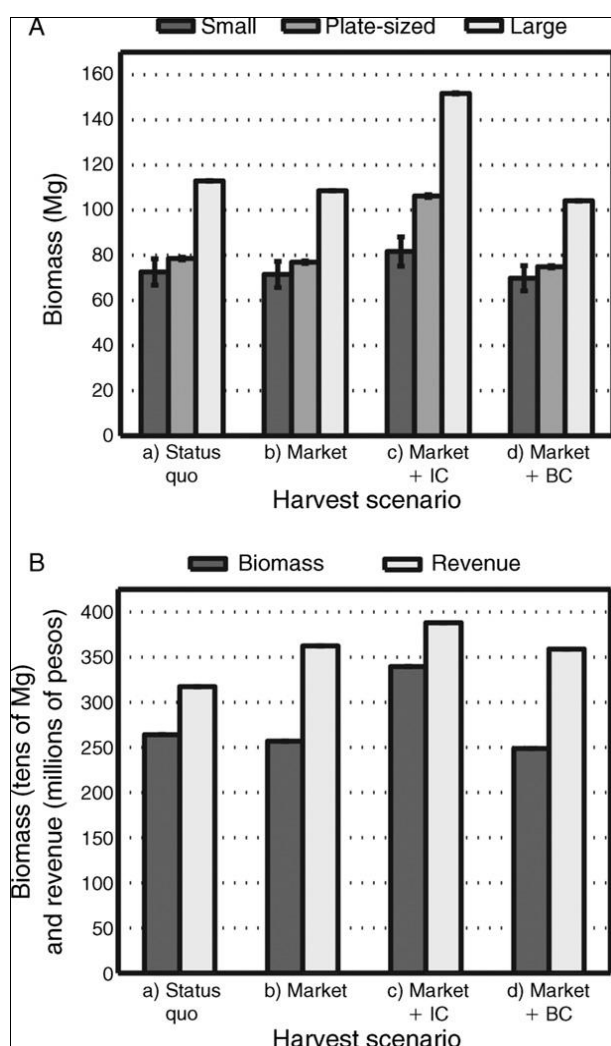


Fig 2: The mean price of *Lutjanus peru* by size class and fishing cooperative

They revealed that, the supply of plate-sized fish increased by 6%, while the supply of large fish decreased by 4% as a result of a 13% price premium for plate-sized fish. This market-driven size selection increased revenues (14%) but decreased total fish biomass (−3%). However, when market-driven size selection was combined with limited institutional constraints, both fish biomass (28%) and fishermen's revenue increased by (22%).

[39, 7] observe that, in the tourism sector, increased tourism demand for plate-sized fish only would be beneficial if it does not stimulate large supply responses by fishermen and if only fishermen selectively harvest plate-sized fish and reduce their harvest of non-plate-sized fish whether large or small sized fish. Most fishing cooperatives would therefore be able to monitor and control fishing effort in a way that is consistent with the afore two mentioned conditions. In addition effective, strict monitoring and collective action by cooperative members could limit entrance of would be new fishermen, who may be attracted by the increase in fish prices.



The results reveal that the direction and magnitude of the effects of market demand on biological populations and human behavior can depend on both biological attributes and institutional constraints. They recommend that, Fisheries management may capitalize on these conditional effects by implementing size-based regulations when

economic and institutional incentives will enhance compliance, as in the current case under study or by creating compliance enhancing conditions for existing regulations [31].

Aquaculture fresh fish and fish products market globally in reference to fish size and prices per kg present a unique trend. This is due to the fact that cost of inputs especially fish feeds is critical in determining harvest size of farmed fish mostly referred to as the table size of fish. Once farmed fish has reached a certain optimal table size for the market, continued feeding of the farmed fish will lead to diminishing returns and it will not be economical to continue with feeding. Therefore, just has there is consideration of medium plate-sized fish in Mexico [31] in aquaculture economics, there is consideration of optimal economic size of farmed fish, a level where it fetches premium price in the market in order to break-even in aquaculture. A good example of fresh fish optimal market size of farmed fish is in Kenya where a kg of fish is currently fetching as high as Kshs 400/US\$ 1.86 per kg [12], [27].

Type of fish	Price (Ksh/kg)		
	High season	Low season	Average
Nile perch	150	350	250
Tilapia	280	400	340
Catfish	200	400	300
Omena	200	250	225
Others	150	300	225

Fig 3: Prices per Kg of different fish type sold in fish farms and landing beaches in Kisumu County (Erick *et al.*, 2021)

Beyond a certain size, fish price increases may taper off due to shifts in consumer demand, processing inefficiencies, plate-size preferences, transport and storage challenges. A classic example; overgrown and oversized shrimp may be priced lower per kilogramme than average-sized shrimp due to lower yield in ready-to-cook shrimp byproducts [26].

Prices of fish at the global fish market normally reflect a number of parameters, the species and their sizes including the aggregate amounts of the product on the market, seasonality, the 'quality' of available catch, the availability of supplies from alternative sources, fuel prices, number of would be buyers and underlying retail demand conditions [29, 42], reported that both bonito and bluefish have higher price variations in their larger rather than smaller fish sizes, but their prices are also affected by seasonality.

They reported that, prices were lowest in peak periods and highest especially for larger fish during the years with low landings. Monthly variations of bonito and bluefish prices were totally different than all the other species examined. Highest monthly prices were during the highest monthly landings for bonito and during the migration period for bluefish [13, 42].

They further revealed that, fish maximum length had the highest influence on market prices, with trophic level and common length of fish having a small effect. When correlations between predictors were removed, the strongest confidence level was found for local maximum length of fish as the best predictors on unit price of fish, demonstrating that market price is influenced by larger fish [42, 13].

Other studies have also found size to be the most important attribute in setting the price for many species [9, 3, 15, 32, 17]. Although the effect of fish size on fish prices [42], has long been understood, this important relationship has indeed gone overlooked in fisheries science [34, 40, 41, 43], but is a great predictor of profit, and hence targeted species, as fishers try to generate the highest profit available to them. [36, 33, 37] also revealed that larger fish related to higher prices, and their selective removals may have contributed to overfishing [38].

While investigating the economic incentives to target fish size and species: prices and fine-scale product attributes in Norwegian fisheries [13] found that, specifically for cod fish, the fish size accounted for nearly all variation in prices recorded while in whitefish, in terms of the species landed accounted for only three-quarters of the variation in prices of the whitefish. They conclude that market conditions justified management focus on the biological composition of the fish catch in Norway [42].

[3] argue that using landings data, the intensity of economic incentives can specifically be assessed in at least two categories, fish size and harvest timing. [5] report that, several species are characterized by size-dependent pricing, [18, 26], and the more the pronounced the price difference is between different size categories, the more the fishers' incentives to target specific fish sizes [45]. The timing of the catch is also related to size-dependent pricing for short-lived species, [21]. Market incentives can increase or decrease the effects of natural aggregations depending on the timing resulting in more or less evenly distributed catches across the season under study [22]; [4]. Additionally, [2] reveal that, the Norwegian coastal fleet generates higher profits than the trawlers per unit of quota due to the higher average fish size [45].

According to [13], the size of fish is clearly a critical factor in pricing. They reported four sized categories with the smallest, less than a kg, as their reference point. The other categories were 1-2.5, 2.5-6 kgs and largest more than 6 kgs. They found that the size of the premiums increased with increase in fish size. Their results are consistent with those by [18], who revealed that size-based pricing for cod fish was dominating but in a model that was unable to control for other potentially correlated attributes like species and catch. The premiums associated with the different sizes were, 24.8, 40.2, and 59.3% respectively [24].

Despite the dominance of fish size, [42], found there was statistical significance of premiums associated with all the attributes investigated: size of fish, quality, seasonality, species, fuel price, product form, grading, vessel length, gear type, company, and landing location. They found that the importance of differ [42] different attributes varied substantially across the whitefish and crab fisheries such that the corresponding price incentives for fishermen varied across the fisheries.

[16] observe that, consumer behavior is one of the main drivers behind global resource exploitation and is strongly related to cultural habits, size and supply of fish, income, quality, as well as substitution. The size of fish selectivity through fisher behavior and consumer affect the health of many marine ecosystems and demonstrates the need for a paradigm shift in fish preferences for sustainable fisheries [28].

[42] stated that, among the attributes that influence the value of a fish, fish size and species were key, others; seasonality, quality, fuel prices, vessel size, gear used, landing location, and sex, all explain variation in prices. They revealed that, fish size and species dominated the other parameters in economic importance for whitefish, a finding that is consistent with other studies that use less detailed data. More future research studies with a similarly fine or finer grid of attributes that represent other regions around the globe, other seafood types, and a longer time span would be appropriate. Another critical field for future research would be to link fine-scale analyses of seafood prices to fishing behaviour on the water and bioeconomic models of stock composition. While admittedly ambitious, this research would provide managers new tools to promote desired biological and sustainable fisheries resources exploitation outcomes while helping fisheries generate more economic value from aquatic resource base [13, 10] argue that, some specific attributes of fresh fish and fish products are more valuable than others, hence fishers have incentives to target these attributes in the water while fishing. He however observes that, a systematic targeting of specific fresh fish and fish products attributes can lead to growth overfishing of some size classes especially the larger fish. According to [8, 44] size-based regulations that protect key sized categories of fish, mostly larger fish against overfishing, or threatened life stages of fish, such as juveniles that are needed to recruit to the population that are disproportionately fecund, are a widely used fishery strategic regulation.

6. Conclusion

Globally larger fish often fetch higher prices due to, high quality and greater quantity of edible meat, greater fillet yield, flavour, better visual appeal, and higher perceived quality. In premium markets such as Japan, large Bluefin tuna are auctioned at high prices, sometimes exceeding USD 60/kg [20]. The same trend is observed for salmon, where 4-5 kg fish receive higher demand due to unique quality, flavour and uniform fillet pieces [1].

The journey through the most mesmerizing world of the most expensive fish has shown their breathtaking price tags and the unique allure and scarcity that makes them the jewels of the aquatic ecosystem. In addition to these fish being collectibles, pets and food, they are also symbols of natural beauty, prestige and the astonishing lengths enthusiasts will go to for the love of marine organisms.

The value of these amazing sea creatures exceeds monetary worth, reflecting a deep fascination with the wonders of the underwater ecosystem. Fish size greatly influences market prices, but this scenario is not uniform across regions or species. Knowledge of these dynamics is critical for fish market analysts, producers, exporters, targeting optimizing their marketing strategies and fish harvest schedules.

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