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RESEARCH ARTICLE

ANALYSIS OF CARP VALUE CHAIN IN BARA DISTRICT, NEPAL

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ABSTRACT

Carp is the major fish produced under polyculture in Nepal. A study was conducted to analyze the value chain of carp in the Bara district from January to April 2020. A total of 120 respondents; 60 each from Simraungadh and Pachrauta municipality on an equal basis was sampled by using the cluster sampling technique. 60 respondents include; 45 carp producers, 10 traders (local collector, district collector, local wholesaler, processor, retailer), and 5 consumers from Simraungadh and Pachrauta municipality were sampled randomly. Data were entered and coded in SPSS 25 and analyzed using STATA 12.1. The study revealed a benefit-cost ratio was 1.76. The maximum share was contributed by the cost of feed (70%) to the total variable cost and cost of pond construction (80%) to the total fixed cost. The unit cost of production of carp under polyculture was NRs. 201.5. The key actors involved in the chains were producer, wholesaler, collector, processor, retailer, and consumer. The price spread was higher in the regional market chain i.e. NRs 66.73 as compared to the local market (NRs 40.38). The producer's share was higher in the local market chain (87.5%) as compared to the producer's share in the regional market chain (81.73%). The study revealed that the value chain of carp was dominated by the trader. Consumers kept the freshness of the carp under major consideration while purchasing. The major problem faced by the trader was identified as the unavailability of plastic crates. Carp production is a profitable enterprise, yet producers were not realizing potential benefits due to the involvement of middlemen and their dominant role while determining the price. Thus, carp enterprise could be bolstered through government stringent rules and proper policy to determine the price and to customize the efficient marketing channel.

KEYWORDS

Benefit-cost ratio, Cluster sampling, Price spread, Producer's share, Value chain.

1. INTRODUCTION

Aquaculture is a promising sub-sector of agriculture in Nepal which contributes 1.13% to Gross Domestic Product (GDP) and 4.18% to AGDP in 2075/76 (CFPCC, 2018/19). A plethora of water resources makes a country potential for fish farming. Nepal is gifted with enormous aquatic resources that comprise 5.5% of the total land area of the country. However, only 2% of the estimated 826,818-hectare water surface area of Nepal is used for aquaculture and capture fisheries (Husen, 2019). The country has overall production of 91,832 metric tons to which aquaculture contributes 70,831 Mt and capture fisheries contributes 2100 Mt (CFPCC, 2018/19). A recent scenario showed per capita production of fish in Nepal is 3.11 kg during 2018/19 (CFPCC, 2018/19) which is less compared to the national demand. Thus, Nepal imported 9,344 metric tons of fish to ensure the fulfillment of national demand in 2018/19.

There are approximately 29,270 fish ponds in the country. The plain Terai alone shares 95% of total fish ponds and the area dedicated to the fishery sector measures more than 10,718 ha (DOFD, 2017). Bara district alone has a pond area of 1916 ha, pond number of 4340, and productivity of 5.3 Mt/ha which is high compared to national productivity (Super zone profile book, 2075/76). Carp polyculture is by far the most common and popularly used method of fish rearing in Nepal and it is predominant in the Bara district too. In Nepal, 252 fish species are available in various aquatic ecosystems among them 236 are indigenous and 16 exotic fish species (Shrestha, 2019). At present, seven commercially valuable carp species are reared and bred under polyculture and it has provided a new dimension in commercial fish farming in Nepal.

Aquaculture has not fully realized its production potential due to the various production complications and technical glitches involved in the sub-sector. Few constraints like the absence of postharvest centers, cold storage, and processing center have impeded the production potentiality and profitability from aquaculture. Fish being an extremely perishable commodity, marketing issues are indeed a greater threat to the enterprise. The marketing system of Nepal is not so systematic which lacks marketing

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infrastructure and marketing facilities (Husen, 2019). Thus, aquaculture development more or less relies on improved technology and a well-developed marketing system with efficient supply chains. Value chain analysis aids to study the relationship between the different stages of production, processing, and distribution and gives information about the market flow of the products (Bellu, 2013). Thus, this study was conducted to identify the key actors, their associations, and their roles in the development of the carp value chain in the Bara district.

2. METHODOLOGY

2.1 Study area and sampling design

The study was conducted in the Bara district from January to April 2020. A two-stage sampling technique was adopted. Altogether 120 respondents; 45 carp producers, 10 traders (local collector, district collector, local wholesaler, processor, retailer), and 5 consumers, a count of 60 respondents from Simraungadh and Pachrauta municipality on an equal basis were sampled by using a cluster sampling technique. Primary data were collected by conducting field surveys using a pre-tested semi-structured household interview schedule, focus group discussions, key informant interviews, rapid market appraisal, and case study of fish producers. Secondary data were collected from various publications, journals, proceedings, books, and websites. After the collection of necessary data, it was coded and entered in SPSS 25 and was analyzed using STATA 12.1

2.2 Cost and Return Analysis

All the variable inputs incurred in carp production namely pond maintenance, fry/fingerlings, medicine, human labor, fertilizer, electricity/fuel, feed, and miscellaneous were considered and valued at the current market price to estimate the cost of production.
The variable cost was estimated by using following formula:

$$\text{Variable cost} = C_{\text{pond maintenance}} + C_{\text{fry/fingerlings}} + C_{\text{medicine}} + C_{\text{labour}} + C_{\text{fertilizer}} + C_{\text{electricity \& fuel}} + C_{\text{feed}} + C_{\text{miscellaneous}}$$

where,

$C_{\text{pond maintenance}}$= cost of pond maintenance (NRs/ha),$C_{\text{fry/fingerlings}}$ = cost of fry/fingerlings (NRs/ha), C_{medicine} = cost of medicine (NRs/ha), C_{labour} = cost of labor (NRs/ha), $C_{\text{fertilizer}}$ = cost of fertilizer and manure (NRs/ha), $C_{\text{electricity \& fuel}}$ = cost of electricity and fuels (NRs/ha), C_{feed} = cost of feed (NRs/ha), $C_{\text{miscellaneous}}$ = cost of miscellaneous (NRs/ha)

Similarly, the fixed cost was estimated by using the following formula:

$$\text{Fixed cost} = C_{\text{pond construction}} + C_{\text{depreciation}} + C_{\text{farm buildings}} + C_{\text{farm machinery}}$$

$C_{\text{pond construction}}$= cost for pond construction (NRs/ha), $C_{\text{depreciation}}$ = cost of depreciation (NRs/ha), $C_{\text{farm buildings}}$ = cost of farm buildings (NRs/ha), $C_{\text{farm machinery}}$ = cost of farm machinery (NRs/ha)

Depreciation was charged at the rate of 10% per annum on an average for different equipment and machinery used in fish farms like pipes, motor, pump set, generator, boring, aerator, farm buildings, etc. Gross return was calculated by multiplying the quantity of carp produced (kg) with an average price of carp during harvesting (NRs/kg). The undiscounted benefit-cost ratio was estimated as a ratio of gross return to total variable cost. BCR greater than 1 indicates the investment yields profit and feasibility of the enterprise.

BCR was calculated by using the following formula given by (Tunde et al., 2015).

Benefit cost ratio (BCR) = Gross return/total variable cost

The price spread is the difference between the average price paid by the consumer and the price received by the farmers (Buzzell and Beckman,1995). This will be calculated by subtracting farm gate prices from retailer prices.

Price spread = Retailer Price – Farmgate Price

The producer's share is the price received by the farmer expressed as a percentage of the retail price which is paid by the consumer. It can be calculated by the formula as used (Bhandari et al., 2018).

Producer's share (Ps) = $(P_f/P_r) \times 100\%$

where, P_f= Farm gate price, P_r= Retailer price

The index was calculated using the following formula:

$$I = \sum \frac{S_i f_i}{N}$$

where,

I = Index ($0 < I < 1$)
S_i = Scale value at i^{th} severity
f_i = frequency of the i^{th} severity
n = total number of respondents = $\sum f_i$

This scaling technique was used to identify the production problems associated with coffee in the Gulmi and Arghakhanchi districts of Nepal (Bhattarai et al., 2020).

3. RESULTS AND DISCUSSION

3.1 Socio-economic and demographic characteristic

The average of respondents of Simraungadh municipality was 45.36 years and the average age of respondents of Pachrauta municipality was 41.65 years. The average percentage of respondents belonging to Hindu ethnicity was calculated to be 74.8% while 25.2% were categorized to have Muslim ethnicity. Out of the total respondents, 94.6 % were male and only 6.4% were female, indicating the male dominant society. The average percentage of the literate and illiterate respondents was 92.2% and 7.8% respectively. The average pond area in the study premise was 3.02 hectares.

3.2 Species wise stocking density under polyculture [per hectare]

The species-wise seed stocking density per year under polyculture among municipalities-wise carp producers (Table 1). The average fry number of Rohu per hectare per year was 15504 and the fry number of Naini per hectare per year was 198451 for Chhari fish production. The seed stocking density per hectare per year for Bhakur, Silver carp, Bighead carp, Grass carp, and Common carp was 1727, 1757,1321, and 22170 respectively.

Table 1: Species wise seed stocking density per year among municipalities wise carp producers

Variables (per/hectare)	Simraungadh (n=45)	Pachrauta (n=45)	Total (N=90)
Fry no. of Rohu	14833.45(1530)	16174.92(1853.49)	15504(1691.75)
Fry no. of Naini	184885(7246)	212016(6348.26)	198451(6797.13)
Fry no. of Bhakur	351.22(53.32)	365.15(54.34)	358.18(53.99)
Fry no. of Silver carp	1693.56(615)	1761.79(468.70)	1727.68(545.25)
Fry no. of Bighead carp	1664(626)	1850.97(473.73)	1757.53(559.93)
Fry no. of Grass carp	1228.55(847)	1414.77(464.17)	1321.66(685.56)
Fry no. of Common carp	2058.29(706)	2282(538.78)	2170.42(634.81)

Notes: Figures in the parenthesis indicate Standard deviation
Source: Field survey 2020

3.3 Selling Prices of Individual Carp Species cultured under polyculture

The average selling prices of individual carp species under polyculture among municipalities-wise carp producers were shown (Table 2).

Table 2: The selling price of individual carp species among municipalities wise carp producers

Selling price (NRs/Kg)	Simraungadh (n=45)	Pachrauta (n=45)	Total (N=90)
Rohu	262.25(18.73)	254.63(20.50)	258.44(19.61)
Naini	186.45(7.89)	182.05(6.98)	184.25(7.57)
Bhakur	393.44(18.79)	395.56(20.78)	394.50(19.73)
Grass carp	321.78(17.29)	322.38(16.68)	322.08(16.89)
Silver carp	228.91(12.36)	230.47(19.59)	229.69(16.41)
Bighead carp	291.11(15.73)	295.78(7.60)	293.44(12.51)
Common carp	320.1(18.15)	313.80(14.98)	316.93(16.85)

Notes: Figures in the parenthesis indicate S.D
Source: Field survey 2020

3.4 Cost of Production

The average cost of items of variable cost, the total variable cost, total fixed cost, and the total cost incurred per hectare per year in carp production are shown in table3. The average variable cost per hectare in the study area NRs. 1095755 per hectare. The items of variable cost namely pond maintenance cost were NRs. 27100 per hectare, cost of fry/fingerlings was NRs. 122933 per hectare, cost of feed was NRs.767315 per hectare, cost of electricity was NRs. 28187 per hectare, cost of lime was NRs. 4040.67 per hectare, cost of fertilizer/manure was NRs. 12431 per hectare, cost of labor was NRs. 111576 per hectare, cost of medicine was NRs. 7644 per hectare and cost miscellaneous was NRs. 14524 per hectare. The average total fixed cost per hectare was NRs. 848413 per hectare. The total cost of production summing TFV and TVC was NRs. 1944169 per hectare. The average share of variable cost per hectare in the total cost of production was approximately 56.36% and the share of the fixed cost was 43.64% and the finding was aligned (Okpeke and Akarue, 2015).

The result showed among the items of variable cost, cost differences were highly significant with the cost of medicine and cost of pond maintenance at 1 percent level of significance. The cost of fry/fingerlings, cost of lime was found significant at 5 percent level of significance, cost of feed, cost of electricity, cost of labor, and cost of fertilizer were found no significant at all. The total variable per hectare and the total cost of production were found significant at 5 percent level of significance, while the cost of unit production was found significant at 1 percent level of significance.

Table 3: Cost of production among municipalities wise carp producers

Cost (NRs/hectare)	Simraungadh (n=45)	Pachrauta (n=45)	Total (N=90)	Mean Differences	t-value
Pond maintenance	29081(7979)	25120(8632.7)	27100.7(8500.92)	3961.46***	2.66
Cost of fry/fingerlings	120821(9904)	125046(7607)	122933.7(9034)	-4224**	-2.27
Cost of feed	754543.4(74578)	780088.45(69085)	767315.7(71905)	-25545	-1.03
Cost of electricity/fuel	27569(7099)	28806.73(5331)	28187.8(6273)	-1237	-0.94
Cost of lime	4217.89(757)	3,863.46(899)	4,040.67(845)	354.42**	2.02
Cost of fertilizer/manure	12028(3004)	12835.3(2913)	12431.88(2970)	-806.80	-1.30
Cost of labor	118028(18552)	105124.06(16898)	111576.03(17694)	12904	0.71
Cost of medicine	6838.2(2689)	8451.7(3542)	7644.97(3230)	-1613.53***	-2.43
Cost of miscellaneous	13474.6(6844)	15575(6176)	14524.86(6568)	-2100	-1.55
Total Variable cost	1086600.7(121077)	1104910.7(134978)	1095755.8(127357)	-18309.8**	-2.08
Total Fixed cost	935372.9(1309864)	761453.65(165367)	848413.32(932416)	173919.3	1.25
Total cost	2021973(1365861)	1866364.3(253484)	1944169(979896)	207087.32**	2.25
Cost of unit production (NRs/kg)	199.85(14.2)	203.15(7.81)	201.5(11.01)	3.30***	2.52

Notes: Figures in the parenthesis indicate Standard deviation. ***, and ** represent 1% and 5% level of significance.
Source: Field survey 2020

The maximum percentage share of the variable cost was found to be the cost of feed i.e. 70% followed by the share of the cost of fry/fingerlings (11.22%), cost of labor (10.2%), cost of electricity/fuels (2.57%), cost of pond maintenance (2.4%), cost of miscellaneous (1.32%), cost of medicine (1.16%) and cost of fertilizer/manure (1.13). This finding was aligned with who have found a similar result of a 67% share of feed cost and a 13% share of seed on the operating cost (Macfadyen et al., 2012).

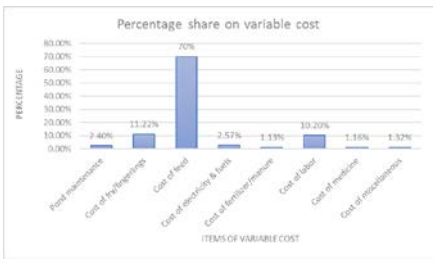

Figure 1: The percentage share of items of variable cost

Figure 2 showed the share of items of fixed cost on the fixed cost per hectare for carp production. The maximum share was contributed by the cost of pond construction i.e. 80.30 % of the fixed cost followed by a share of a farm building (4.97%), farm machinery (3.93%), and depreciation (1.08%).

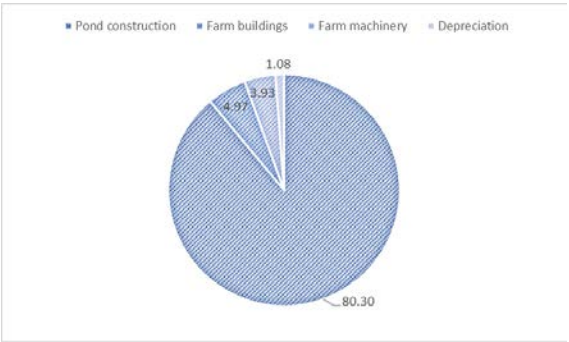

Figure 2: The percentage share of items of fixed cost

3.5 Benefit-Cost Ratio Analysis

The total variable cost per hectare, gross revenue per hectare, and benefit-cost ratio among the municipalities-wise carp producers were shown in table 4. The gross revenue per hectare was NRs. 1928528 which was significant at 5 percent level of significance. The BCR in the carp production was 1.76 which was also significant at 5 percent level of significance. The BCR of 1.76 represents carp production was a profitable enterprise in the study area. The result was consistent with who has found a BCR of 1.88 in the fish farming enterprise using a government credit agency loan in the Ogun State of Nigeria (Olaoye et al., 2012). The result was also aligned with, where BCR from fish farming was found to be 1.9 indicating fish farming as a highly lucrative enterprise (Tunde et al., 2015). A similar result was found (Adewuyi et al., 2010). The finding was aligned with, who reported a BCR of 1.97 for Chhari production and a BCR of 1.67 for Marketable-size carp in Bara district, Nepal (Adhikari et al., 2019). Further, a similar figure was reported in Sharma *et.al.* (2018) indicating B:C ratio of 1.63 for fish farming in the Chitwan district.

Table 4: Comparative total variable cost, gross revenue, and b:c ratio among municipalities wise carp producers

Cost (NRs/ha)	Simraungadh (n=45)	Pachrauta (n=45)	Total (N=90)	Mean Differences	t-value
Total Variable cost	1086600.7(121077.5)	1104910.7(134978)	1095755.8(127357)	-18309.8**	-2.08
Gross revenue	1977612(256412)	1878348.2(138923.5)	1928528.8(209021)	99264**	2.02
B:C ratio	1.82(0.35)	1.70(0.20)	1.76(0.29)	0.12**	1.98

Notes: Figure in the parenthesis indicates S.D. ** represents 5% level of significance
Source: Field survey 2020

3.6 Value Chain Analysis of Carp Production

A value chain analysis is the collaboration of activities and services required to bring a product and services from production to the consumption or its end-user (Kaplinsky and Morris, 2001). Input suppliers, producers, processors, traders (includes local collectors, wholesalers, retailers) and consumers are the actors involved in the value chain of carp. Analysis of the carp value chain was done to investigate the links and information flow within the chain, problems intertwined within the chain. The major actors were recognized along with their relationship, as well as value addition involved in each stage of the chain.

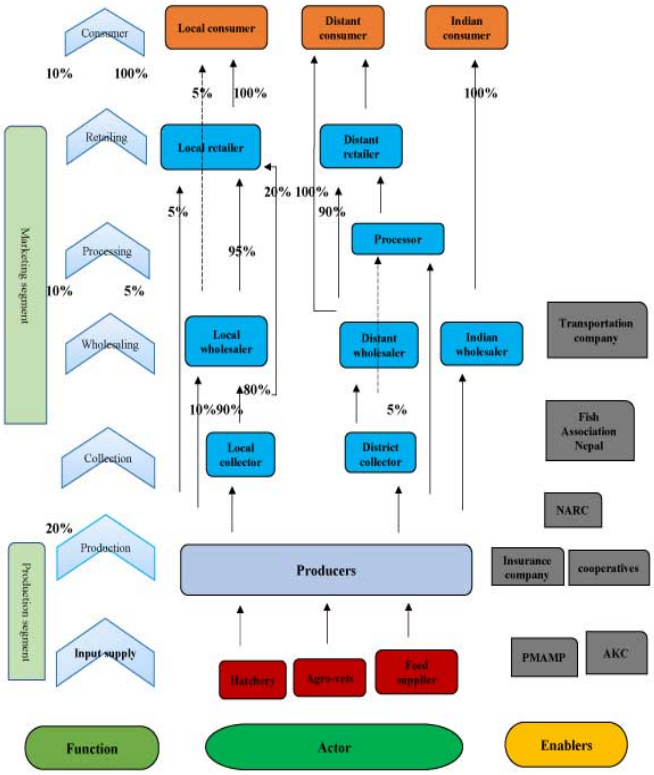

Figure 3: Value chain mapping of Carp

3.7 Price spread and Producer share in different market chains

3.7.1 Price spread and Producer Share in the Local market

This value chain described that the average cost of unit production of carp (average of Simraungadh and Pachrauta) was NRs 201.5 per kilogram (Table 3). The change in value at different nodes/chain is presented in figure 4.

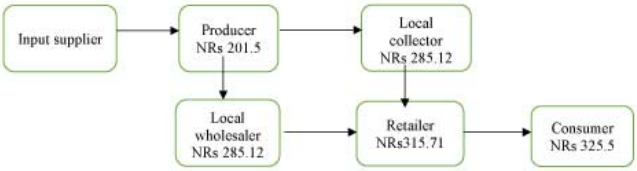

Figure 4: Value chain in the local market (Field survey 2020)

The price spread (PS) was,

PS= Retailer price (Pr) – Farm gate price (Pf)

= 325.5 – 285.12 = NRs 40.38

Similarly, producer's share = Pf/Pr * 100 =285.12/325.5 * 100

= 87.5 %

3.7.2 Price spread and Producer Share in the Regional market

This value chain described that the average cost of unit production of carp (average of Simraungadh and Pachrauta) was NRs 201.5 per kilogram (Table 3). The change in value at different nodes/chains was presented (Figure 5).

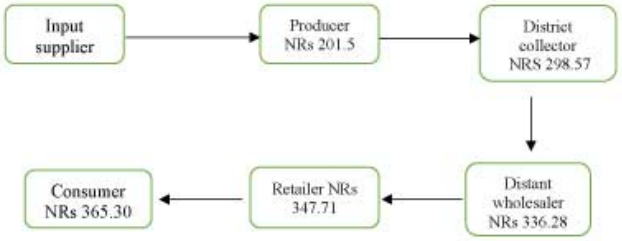

Figure 5: Value chain in the regional market (Field survey 2020)

The price spread (PS) was,

PS= Retailer price (Pr) – Farm gate price (Pf)

= 365.30 – 298.57= NRs. 66.73

Similarly, producer's share = Pf/Pr * 100 = 298.57/365.30 * 100

= 81.73%

3.8 Trader

3.8.1 Percentage of carp sold by the trader to customer

The percentage of carp sold by the trader to customer namely Wholesaler was 80%, followed by Retailer (12%), Processor (5%), and Consumer (3%) (Figure 6)

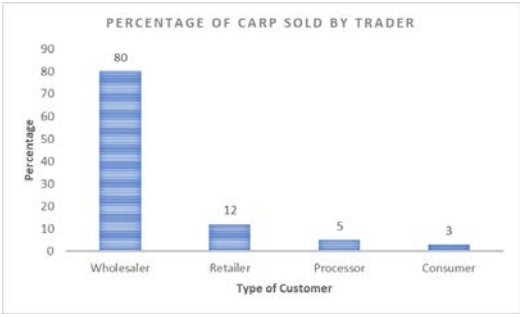

Figure 6: Percentage of carp sold to different customer

3.8.2 The operation carried out when the entire product is not sold

The study revealed 50% of the trader used to store the product when the entire product was not sold followed by 30% performing price cut and 20% were compelled to waste the product (Figure 7)

Figure 7: Operation performed when the entire product is not sold

3.8.3 Percentage share on marketing cost

The percentage share of different items on the marketing cost was showed (Figure 8). Transportation cost contributing the highest share of 50% followed by labor cost (20%), storage cost (15%), grading, and packaging cost (10%), and rent cost (5%) on the marketing cost. The maximum share being contributed by the transportation cost.

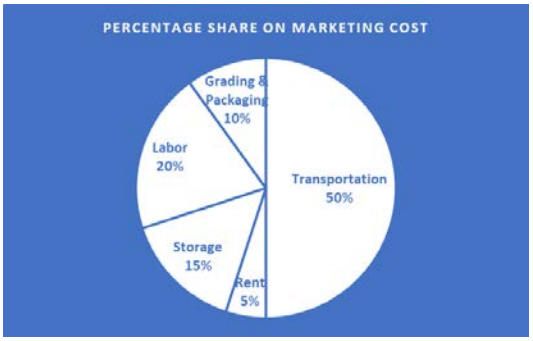

Figure 8: The percentage share of different items on marketing cost

3.8.4 Buying and Selling Prices of Individual Species of the Carp for Trader

The buying and selling prices of different species of carp under polyculture were presented (Figure 9).

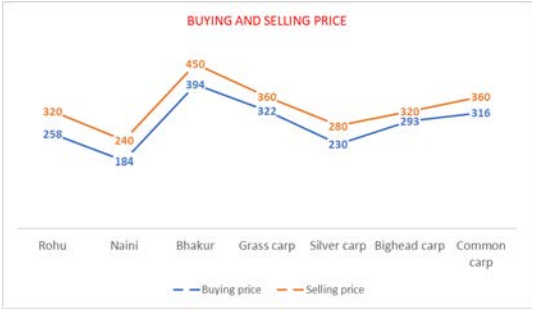

Figure 9: Buying and Selling prices of different carp species

3.8.5 Percentage of Different Processed Product

The study revealed 40% of the processor formed Sukuti, 25% formed Sun-dried products, 20% formed Pickle, and 15% Smoked products (Figure 10).

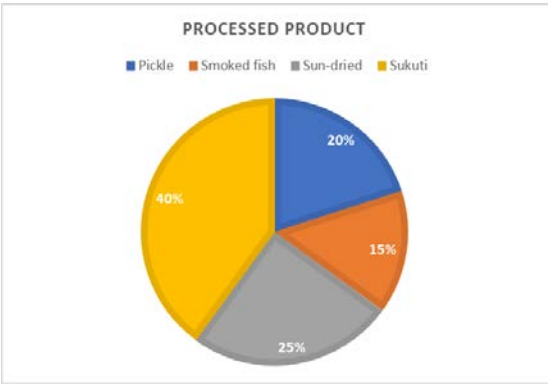

Figure 10: Percentage of different processed product

3.9 Consumer

3.9.1 Frequency of Fish Consumption

In the study area, 60% of the consumer consumed fish weekly followed by the percentage of consumer consuming Daily (20%), Fortnightly (10%), and Monthly (10%) (Figure 11).

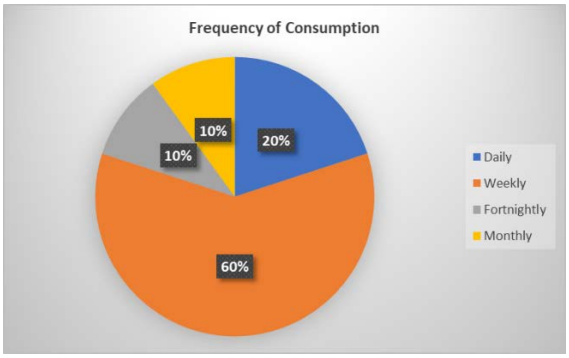

Figure 11: Frequency of fish consumption

3.9.2 Things consider by Consumer while purchasing

The study revealed 50% of the consumer considered freshness while purchasing the fish, 25% considered price, 15% considered species, and 10% considered size (Figure 12).

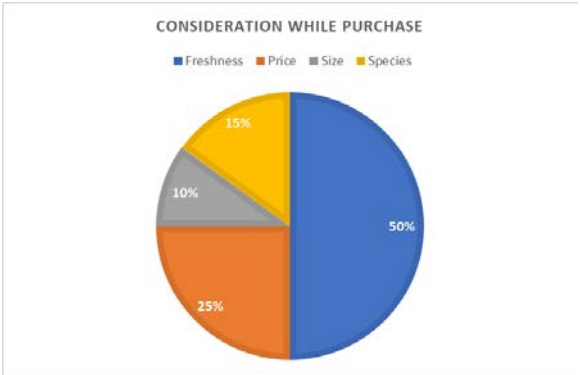

Figure 12: Things under consideration while purchase

3.10 Indexing of problems faced by the trader

Five of the major problems faced by carp traders were identified from the face-to-face interview schedule. Carp traders were asked to rank these problems based on severity. A five-point scaling technique (1, 0.8, 0.6, 0.4, and 0.2) was used to measure the relative severity of those problems.

The unavailability of plastic crates was identified as the first major problem faced by a trader with an index value of 0.91. Followed by this, the indices revealed a scarcity of ice (0.82) for longer fish storage; transportation loss (0.68), product scarcity (0.28), and lack of capital (0.25) were the latter serious constraints as ranked by the carp trader in the study area.

Table 5: Problems faced by the trader

Problems	Index Value	Ranking
Unavailability of plastic crates	0.91	I
Scarcity of ice	0.82	II
Transportation loss	0.68	III
Product scarcity	0.28	IV
Lack of capital	0.25	V

4. Conclusion

The study showed that carp production was a lucrative enterprise. However, the producer was still not realizing the potential benefit from the enterprise due to the active involvement of middlemen and their predominant role in determining the prices. The traders were compelled to face the unfortunate unavailability of plastic crates. This problem of traders must be resolved immediately by the concerned authority. The value chains had a minority of processors and the value addition of product employing processing technique had been marginal. Private initiatives were reluctant to establish fish processing factories mainly due to the fear of under capacity (shortage of fish for processing in the factory) utilization and the unwillingness of the consumers to accept processed fish. Thus, the proper study of consumer's preferences and production of carp must be escalated to assure the establishment and initiatives of private sectors. Refrigerated storage facilities must be developed in assembling centers so that the perishability of fish could be checked. Furthermore, the involvement of intermediaries could be minimized through better road networks and strict market regulation. Thus, the government should step forward with effective stringent rules and regulations and an efficient marketing channel was identified as an immediate need of the time.

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Author's Contribution

S.B designed and performed experiments; S.B, B.S, P.D, S.A, S.P, and C.B analyzed the data and S.B prepared the manuscript in consultation with D.K.J; D.K.J approved the final manuscript.

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