Determining and modelling consumers' preferences for ornamental fish keeping

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ABSTRACT

A study was carried out in metropolis Chennai, Tamil Nadu with the objective to find out and model the consumers' preferences for ornamental fish keeping. Data were collected through personal interview with the help of pilot-tested interview schedule and orthogonal plan cards. Conjoint analysis and the consequent part-worth estimates for the ornamental fish attributes showed highest average importance score of 38.76 per cent for fish care attribute followed by aquarium type (37.92%) and fish size (23.32%). Among the type of aquaria, community aquarium had high utility value followed by single species and planted aquaria. In fish care level, the consumers preferred mostly the easy care level fishes followed by intermediate level while showing a negative attitude towards fishes warranting intense care. Among ornamental fish sizes, consumers showed more interest for large size fishes followed by medium and small size.

Keywords: Ornamental fish; aquarium; consumer preferences; conjoint analysis

INTRODUCTION

Ornamental fish trade is a multibillion-dollar industry estimated to be more than US$ 15 billion and more than 2 billion live ornamental fishes are traded globally (Satam et al 2018). The ornamental fish sector is a vital part of international fish trade. It contributes positively to rural development in many developing countries. In the major markets for ornamental fish the retail value is many times that of its trade value with a positive impact throughout the value chain (Monticini 2010). The ornamental fish industry is expected to grow by 8 per cent with the increasing demand for ornamental fishes (Raja et al 2019). With increase in income and urbanization the hobby of rearing ornamental fishes has been increasing at a rapid pace (Swain et al 2008). Although majority of researchers have focused on the biological characteristics like feeding, breeding and genetics of ornamental fishes (Chitra and Krishnaveni 2013, Arul Joshpin and Meena 2015, Kaur and Shah 2017) there is an important deficiency regarding trade and consumers' preferences for ornamental fish keeping.

The decision making process of customers among various competing alternatives should be clearly identified (Rao 2014). One of the most appropriate methods used to determine customers' preferences is the conjoint analysis, an efficient tool to analyse multi-attribute choices (Green and Srinivasan 1978) as a mean for quantifying customers' preferences among multi-attribute alternatives (Currim 1981). The objective of conjoint analysis is to determine what combination of a limited number of attributes is most influential in respondent choice or decision making (Whittington 2008). The strength of conjoint analysis is the ability to develop market simulation models that can predict consumers' responses to product varieties (Tolon 2018).

In the presnet study the consumers' preferences of ornamental fish keeping on the main attributes of ornamental fishes were determined using conjoint analysis. The objectives of this study were to analyse the factors predisposing consumers' preferences for ornamental fish keeping and to estimate the part-worth of attributes of ornamental fishes.

METHODOLOGY

Research locale

The research work was carried out in Chennai, the metropolis capital city of Tamil Nadu for its industrial, commercial, cultural, economic and educational prominence. Major portion of ornamental fish export from India is done from Kolkata followed by Mumbai and Chennai. In Chennai, Kolathur is well known for ornamental fish production as cottage industry. Considering these production and consumption factors, Chennai was chosen as the study area.

Selection of ornamental fish consumers

A multistage random sampling was adopted for the selection of respondents for the present study. In the first stage five zones were selected through simple random sampling technique. In the second stage from each of the selected zone three wards were selected through simple random sampling technique. In the third stage one aquarium/pet retail outlet was selected randomly from each selected ward. In the fourth stage 10 consumers visiting these shops were selected through random sampling and interviewed. Thus this study had the sample size of 150 consumer respondents comprising 30 from each of the chosen zones.

The analysis of the data was carried through conventional, tabular and functional methods. In addition to chi-square test for evaluating the association between factors the following statistical models were employed to study the consumers' preferences.

Ordered probit model

Ordered-response models recognize the indexed nature of various response variables. In this study consumers' preferences towards attributes of ornamental fishes were the ordered responses. An individual consumer's utility function or preference

$$U_{ij} = \sum_{k=1}^{K} \sum_{l=1}^{L_k} \beta_{ikl}\, x_{jkl} + \varepsilon_{ij}$$

where k= Number of attributes, L_k= Number of levels of attribute k, β_{ijkl}= Respondents i's utility with respect to level l of the attribute k. x_{ijkl} is such a $\{0,1\}$ variable that equals 1 if profile j has attribute k at level l, otherwise it equals 0, ε_{ij}= Stochastic error term

ordering was hypothesized to be represented by consumers' importance rating R (1- strongly no, 2- no, 3- slightly no, 4- slightly yes, 5- yes, 6- strongly yes) on different attributes of ornamental fish. Ratings were determined by a 1 x 1 vector (X) consisting of socio-economic and demographic factors of the ornamental fish consumers (Table 1).

The following model specification was used here:

$$Y_n^* = \beta' z_n + \varepsilon_n$$

where Y_n^*= Latent and continuous measure of preference of the respondent n in the study, z_n = A vector of explanatory variables describing the respondent, β = A vector of parameters to be estimated, n= A random error term (assumed to follow a standard normal distribution)

The ordered probit models of this study were estimated using STATA 9.0®. The ordered probit model is a fairly straight forward extension of the binary probit model that can be used in cases where there are multiple and ranked discrete dependent variables.

Conjoint analysis

In the present study conjoint analysis was used for modelling the consumers' preferences of ornamental fishes. Conjoint analysis is a marketing research technique suited to study customers' preferences and determining trade-offs among the attributes of a product (Rao 2014). This technique is nowadays widely used in new product planning, pricing policies, development of existing products, advertising work and distribution studies.

The respondents i's predicated conjoint utility for a profile j is specified as follows:

$$i = 1, \ldots\ldots, \text{I and } j = 1, \ldots\ldots, \text{J}$$

Three important attributes viz aquarium tank type, ornamental fish care level and ornamental fish size were selected based on the discussion held with scientists, ornamental fish sellers, aquarium service providers and consumers of the ornamental fishes.

Survey, design and implementation

The implementation of the conjoint analysis consisted of the following stages in order to provide the best results:

Identification of key attributes and their levels in ornamental fish preferences

The important key attributes and their attribute levels are exemplified in Table 2.

Generating orthogonal set of combinations

With the selected attributes and factor levels it was possible to generate 27 different profiles (3 × 3 × 3 = 27). Rather than asking respondents to rank all 27 profiles a fractional factorial experiment design was used. A component of statistical package SPSS 15.0 (Orthoplan) was used to reduce the possible number of profiles to a manageable level while still showing the preferences to be inferred an orthogonal main effects design thus ensuring the absence of multi-collinearity between the attributes. By using the design the 27 possible profiles were reduced to 11 including 2 holdouts.

The profile generated had 2 control profiles (holdout tasks) which were not used by the conjoint

Table 1. Description of variables used in ordered probit analysis

Explanatory variable	Level of attributes	Scoring/measurement scale
Sex of respondent	Male, female	1- Male, 0- otherwise
Age of respondent (years)[a]	<18, 18 to 35, >35	1- 18 to 35, 0- otherwise
		1- Above 35, 0- otherwise
Marital status	Married, unmarried	1- Married, 0- otherwise
Educational level of respondent	Illiterate, primary, secondary, collegiate	0- Illiterate, 1- primary, 2- secondary, 3- collegiate
Residence type	Owned, rented	1- Owned, 0- otherwise
Religion	Hindu, others	1- Hindu, 0- otherwise
Annual income (Rs in lakhs)[b]	Low (<2), middle (2-5), high (>5)	1- Middle, 0- otherwise
		1- high, 0- otherwise

[a]Reference category: Less than 18, [b]Reference category: Low income

Table 2. Attributes and levels for the conjoint analysis

Attribute	Attribute level
Aquarium tank type	Community aquarium
	Single species aquarium
	Planted aquarium
Fish care level	Easy to care
	Intermediate
	Intense
Ornamental fish size	Small
	Medium
	Large

Table 3. Orthogonal design for ornamental fish preferences profiles

Card ID	Aquarium tank type	Fish care level	Ornamental fish size
1	Single species aquarium	Easy to care	Medium
2	Planted aquarium	Easy to care	Large
3	Community aquarium	Easy to care	Small
4[a]	Single species aquarium	Easy to care	Small
5	Single species aquarium	Intense care	Large
6	Community aquarium	Intense care	Medium
7[a]	Planted aquarium	Intermediate care	Small
8	Single species aquarium	Intermediate care	Small
9	Community aquarium	Intermediate care	Large
10	Planted aquarium	Intense care	Small
11	Planted aquarium	Intermediate care	Medium

[a]Holdout

procedure for estimating the utilities. Instead the conjoint procedure calculates correlations between the observed and predicted ran orders for these profiles as a check of the validity of the utilities. The orthogonal design for the ornamental fish preferences is shown in Table 3.

Designing illustrations of the attribute levels

Tabular illustrations representing each orthogonal set of combinations were prepared which included some basic social characteristic questions and also related with aquarium details which the customers were having in their home/institute/business centers.

Administering ranking experiment with sample consumers

Following Hair et al (1995), consumers visiting the aquarium/pet retail outlets were presented with 11 hypothetical ornamental fish preference combinations and were asked to rank each using an interval ranking scale from 0 to 11.

Estimating the parameters

Statistical package SPSS 15.0 was used to estimate the parameters of the model in the study.

RESULTS and DISCUSSION

Distribution of respondents on the basis of socio-economic characteristics

The socio-economic characteristics of the ornamental fish consumers studied are described in Table 4.

Out of 150 consumers 95.33 per cent were males and 4.67 per cent were females. The gender percentage revealed that males were commonly visiting the ornamental fish retail outlets for purchasing the fish, fish food and accessories as compared to females. Similar results have been documented by Selvarasu and Sankaran (2011) in Cuddalore district of Tamil Nadu and by Saha and Patra (2013) in West Bengal.

Study on the age group of the respondents showed that the highest percentage of respondents (49.33) belonged to middle age group (19 to 35 years) followed by old age (more than 35 years) and young age (up to age 18 years) groups with 30.67 and 20.00 per cent respectively. This clearly reveals that younger age group was less involved in aquarium keeping activity as compared to other age groups which might be because of the lack of free time and education

related activities. In addition youngsters seldom receive support of their parents as aquarium keeping involves costs and live species. Similarly in a study by Saha and Patra (2013) on the consumer preference for ornamental fishes in West Bengal nearly half of the respondents belonged to age group of 15 to 30 years.

Majority of the respondents in this study had college level education (62.00%) followed by primary (27.33%) and secondary (8.67%) education whereas only 2.00 per cent of the consumers visiting aquarium outlets were illiterate. On comparing the overall educational status of different categories of ornamental fish consumers it was found that majority of the consumers were literates with college level and/or higher education. Similar results were also reported by Selvarasu and Sankaran (2011) in their study in Cuddalore district of Tamil Nadu. This shows that consumers with a higher educational status had higher preference for ornamental fishes which could be attributed to their knowledge gained on aquarium management through comprehension.

The highest group of consumers (38.00%) was of employees of private firms followed by those owning business (32.00%), students (20.67%), government employees (4.00%) and others (5.33%) who were retired, job seekers and housewives etc. These results are contradictory to those expressed by Selvarasu and Sankaran (2011) in Cuddalore district wherein students formed highest group of consumers (43.29%) followed by employees of private firms (18.55%), government employees (9.27%), self employed (16.49%), unemployed (9.27%) and the retired persons (4.12%). The difference in the occupational status of the respondents could be attributed to the fact that this study was conducted in the cosmopolitan area, Chennai.

The residential ownership pattern of the ornamental fish consumers depicted that the 59.33 per cent of the consumers were residing in their own premises. The reason for this could be their higher purchasing power to own aquaria and freedom to maintain them at their owned houses unlike the consumers who were residing in rented houses. Further owners of houses were not worried about anticipated risks involved in transport of glass aquaria during shifting of their residence as in the case of residents of rented houses.

Table 4. Distribution of respondents as per their socio-economic characteristics

Parameter	Respondents (n= 150)		
	Class	Number	Percentage
Gender	Male	143	95.33
	Female	7	4.67
Age (years)	Up to 18	30	20.00
	19 to 35	74	49.33
	More than 35	46	30.67
Education	Illiterate	3	2.00
	Primary	41	27.33
	Secondary	13	8.67
	College	93	62.00
Occupation	Students	31	20.67
	Private	57	38.00
	Own business	48	32.00
	Government job	6	4.00
	Others	8	5.33
Residence	Own	89	59.33
	Rented	61	40.67
Marital status	Married	77	51.33
	Unmarried	73	48.67
Income (Rs in lakh)	Low (<2.00)	56	37.33
	Middle (2.00 to 5.00)	71	47.33
	High (>5.00)	23	15.34

Observation on marital status of the respondents showed that 51.33 per cent were married and 48.67 per cent were unmarried. Of the unmarried consumers most of them were students. A slightly more proportion of married population preferring ornamental fishes/aquarium could be attributed to the availability of more family members to care and maintain fishes besides keeping for luck (Vaasthu) and as a relief against psycho-somatic disorders.

About half (47.33%) of the respondents belonged to middle income group with annual earnings in the range of Rs 2.00 to 5.00 lakh followed by low income group with earnings less than Rs 2.00 lakh (37.33%) and high income group with earnings above Rs 5.00 lakh (15.34%).

Estimates of the ordered probit model for the attributes of aquarium keeping

Ordered probit models were fitted for analyzing the socio-economic, geographic and demographic factors determining the consumers' preference ratings of ornamental fish/aquarium attributes.

Estimation results of the eight separate ordered probit models fitted for the attributes of aquarium keeping viz the tank type, fish care, fish size, fish colour, fish movement, fish price, life expectancy and fish variety are presented in Table 5. The log-likelihood ratios and chi-square test results indicated that all the eight models fitted were good fits.

The explanatory variable gender was significant for tank type (P <0.05), fish care (P <0.10), fish size (P <0.10), fish price (P <0.01) and fish variety (P <0.05). The positive coefficients for tank type, fish size and variety indicated that male attached more importance towards the type to be owned, size and variety of the fish to be housed than their female counterparts. However the negative significance for the fish care and fish price attributes exhibited that the male members were less bothered about the fish care and price. That is they were confident of managing the fishes with adequate care and support.

The dummy variable middle age was significant at one per cent level in fish care, size, movement and price and significant at five per cent level in fish colour and variety. The positive coefficient in fish care and fish size showed that the middle age consumers attached more importance towards these attributes than young consumers. The negative sign in fish colour, fish movement, fish price and fish variety showed that

Table 5. Estimates of the ordered probit model for the attributes of aquarium keeping

Explanatory variable	Effects of important ratings on attributes of aquarium keeping							
	Tank Type	Fish care	Fish size	Fish colour	Fish movement	Fish price	Life expectancy	Fish variety
Gender	0.3142**	-0.1605*	0.1494*	-0.4803	0.0172	-0.3347***	0.2683	0.5913**
	(0.1251)	(0.0824)	(0.0682)	(0.2982)	(0.1324)	(0.1285)	(0.1951)	(0.2545)
Middle age	0.3546	0.5548***	0.4165***	-0.6345**	-1.3317***	-0.9824***	-0.5232	-0.7203**
	(0.2245)	(0.1966)	(0.0969)	(0.2631)	(0.2668)	(0.2287)	(0.4981)	(0.3114)
Old	-0.2443	0.4586**	0.2607*	-0.5152**	-0.8188**	-0.3753**	-2.0003**	-1.0626***
	(0.3934)	(0.1452)	(0.1330)	(0.1107)	(0.2177)	(0.1279)	(0.8301)	(0.3706)
Religion	0.5092**	-0.8566	-0.1500	0.3117**	0.1748	-0.5949***	1.7494*	0.0748
	(0.2193)	(0.7899)	(0.8338)	(0.1553)	(0.6229)	(0.1365)	(0.9148)	(0.0529)
Education	0.2796**	-0.5782***	-0.2486	0.1929	-0.9213***	0.4136***	0.2493*	0.3262***
	(0.1272)	(0.1126)	(0.2937)	(0.6225)	(0.3365)	(0.1285)	(0.1313)	(0.0282)
Residence ownership	2.0181**	0.1396	0.0842	-0.1466	-0.1007	-0.6104**	0.3566**	0.4815**
	(0.7104)	(0.2229)	(0.6321)	(0.1917)	(0.3211)	(0.2914)	(0.1325)	(0.1263)
Marital status	0.0124	-0.5913**	0.0538	0.5769**	-0.0862	-0.0020	0.6104*	0.3107
	(0.2061)	(0.2545)	(0.4115)	(0.2387)	(0.2199)	(0.2040)	(0.3052)	(0.2286)
Middle income	-0.3217**	-0.6374	0.7183***	0.8265***	0.2900	-1.2619***	-0.6258***	0.5924*
	(0.1893)	(0.5768)	(0.2791)	(0.1594)	(0.2338)	(0.3292)	(0.1393)	(0.3230)
High income	-0.8700***	-0.0294	1.7754***	2.3981***	0.1097	-0.8520**	-0.5358**	0.2636
	(0.2894)	(0.2683)	(0.2182)	(0.4403)	(0.3378)	(0.3045)	(0.2444)	(0.2998)
Log likelihood	-194.9475	-225.6910	-97.2231	-123.1377	-157.3560	-163.8990	-148.2481	-166.3245
Model chi-square	54.18***	33.44***	112.50***	94.60***	66.95***	57.24***	52.77***	73.65***
Number of observations	150	150	150	150	150	150	150	150

Figures in parentheses indicate standard errors, *Significant (P $\leq$ 0.10), **Significant (P $\leq$ 0.05), ***Significant (P $\leq$ 0.01)

compared to young consumers, middle age consumers showed lesser attention for these attributes. Similarly the dummy explanatory variable for old age was positive and significant for fish care and fish size attributes while showing a negative significance towards fish colour, fish movement, fish price and fish variety in addition to life expectancy of ornamental fishes. The results showed that as the experience in ornamental fish rearing and aquarium management increased the level of consideration of managemental attributes got reduced significantly.

The variable religion was positively significant for tank type, fish colour and life expectancy of ornamental fishes while showing a negative significance for fish price attribute. The positive coefficient in tank type, fish colour and life expectancy attributes exhibited that the Hindus paid more importance towards these characters and wished to have specific coloured fishes that had lengthy life in the tank types that suited to their homes. The negative coefficient in fish price indicated that the Hindus were less bothered to pay more in order to have their desired aquarium.

The education level was significant at one per cent level with respect to fish care, fish movement, fish price and fish variety at five per cent level in tank type and ten per cent level in life expectancy. The positive coefficients for attributes such as tank type, fish price, life expectancy and fish variety showed that as the education level increased the level of importance attached to these characteristics was also growing. The negative coefficient in fish care and fish movement indicated that consumers with low level of education showed more preference to fishes demanding less care and with low price compared to high educated consumers.

The explanatory variable residence ownership showed five per cent significance in tank type, fish price, life expectancy and fish variety attributes. The positive coefficient in tank type, life expectancy and fish variety demonstrated that the consumers with own residence preferred the fishes with long life expectancy and fish variety to the tank type preferred. The negative coefficient in fish price indicated that renters preferred the low cost fishes compared to owners of residence.

The factor marital status was positively significant for fish colour and life expectancy of ornamental fishes while showing a negative significance for fish care attribute. The positive coefficient in fish

colour and life expectancy attributes exhibited that the married consumers wished to have specific coloured fishes that had lengthy life compared to unmarried consumers. The negative coefficient in fish care indicated that the married ones were less bothered about fish care as there could be family members to support the aquarium management.

The dummy variable included for middle income exhibited significance at one per cent level for fish size, fish colour, fish price and life expectancy at five per cent for tank type and at ten per cent for fish variety attributes. The positive significance for fish size, fish colour and fish variety pointed out that those consumers with middle income preferred the large size fishes with different colours and varieties compared to low income consumers. The negative sign in tank type, fish price and life expectancy showed that middle income group attached lesser importance to tank type, fish price and life expectancy attributes vis-a-vis low income group. Similarly the dummy variable high income was positive and significant for fish size and fish colour attributes while showing a negative significance towards tank type, fish price and life expectancy of ornamental fishes. The results showed that as income of ornamental fish consumers increased the level of consideration for expenditure was reduced significantly.

Estimates of the part-worth of attributes of aquarium keeping

The conjoint analysis was carried out to find out the important attributes preferred by the ornamental fish consumers in Chennai corporation. The most important attributes selected for the study of ornamental fishes were the type of aquarium, care level of fishes and fish size. The internal validity of the model was estimated by Kendall correlation coefficient as suggested by Green and Srinivasan (1978). The Kendal correlation coefficient of 0.833 (p $\leq$0.01) indicated a high level of correlation between the observed and estimated preferences and confirmed the high level of significance of the obtained results. The relative importance of attributes of ornamental fishes was evaluated and the part-worth estimates of these attributes are presented in Table 6.

The most relevant factor for ornamental fish consumers in Chennai corporation was the fish care level with a relative importance of 38.76 per cent followed by the tank type (37.92%) and the ornamental fish size (23.32%) as given in Fig 1.

Table 6. Estimated Part-worth of attributes of aquarium keeping

Aquarium attribute		Utilities for ranking			
	mportance score (%)		Attribute level	Utility estimate	SE
Tank type	37.92	Community tank	0.349	0.427	
		Single Species	0.307	0.427	
		Planted aquarium	-0.656	0.427	
Fish care level	38.76	Easy to care	1.386	0.427	
		Intermediate	0.037	0.427	
		Intense	-1.423	0.427	
Ornamental fish size	23.32	Small	-0.145	0.427	
		Medium	0.024	0.427	
		Large	0.121	0.427	
Constant	5.000		0.302		

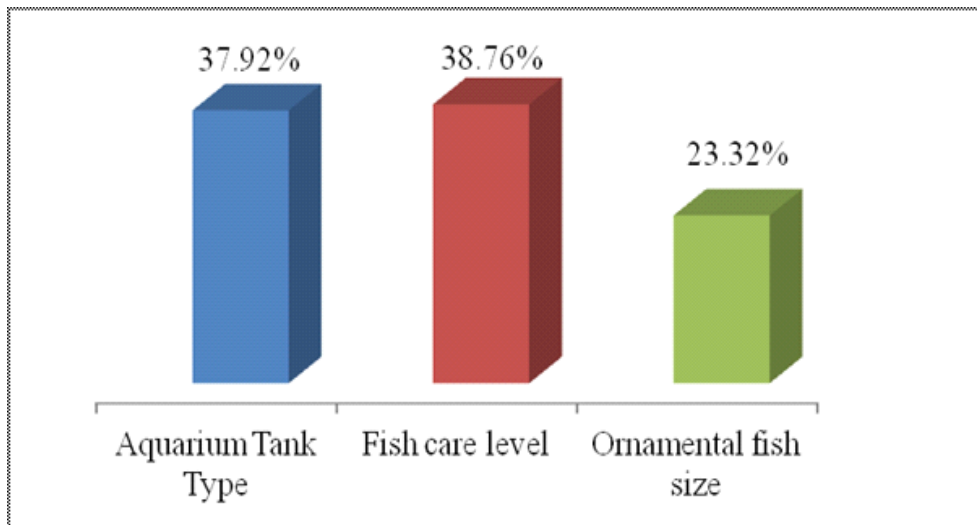| Correlation	Value	P-value
Pearson's R	0.946	.000
Kendall's tau	0.833	.001
Kendall's tau for holdouts	1.000	

Fig 1. Average relative important score for attributes of ornamental fish

Aquarium tank type

The conjoint analysis and consequent Part-worth estimates of attributes of ornamental fishes showed an importance score of 37.92 per cent for the aquarium tank type. The different kinds of aquaria considered for this analysis were single species aquarium, community aquarium and planted aquarium. Among the different aquarium types, community tank had the highest utility value of 0.349 (Fig 2) followed by single species (0.307) whereas planted aquarium had least negative utility value (-0.656). The negative utility value for the planted aquarium indicated that the consumers preferred plant free aquaria over other

types. The results also indicated that the consumers preferred community aquarium over single species aquarium which could be attributed to its proximity, affordability and long life expectancy.

Fish care level

In order to assess the relative importance of care level attribute, three levels were considered viz easy to care, intermediate care and intense care. The relative important score of the ornamental fish care (38.76%) showed that the ornamental fish consumers mainly preferred to have easy care level fishes with utility value of 1.386 (Fig 2) followed by the fishes
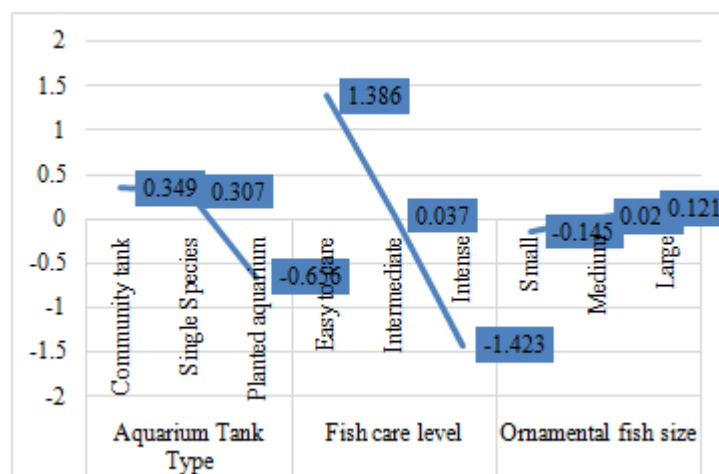
Fig 2. Estimates the Part-worth of attributes of ornamental fishes

with intermediate care level (0.037) while showing a negative utility estimate value of -1.423 for the fishes requiring intense care. The results implied that the ornamental fish consumers in this region showed more preference towards easy care ornamental fishes vis-a-vis fishes requiring extreme care.

Fish size

With the objective of ascertaining ornamental fish size attribute three sizes viz small, medium and large were taken into account for conjoint analysis. The relative importance score for the ornamental fish size attribute was worked out to be 23.22 per cent. Among the fish sizes evaluated ornamental fish with large size showed the highest utility value of 0.121 (Fig 2) followed by medium (0.024) and small size (-0.145). The results implied that the ornamental fish consumers preferred to have large size fishes in their aquarium followed by the medium size while showing a negative desire towards small size fishes. The reasons could be that the large and medium sized ones have long life expectancy besides warranting less maintenance.

Conjoint analysis revealed that the large size fishes which require less care and are reared in community tank were highly preferred while least preferred were small size fishes in planted aquarium that required intense care.

CONCLUSION

The results of the study provide remarkable and important implications for ornamental fish traders to understand the essential characteristics of hobbyists/ consumers in the ornamental fish market. Although the results of this study are limited to a group of ornamental fish hobbyists and do not cover the whole population, this study would be a good example for those who are willing to understand hobbyists' preferences on the attributes of aquarium keeping to understand the market potential. Research studies focusing on aquarium keepers/hobbyists' preferences are very limited. Appropriate research programmes should be taken up to evolve and develop new varieties in line with consumer preferences for the attributes of ornamental fishes.

Furthermore information derived from conjoint analysis can be used to guide aquaculture management and marketing strategies of ornamental fish. As the consumers are segmented by the key quality attributes of ornamental fishes and by socio-economic factors, strategies are necessarily to be evolved and strengthened for enabling niche marketing on identifiable sub-groups. The ornamental fish production and marketing approaches should take into account the various determinants of consumer demand such as preferences, choices and sentiments that influence the consumer behaviour of households while popularizing species specific farming.

REFERENCES

Arul Joshpin A and Meena R 2015. Study the breeding biology of ornamental fish *Poecilia reticulata* (Guppy). Species **14(46):** 158-168.

Chitra G and Krishnaveni N 2013. Effect of probiotics on reproductive performance in female livebearing ornamental fish *Poecilia sphenops*. International Journal of Pure and Applied Zoology **1(3):** 249-254.

Currim IS 1981. Using segmentation approaches for better prediction and understanding from consumer mode choice models. Journal of Marketing Research **18(3):** 301-309.

Green PE and Srinivasan V 1978. Conjoint analysis in consumer research: issues and outlook. Journal of Consumer Research **5(2):** 103-123.

Hair JF Jr, Anderson RE, Tatham RL and Black WC 1995. Multivariate data analysis, 3rd ed, Macmillan Publishing Company, New York.

Kaur R and Shah TK 2017. Role of feed additives in pigmentation of ornamental fishes. International Journal of Fisheries and Aquatic Studies **5(2):** 684-686.

Monticini P 2010. The ornamental fish trade: production and commerce of ornamental fish: technical-managerial and legislative aspects. Globefish Research Programme, Food and Agriculture Organization of the United Nations, Globefish, Products, Trade and Marketing Service, Fisheries and Aquaculture Policy and Economics Division, Viale delle Terme di Caracalla, Rome, Italy, Vol 102, 134p.

Raja K, Aanand P, Padmavathy S and Sampathkumar JS 2019. Present and future market trends of Indian ornamental fish sector. International Journal of Fisheries and Aquatic Studies **7(2):** 6-15.

Rao VR 2014. Problem setting. In: Applied conjoint analysis (VR Rao eds), Springer-Verlag Berlin, Heidelberg, pp 1-36.

Saha MK and Patra BC 2013. Customers preference for aquarium keeping: market survey, special emphasis on indigenous ornamental fishes in four districts of West Bengal, India. Research Journal of Recent Sciences **2(12):** 43-53.

Satam SB, Sawant NH, Ghughuskar MM, Sahastrabuddhe VD, Naik VV, Pagarkar AU, Chogale ND, Metar SY, Shinde KM, Sadawarte VR, Sawant AN, Singh H, Sawant PA, Patil VK, Rane AD, Haldankar PM and Bhattacharyya T 2018. Ornamental fisheries: a new avenue to supplement farm income. Advanced Agricultural Research and Technology Journal **2(2):** 193-197.

Selvarasu A and Sankaran A 2011. Marketing strategies vis-a-vis consumer preference for aquarium business service. International Journal of Latest Trends in Finance and Economic Sciences **1(1):** 23-29.

Swain SK, Singh SK, Routray P and Barik NK 2008. Indigenous ornamental fishes: status, issues and strategies for propagation and conservation. e-planet **6(2):** 20-26.

Tolon MT 2018. determination of hobbyist preferences for livebearer ornamental fish attributes by conjoint analysis. Turkish Journal of Fisheries and Aquatic Sciences **18:** 119-126.

Whittington R 2008. Introduction to health economics concepts: a beginners guide. Rx Communications Ltd, Flintshire, UK, 34p.