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**Original Article**

# Does fish price depend solely on weight? A market survey analysis from four districts of West Bengal, India

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**Abstract**

Fish is an important food item that contains perfect combination of essential nutrients. The main consumable fishes in West Bengal, India are various carps and other small indigenous fishes. The objective of the study was to find out whether fish weight was a crucial factor to decide pricing and what kind of fish was beneficial for consumer from economic perspective. Thirteen markets in four districts (Kolkata, North and South 24 Parganas, Howrah) of West Bengal were surveyed to collect information about price, weight and number of vendors selling a particular fish considering 22 fish species. Subsequent statistical analyses were performed to conclude about the relationship between fish weight and price. The study indicates that pricing of every fish species does not depend solely on their weight. Weight plays important role to determine the price of few fish species such as *Liza persia*, *Lates calcarifer*, *Wallago attu*, *Ompok pabo* and *Mystus tengara*. But, the price of small indigenous fishes like *Chanda nama*, *Colisa fasciata*, *Harpadon nehereus*, *Monopterus cuchia*, *Rhingomugil corsula*, *Sperata aor* and *Puntius puntio* does not depend on the weight of individual fish. Seasonal availability, taste, consumer's personal preference have important role to determine fish price.

**Keywords:** Consumer preference; fish price; fish weight; hierarchical cluster analysis; nutritional value; small indigenous fishes

## 1 | INTRODUCTION

Fish is one of the leading food options enriched with essential amino acids, low saturated fats and micronutrients (Dural *et al.* 2007; Tacon and Metian 2013). This food item is comparatively cheaper in cost and found to be healthier and more easily digestible compared to other protein sources like goat and chicken meat (World Bank 2006). As a consumption item at fairly low price, fish serves to be one of the primary options to provide nutritional security to the financially deficit population of the developing countries and others (FAO 2012). In 2010, out of the 30 countries where fish contribute more than one-third of the total animal protein supply, 22 are financially and nutritionally backward countries (Kawarazuka and

Béné 2010). According to FAO (2016), aquaculture roughly provides around 50% of the total fish consumption. In Indian context, the eastern part of India, specifically in the states like West Bengal, Assam, Odissa, fish is found to be a part of daily meal. The significant fact is that in India one third of the population is fish eater (Dey *et al.* 2005).

Marketing orientation of fish is complex due to involvement of different intermediate participants along with number of factors like shortage of supply, poor fish quality, drying up of the source, transport problems and others (Tomek and Robinson 1981). There are very limited studies in Indian subcontinent covering a wider range of fish species, their respective markets and infrastructure, performance and the status of policies relevant to fish marketing in each state regarding the parameter of fish production and fish import. Researchers (e.g. Gupta *et al.* 1984; Srivastava 1985) have documented that infrastructural bottleneck is a parameter to determine the effective market economy. Existing studies conducted so far primarily deals with local markets with respect to few species (Sathiadhas 1998). The size of a specific fish species is often considered a major factor to determine the pricing of that particular fish species (Kristofersson and Rickertsen 2004; Asche and Guillen 2012). Generalized trend focuses over large sized fish with greater price tendency but comparatively less studies about price-weight relationship of fish species have been reported and there is scarcity of data in this regard (Sumaila *et al.* 2007). Being the major percentage in total aquaculture production, carp fishes tend to attain comparatively better pricing than other indigenous fishes (FAO 2016). Although smaller in size, the small indigenous fishes are not with the state of low demand items as the entire fish provides high nutrient content with rich source of micronutrient and other essential items (Roos *et al.* 2002). Considering all the above facts, it is difficult to generalize the size- price relationship of fish economy as fish is a highly heterogeneous consumable item with remarkable seasonal and spatial variations in size, quantity, quality and price. Besides the specific pricing of fish species determines the behavioural status of fishermen, as the pricing variation determine the preference of particular fish species to vendor (Brown 2000; Holley and Marchal 2014). So the fish species with probable higher market price are always aimed with greater profit chances (Sethi *et al.* 2010).

Therefore, in the present study it has been tried to find out whether any relationship exists between weight and corresponding price of different fish species surveyed in the markets of Kolkata and adjoining areas of West Bengal, India. The work was conducted with the primary hypothesis that price of the surveying fish species is not dependent over the corresponding weight of the fish. The results will help to understand the species specific consumer preference that ultimately pertains to the pricing of the fish species. The intention of using the price-weight connection of the fish species as indicator of the market demand can be justified from the results.

## 2 | METHODOLOGY

### 2.1 Market surveys

To figure out the cost-effective representation of fish market, 13 different markets in Kolkata and surrounding areas were surveyed. Five markets were in Kolkata, three markets both in North and South 24 Parganas and two markets in Howrah district (Figure 1). The survey was conducted throughout six months on regular basis in the morning period (7 – 9 am) from May to October 2016. The data of the fish species in the selected markets were documented through constant inspection using fish weight, its corresponding prices and available vendors of each of the fish species we have selected for this study. The fish species were *Apocryptes bato*, *Chanda nama*, *Colisa fasciata*, *Channa orientalis*, *C. punctata*, *C. striata*, *Coilia* spp., *Eleutheronema tetradactylum*, *Harpadon nehereus*, *Lates calcarifer*, *Liza parsia*, *Monopterus cuchia*, *Mystus tengara*, *Notopterus notopterus*, *Ompok pabo*, *Pangasius pangasius*, *Puntius puntio*, *Rhingomugil corsula*, *Mugil cephalus*, *Sperata aor*, *Setipinna phasa* and *Wallago attu*. The entire fish weight variable of any species was divided into three subdivisions: 1 – 250 g, 251 – 1000 g and more than 1000 g. The data considering unit price of corresponding weight group of the available species was obtained from the fish markets. Number of persons trading the specific fish species was used as the explanatory parameter to understand the demand of the respective fish species. The exploratory analysis of collected data was carried out to establish difference between the demands of the diverse fish species available in the surveyed markets of abovementioned location.

### 2.2 Data analysis

Based on the information collected from the selected markets, a comparative analysis was performed to highlight the relative value of different fish considering consumer preference. Firstly, the normal distribution of the response variable (price) is a prerequisite before conducting the ANOVA test. We performed Shapiro-Wilk's test for normality on the variable price and the result is affirmative in each of the cases. After that we have conducted ANOVA in SPSS (Version 20.0) using weight, district, fish species and number of vendor as independent factor and price as the response or dependent factor. After that we have performed ANOVA for every surveyed fish species using the price of fish species as the response variable and the weight groups of the fishes, no. of vendor of each fish species and the zones or districts as different factors. The significance of the main effects of these three factors as well as the interaction effects on the price of different fish species were studied through the *p*-value of the test

procedures at 5% level of significance. For each of the fish species, the regression line of the price on the weight of the species was also fitted. The significance of the weight of the fish species on their prices was explained from the p-values of the regression analysis. The analysis was also accompanied by the standardised residual plot against the weight of each of the fish species. The hierarchical cluster analysis was also performed to find similarity among different fish species with respect to the preference of the consumer belonging to different economic backgrounds. The entire surveyed individuals were divided in three groups according to their estimated earning per month. These three groups were termed as low (INR <5000 month$^{-1}$; 1 USD = ~74 INR), medium (INR 5000 – 25000 month$^{-1}$) and high (INR > 25000 month$^{-1}$) income groups. For this analysis we have assigned the proportions of individuals from each of the group purchasing a particular fish species as response variables. fdANOVA package (Górecki and Smaga 2019) of R software (version 4.0.1) was used for the analysis.

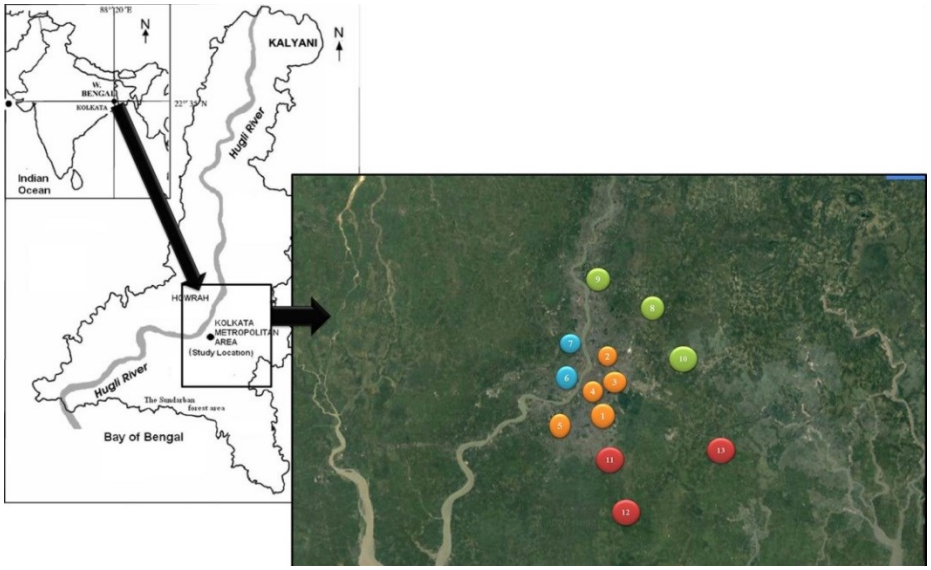


**FIGURE 1** Location of surveying fish markets present in and around Kolkata, West Bengal, India. Notes: Orange circles denote markets of Kolkata, blue circles denote markets of Howrah, green circles denote markets of North 24 Parganas and red circles denote markets of South 24 Parganas.

## 3 | RESULTS

Considering the interaction of four main factors, fish, vendor and weight wise result of interaction showed significant result ($p < 0.05$). In contrast, district wise interaction showed insignificant result ($p > 0.05$). Fish and weight interaction also exhibited significant result ($p < 0.05$) denoting that precise weight of a particular fish species showed significant price variation compared to the same weight of a different fish species. The combined interaction of all four main factors showed insignificant result ($p > 0.05$) (Table 1).

Considering interactions of three different factors namely district, weight and vendor, fish species such as *Coilia* spp., *E. tetradactylum*, *H. nehereus*, *O. pabo*, *L. calcarifer* and *L. parsia* showed significant variation ($p < 0.05$) in pricing in the markets in respect of district wise orientation. In contrast, fish species like *L. calcarifer*, *A. bato*, *L. parsia*, *C. punctata*, *C. striata*, *O. pabo*, *P. pangasius* and *M. tengara* showed significant disparity ($p < 0.05$) in pricing when only weight group was considered. Weight groups was not found to be significant ($p > 0.05$) factor to determine price for other fish species or those without any weight variations. Considering the scenario of significant price variation correlated with vendor preferences for fish, it was found that fishes like *A. bato*, *M. tengara*, *C. striata*, *C. punctata* and *L. parsia* showed significant results ($p < 0.05$). Considering the interactions between fixed factors, *L. parsia*, *E. tetradactylum* and *C. striata* showed significant interactions ($p < 0.05$) between district and weight. No fish species except *L. calcarifer* showed significant ($p < 0.05$) interaction between district and vendor. Coming to the interactions of three fixed factors namely district, weight and vendor, we find that *L. calcarifer* is the only fish species that showed significant pricing ($p < 0.05$) output (Table 2).

During regression analysis fish species such as *L. calcarifer*, *A. bato*, *L. parsia*, *C. punctata*, *C. striata*, *O. pabo*, *P. pangasius* and *M. tengara* showed significant relationships ($p < 0.05$). This result represented that the pricing of these fish species is well dependent on the corresponding weight. This result also displayed the positive correlation between price and corresponding weight of the aforementioned fish species. Rest of the studied fish species displayed insignificant outcomes implying that their pricing were not dependent on available weight (Table 3).

The residual values of price plotted against corresponding weight of different fish species displayed variable results. Fish species such as *L. calcarifer*, *A. bato*, *M. tengara*, *L. parsia* and *W. attu* showed their abundance in a large range of weight variety. In contrast fishes like *N. notopterus*, *R. corsula*, *O. pabo*, and *Coilia* spp. showed their abundance within short range of weight variation. Fish

species like *C. nama, S. phasa*, *P. pangasius* and *C. orientalis* showed comparatively less abundance than other studied fishes. Within all the studied species, *L. parsia*, *L. calcarifer*, *M. tengara*, *N. notopterus* and *O. pabo* showed a dense clump like presence within a very short range of weight variation (Figure 2).

**TABLE 1** ANOVA table displaying the degree of association of the price on different factors as well as the interactions between different independent factor (district, fish, weight and vendor).

| Source | Sum of Squares | *df* | Mean Square | *F* | *p*-values |
|---|---|---|---|---|---|
| Corrected model | 6150856 | 327 | 18810 | 17.0 | **<0.001** |
| Intercept | 6143199 | 1 | 6143199 | 5539.5 | **<0.001** |
| District | 7343 | 3 | 2448 | 2.2 | 0.085 |
| Fish | 867675 | 21 | 41318 | 37.3 | **<0.001** |
| Weight | 41084 | 2 | 20542 | 18.5 | **<0.001** |
| Vendor | 15954 | 7 | 2279 | 2.1 | **0.045** |
| District * Fish | 63536 | 63 | 1009 | 0.9 | 0.676 |
| District * Weight | 14141 | 6 | 2357 | 2.1 | **0.048** |
| District * Vendor | 10218 | 14 | 730 | 0.7 | 0.817 |
| Fish * Weight | 149863 | 23 | 6516 | 5.9 | **<0.001** |
| Fish * Vendor | 32500 | 35 | 929 | 0.8 | 0.737 |
| Weight * Vendor | 6180 | 7 | 883 | 0.8 | 0.591 |
| District * Fish * Weight | 22068 | 28 | 788 | 0.7 | 0.866 |
| District * Fish * Vendor | 93311 | 72 | 1296 | 1.2 | 0.163 |
| District * Weight * Vendor | 12299 | 12 | 1025 | 0.9 | 0.522 |
| Fish * Weight * Vendor | 9480 | 15 | 632 | 0.6 | 0.899 |
| District * Fish * Weight * Vendor | 18316 | 11 | 1665 | 1.5 | 0.125 |
| Error | 1505983 | 1358 | 1109 | | |
| Total | 102056075 | 1686 | | | |
| Corrected Total | 7656838 | 1685 | | | |

$R^2$ = 0.803 (adjusted $R^2$ = 0.756)

**TABLE 2:** ANOVA test summaries comparing price of different fish species observed in markets of Kolkata, Howrah, North and south 24 Parganas with district, weight and vendor as main factors. Data are means ± SE; ^, denotes positive correlation between main factors; ˅, denotes negative correlation between main factors (*n* = 12).

| Fish species | District | Weight | Vendor | District *Weight | District *Vendor | Vendor *Weight | District *Vendor*Weight |
|---|---|---|---|---|---|---|---|
| *Apocryptes bato* | 2.10 (0.105) | 11.04(0.001)^ | 3.71(**0.028**)^ | 0.82 (0.367) | 0.01(0.997) | 2.24(0.997) | - |
| *Mystus tengara* | 0.73(0.535) | 17.31(**<0.001**)^ | 3.56(**0.003**)˅ | 0.34(0.794) | 0.85(0.579) | 1.95(0.106) | 0.5(0.850) |
| *Chanda nama* | 0.98(0.442) | 2.86(0.125) | 1.60(0.237) | 1.43(0.288) | 0.29(0.601) | - | - |
| *Colisa fasciata* | 1.06(0.384) | - | 0.79(0.383) | | 0.74(0.536) | - | - |
| *Channa orientalis* | - | - | - | - | - | - | - |
| *Channa panctuata* | 0.42(0.733) | 4.45(**0.040**)^ | 0.04(0.833) | 0.23(0.875) | 0.2(0.813) | 0.03(0.854) | - |
| *Coilia sp* | 4.69(**0.005**) | 0.66(0.518) | 0.025(0.975) | 0.001(0.973) | 0.79(0.574) | - | - |
| *Channa striata* | 0.24(0.861) | 12.32(**0.001**)^ | 6.74(**0.012**)^ | 3.82(**0.028**)^ | 0.62(0.599) | - | - |
| *Eleutheronema tetradactylum* | 3.043(**0.038**) | 0.23(0.627) | 4.2(**0.021**)˅ | 1.55(0.221) | 0.48(0.693) | 0.27(0.602) | - |
| *Harpadon nehereus* | 3.11(**0.031**) | - | 1.916(0.154) | - | 0.56(0.727) | - | - |
| *Monopterus cuchia* | - | - | - | - | - | - | - |
| *Notopterus notopterus* | 1.23(0.307) | 0.75(0.389) | 0.06(0.799) | 1.27(0.264) | 1.26(0.291) | 2.18(0.146) | - |
| *Ompok pabo* | 14.57(**<0.001**) | 14.85(**0.001**)^ | 0.52(0.714) | 0.71(0.399) | 0.62(0.801) | 1.38(0.243) | - |
| *Pangasius pangasius* | 0.41(0.740) | 4.31(**0.049**)^ | 0.51(0.481) | 0.39(0.679) | 0.05(0.816) | - | - |
| *Puntius puntio* | 0.32(0.804) | 0.63(0.430) | 0.32(0.722) | - | 0.49(0.740) | - | - |
| *Rhingomugil corsula* | 0.24(0.868) | 2.17(0.144) | 0.2(0.649) | - | 0.27(0.842) | - | - |
| *Mugil cephalus* | 1.24(0.302) | 0.57(0.44) | 1.28(0.287) | - | 0.45(0.767) | - | - |
| *Sperata aor* | 2.33(0.082) | 0.25(0.616) | 1.95(0.150) | 0.06(0.790) | 0.37(0.820) | 0.56(0.453) | - |
| *Setipinna phasa* | 0.92(0.442) | 0.23(0.632) | 0.17(0.675) | 1.02(0.371) | 1.18(0.321) | 1.57(0.220) | - |
| *Lates calcarifer* | 3.58(**0.015**) | 128.4(**<0.001**)^ | 3.05(**0.042**)˅ | 3.7(**0.013**)^ | 2.88(**0.015**)^ | 2.03(0.133) | 2.73(**0.031**)^ |
| *Liza parsia* | 8.6(**<0.001**) | 124.8(**<0.001**)^ | 3.64(**0.004**)^ | 6.49(**0.001**)^ | 0.96(0.489) | 1.16(0.332) | 0.32(0.897) |
| *Walago attu* | 1.78(0.156) | 1.39(**0.024**)^ | 1.14(0.32) | 1.91(0.131) | 0.07(0.991) | 0.12(0.886) | 0.97(0.410) |

**TABLE 3** Summary of the regression coefficients of pricing of studied fish species on corresponding weight.

| Fish species | Coefficients | SE | *t*-value | *p*-value |
|---|---|---|---|---|
| *Apocryptes bato* | 0.125 | 0.034 | 3.72 | **0.001** |
| *Coilia* spp. | 0.005 | 0.014 | 0.35 | 0.729 |
| *Sperata aor* | 0.047 | 0.057 | 0.82 | 0.413 |
| *Channa striata* | 0.103 | 0.023 | 4.40 | **<0.001** |
| *Mugil cephalus* | –0.079 | 0.055 | –1.45 | 0.153 |
| *Ompok pabo* | 0.041 | 0.025 | –1.66 | **0.039** |
| *Eleutheronema tetradactylum* | –0.040 | 0.049 | –0.81 | 0.419 |
| *Liza parsia* | 0.247 | 0.033 | 7.53 | **<0.001** |
| *Mystus tengara* | 0.111 | 0.025 | 4.51 | **<0.001** |
| *Harpadon nehereus* | 0.058 | 0.050 | 1.16 | 0.251 |
| *Rhingomugil corsula* | 0.095 | 0.060 | 1.59 | 0.115 |
| *Puntius puntio* | 0.042 | 0.067 | 0.62 | 0.538 |
| *Notopterus notopterus* | 0.039 | 0.047 | 0.84 | 0.404 |
| *Channa orientalis* | –0.033 | 0.035 | –0.94 | 0.355 |
| *Pangasius pangasius* | 0.092 | 0.053 | –1.74 | **0.009** |
| *Setipinna phasa* | 0.015 | 0.039 | 0.38 | 0.708 |
| *Monopterus cuchia* | 0.045 | 0.058 | 0.76 | 0.449 |
| *Colisa fasciata* | –0.066 | 0.076 | –0.86 | 0.398 |
| *Channa panctuata* | 0.078 | 0.035 | –2.21 | **0.032** |
| *Chanda nama* | 0.061 | 0.058 | 1.05 | 0.309 |
| *Lates calcarifer* | 0.127 | 0.007 | 17.02 | **<0.001** |
| *Walago attu* | 0.009 | 0.012 | 0.80 | 0.424 |

The hierarchical cluster analysis of all the surveyed fish species provided an illustrative grouping with respect to their purchasing by individuals from three different groups, framed in respect of economical earning. As depicted from the dendrogram, three major clusters are formed. The first cluster included *C. fasciata*, *C. orientalis*, *C. punctata*, *C. nama*, *M. cuchia* and *S. phasa*. The second cluster included *H. nehereus*, *R. corsula*, *M. cephalus*, *P. pangasius*, *A. bato*, *C. striata* and *P. puntio*. Whereas, the third cluster included *W. attu*, *L. calcarifer*, *L. parsia*, *E. tetradactylum*, *M. tengara*, *S. aor*, *O. pabo*, *Coilia* spp. and *N. notopterus*. The fishes belonging to the first cluster are those with comparatively low prices, which are nominally popular among the higher income group people. In contrast, fish species from second and third cluster have comparatively higher prices, which are less affordable for the lower income group persons. Fishes like *L. parsia*, *L. calcarifer* and *W. attu* have close proximity with each other displaying similarly high preference of consumers. These fishes have comparatively higher grade of pricing than other fish species (Figure 3).

## 4 | DISCUSSION

The present study was undertaken to understand whether fish weight might have been considered an enough factor to determine the pricing of studied fish species related with customer preferences. In fish markets the number of vendors available for each of the fish species was used as indicator of customer preference for the particular fish species. The fish and weight wise disparity of pricing indicated the tendency of customer preference towards specific fish or specific weight of the fish species. Customer preference towards specific fishes may be due to either their easy availability or nutritional quality and taste. However, earlier studies stated that taste was never a deciding factor for the consumers belonging to rural areas or economically feeble population (Guillotreau and Jiménez-Toribio 2011; Galib *et al.* 2013). The significant price disparity of the fish species considering district wise interaction may be due to the higher demands for particular fish species associated with irregular availability in the studied markets. The region specific distribution, catchment and transport may be the key factors those lead to the unequal abundance of these fish species in studied fish markets (FAO 2018). The results indicated significant variation in pricing of specific weight groups of fish species including *L. calcarifer*, *A. bato*, *L. parsia*, *C. punctata*, *C. striata*, *O. pabo*, *P. pangasius* and *M. tengara*. The significant variation in price considering weight differences may be due to tendency of gaining higher profit for specific weight group of abovementioned fish species. Tsikliras and Polymeros (2014) have mentioned that there was a strong positive correlation between fish weight and unit market price. Zimmermann and Heino (2013) also stated significant increase of unit price against upsurge of weight considering seven out of eight inspected fish stocks. This undoubtedly indicated that market forces rise in the targeting of fishes with comparatively higher body weight to achieve more profit in return. This relationship can explain the noteworthy abundance and pricing of large sized fishes in the surveying markets.

Considering the correlation between fish pricing with vendor preference, previously the study of Oishi and Hagiwara (2015) reported that different catfishes were preferred by vendors as they were tough and available throughout the year. So these species provide the benchmark of assurance of better profit after catchment, transport and selling for the sellers. Significant vendor preference of *A. bato* may be due its seasonal availability correlated with flesh quality (Oishi and Hagiwara 2015). In contrast, other fish species those show non-significant vendor preference may be due to their availability throughout the year. Vendors are reported to prefer different cyprinids for their taste associated with continuous availability throughout the year (Kasumyan and Döving 2003). These two parameters may be the crucial factors to provide steady profit that correlated with non-significant price variation and vendor preference (FAO 2016). This significant interaction of weight and district for certain fish species may denote that pricing of these fishes significantly vary whenever they are present in greater weight and also in specific districts. The significant pricing in this case may be due to different reasons like good taste along with unusual abundance and other fac-

tors (Can *et al.* 2015). In the present study, only *L. calcarifer* showed significant interaction between vendor and district. Two factors may be crucial for this specific result. First is the higher abundance of this fish in the waterbodies of South 24 Parganas and second is its high demand correlated with good taste (Mahapatra *et al.* 2014). For other fishes the results denote that preferences of seller do not change the price of fish whether it is in different district or in different weight group. In this case, may be the uniform preference of consumers towards the surveying fish species ultimately lead to the insignificant pricing differences. Within all the studied fish species *L. calcarifer* is the only one to display significance interaction between three factors namely district, weight and vendor. This significant outcome may be the result of positive combination of all the reasons those play crucial roles to determine the pricing of fishes. These factors are availability of fish in region specific manner, hardiness of fish species during transport period, quality of fish flesh and others (Alabsi and Komatsu 2014).

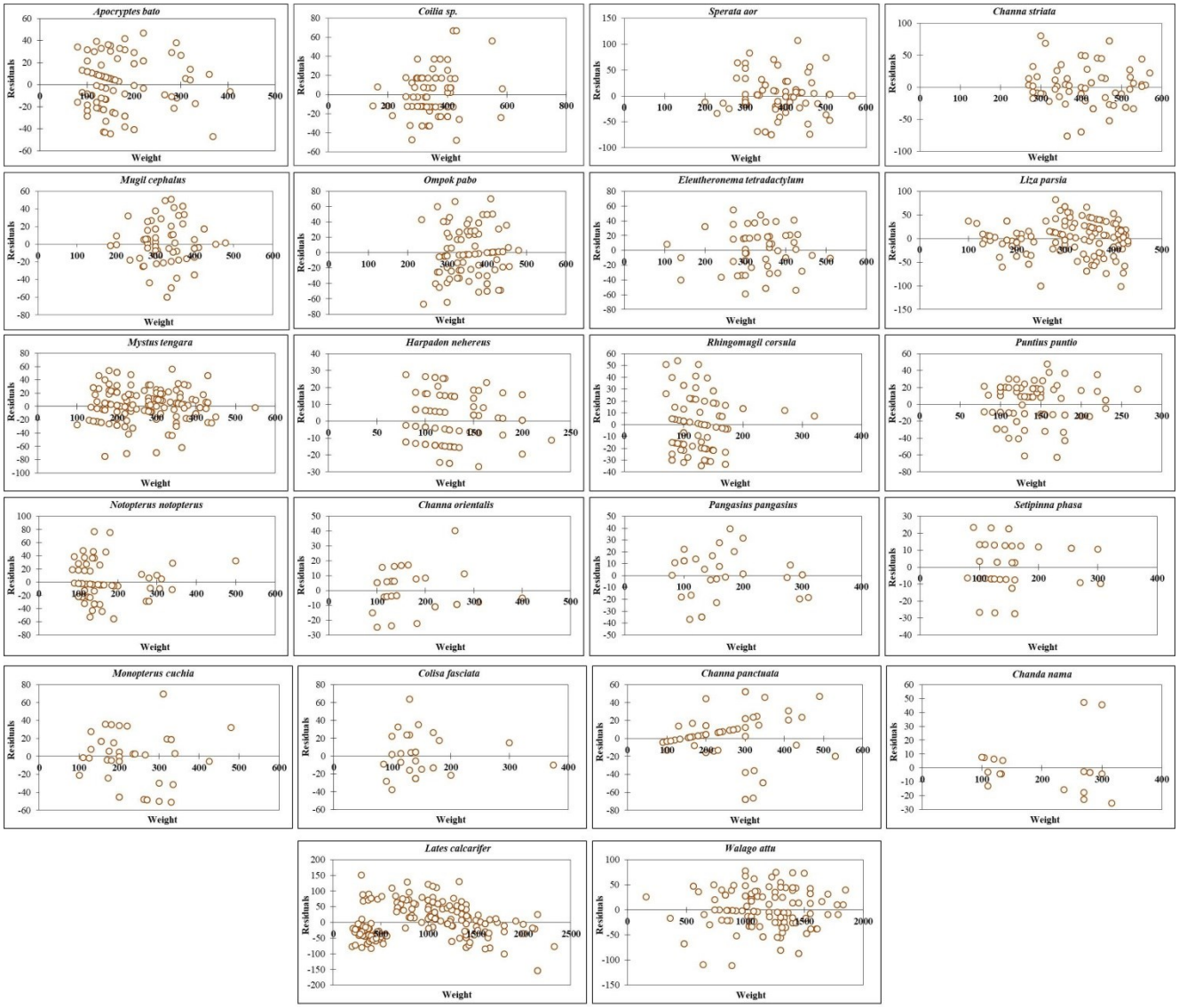


**FIGURE 2** Distribution of residual values plotted against weight (g) variations of different fish species studied in the fish markets in and around Kolkata.

Weight is often considered to be the only substantial factor in urban markets to decide the pricing of the fish. In urban markets, fish are mainly sold depending on fish weight while in sub-urban regions prices are dependent on factors like economical background, available locally produced fishes and others. Moreover, supply is also a crucial factor in sub-urban areas to determine the price. The absence of price standards intensified the situation as the prices are sometime fixed on visual conclusion which is very independent. This state where consumers are ready to pay for any fish species of any size may be temporal as customer preference might alter when the size of fish being offered in the market increases. The preference of some specific fish species to the consumers are so high that they are ready to pay for that fish whenever present in the market (Matiya *et al.* 2005). In the present study,

*O. pabo*, *W. attu*, *M. cephalus* and *N. notopterus* represented such types of fishes for those weight was never a deciding factor rather than its presence. This particular pattern of customer preference may be associated with taste of the flesh or presence of essential micronutrient in comparatively greater content (Sjöberg 2015). Fishes like *L. calcarifer*, *M. tengara* and *L. parsia* showed significant interaction between their abundant weight groups with corresponding price. This denoted that price of these fishes increased with greater weight. This portrayed consumer preference to pay for bigger fishes may be due to improved extent of taste. Sometimes the lesser size of specific fish being sold on the marketplace might be as a consequence of over-fishing. One of the signs of over-fishing is changes in species composition as well sizes of fishes in marketplaces (Njaya and Chimatiro 1999). However, for small indigenous fishes such as *H. nehereus*, *P. puntio*, *S. phasa* and *C. fasciata*, market price might often be exclusively associated with the nutritional quality of such fishes rather than individual fish weight.

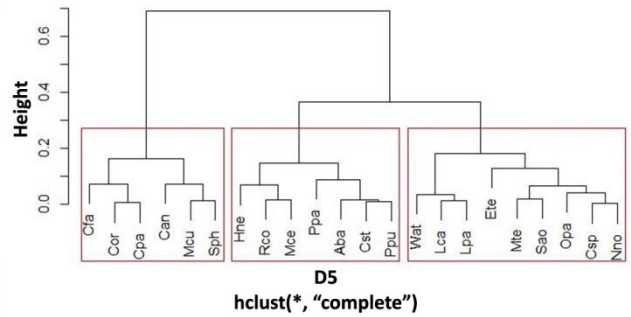


**FIGURE 3** Dendrogram displaying hierarchical clusters analysis of different fish species in respect of their consumers in the markets of Kolkata, Howrah, North and South 24 Parganas using single linkage. Notes: Csp, *Coilia* spp.; Sao, *Sperata aor*; Cst, *Channa striata*; Rco, *Rhingomugil corsula*; Opa, *Ompok pabo*, Ete, *Eleutheronema tetradactylum*; Lpa, *Liza parsia*, Mte, *Mystus tengara*, Hne, *Harpadon nehereus*; Mce, *Mugil cephalas*; Ppu, *Puntius puntio*; Aba, *Apocryptes bato*; Nno, *Notopterus notopterus*; Cor, *Channa orientalis*; Ppa, *Pangasius pangasius*; Sph, *Setipinna phasa*; Mcu, *Monopterus cuchia*; Cfa, *Colisa fasciata*; Cpa, *Channa punctata*; Can, *Chanda nama*; Lca, *Lates calcarifer*; Wat, *Walago attu*.

We have found three separate clusters when all the surveyed fish species are considered against consumer preference. These clusters mainly helped to build a framework of entire study in categorical way. The first cluster includes the fishes those have low price range and variability. These fishes were usually uneven in their abundance (Can *et al.* 2015). This pricing pattern may be due to irregular abundance associated with average taste quality. This taste quality of flesh may be correlated with lesser presence of different crucial fatty acids and other macromolecules. Fishes from this cluster provide food item with minimal quantity of essential macromolecules in comparatively lower price. So, it was quite evident that fishes belonging to this cluster were preferred by economically feeble population. This factor ensures the continuous supply of essential nutrients to the consumers from financially weak population. In contrast *W. attu*, *L. calcarifer* and *L. parsia* from third cluster have high price status. Along with it places of fishes like *M. tengara* and *O. pabo* in third cluster also denote their higher price range. The price status of these fishes correlated with higher demand due to better flesh quality (Tveterås *et al.* 2012). These fishes may be transported to the respective markets in regular basis assuring their steady abundance. Reports have also suggested that weight is a significant factor to determine the price and its corresponding consumer in respective markets. Within this cluster, *W. attu* and *L. calcarifer* represent a subgroup in which greater weight variety persists. Here weight may be a significant factor along with taste to determine the pricing of these fishes (Tsikliras and Polymeros 2014). Based on these facts it may be assumed that fishes from third cluster denoted that these fishes are preferred by consumers belonging to economically better status. Fishes such as *H. nehereus*, *R. corsula*, *M. cephalus*, *P. pangasius*, *A. bato*, *C. striata* and *P. puntio* belonged to a completely different cluster. These fishes do not show greater weight range or variety. So may be the presence of dual factors like steady abundance and taste of the flesh played substantial aspect to determine the price (Kurćubić *et al.* 2017). These two factors decide the ultimate steady price of these fishes. So, combining all scenarios we can say that consumer preference towards fishes played a key role to determine its pricing. The preference of consumers depends on economic feasibility along with different other factors like abundance, taste and personal choices of individuals.

## 5 | CONCLUSIONS

This study was conducted to understand whether weight and vendor preferences play any noteworthy role to determine the pricing of different fish species. The analysis of collected data shows that pricing of all the surveyed fish species do not depend on its weight or preferences of vendor for it. Weight plays crucial role to determine the pricing in corresponding market for few fish species such as *L. persia*, *L. calcarifer*, *W. attu*, *O. pabo* and *M. tengara*. But in contrast, weight does not decide the pricing of small indigenous fishes including *C. nama*, *Coilia* spp., *H. nehereus*, *M. cuchia*, *R. corsula*, *S. aor* and *P. puntio*.

So taking this point into consideration, the primary hypothesis that pricing of all 22 fish species analysed in the surveying markets in and around Kolkata, West Bengal, India does not depend solely on their corresponding weight may be accepted. Some other factors like seasonal availability, nutritional quality, taste or personal preference of consumers may play crucial role in determining the price of a particular fish species. But that point need more study and analysis for further convincing picture of

fish pricing in retail markets.

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**CONFLICT OF INTEREST**

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

**DATA AVAILABILITY STATEMENT**

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

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**CONTRIBUTION OF THE AUTHORS**

**DD** data acquisition, drafting manuscript;
**SM** data analysis and interpretation, drafting manuscript;
**AS** funding acquisition, critical revision of manuscript for important intellectual content;
**SBC** conceptualization and designing, funding acquisition, data interpretation, critical revision of manuscript for important intellectual content.

All authors have given final approval of the version to be published. All authors have participated sufficiently in the work to take public responsibility for appropriate portions of the content; and agreed to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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