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RESEARCH ARTICLE

VALUE CHAIN ANALYSIS OF FISH IN KARAIYAMAI RURAL MUNICIPALITY, BARA DISTRICT OF NEPAL

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ABSTRACT

The research entitled “Value chain analysis of fish in Karaiyamai Rural Municipality, Bara district of Nepal” was conducted in 2020 focusing on the chain of actors involved in supplying inputs to the farmers and thereby supplying finished product to the ultimate consumers through various market intermediaries. The survey research design was used for the study where respondents (60 farmers of Karaiyamai Rural Municipality and 15 traders of Jeetpursimara Sub-Metropolitan City) were selected using simple random sampling techniques. Primary data was collected using pre-tested semi-structured questionnaire and secondary data were obtained from various articles and related documents. Descriptive statistics and indexing techniques were used for the analysis of data for which MS-Excel and SPSS-23 were used. Average cost of production was NRs. 996516.92/ha. The average productivity of fish in the study area was highest (7024.42 Kg/ha) than the national average productivity (4920 Kg/ha), and district average (5298 Kg/ha). Various production and marketing problems were faced by respondents as untimely availability of inputs, poor water supply units, and poor storage facilities. Despite these problems, the fish production was a profitable business (B: C ratio: 2.01) with high gross margin value. The marketing channel of input suppliers – producers – wholesalers – retailers – consumers was found effective. There was a low marketing margin and higher producer share on the retail price that indicates an efficient market system. Hereby, the study of value chain actors and construction of value chain map symbolizes; there are good prospects of fisheries business with commercialization and risky but profitable enterprise.

KEYWORDS

Fish, Value chain, Cost, Productivity, B/C Ratio, Marketing Channel

1. INTRODUCTION

1.1 Background Information

As Nepal is the second richest country in terms of water resources, rich in natural resources, and climatically suitable for fish farming; fisheries seem to be a gold mine for Nepal. It contributes 4.29 percent to Agricultural Gross Domestic Production (AGDP) and 1.34 percent to national GDP (CFPCC, 2020). But due to the under-utilization of these resources, the quantity of fish produced in Nepal is insufficient as compared with world fisheries production (Mishra & Kunwar, 2014). Thus, the sole body i.e. Directorate of Fisheries Development of the Department of Agriculture develops and implements national fisheries and aquaculture development plans and policies to help the country grow economically and reduce poverty by promoting an inclusive, equitable, and ecosystem-based approach to aquaculture (Gurung et al., 2012).

Fisheries in Nepal began in the mid-1940s, with the culture of major indigenous Indian carps’ in ponds while the actual development started in the 1980s with the execution of the Aquaculture Development Project supported by the Asian Development Bank (ADB) and program of the United Nations (UNDP) (FAO, 2005-2021). Nepal has a diverse fish population, with 200 species available, of which nearly 190 are indigenous while the remainder is exotic species (FAO, 2005-2021). The commercially cultured fish species in Nepal are listed below. Several other species can

be found in the country but they are not commercially cultured.

Table 1: Commercially cultured fish species in Nepal

S.No	Types of species	Fish species
1.	Indigenous major carps’ (3)	Rohu - Labeo rohita, catla - Catla catla and Naini/mrigal - Cirrhinus mrigala
2.	Exotic species (2)	Rainbow trout (Oncorhynchus mykiss), common carp – (Cyprinus carpio)
3.	Chinese carps (3)	Grass carp – Ctenopharyngodon idella, Silver carp - Hypophthalmichthys molitrix, and Bighead carp - Aristichthys nobilis

Source: (FAO, 2005-2021).

Eastern terai produces and yields more fish than western terai, but hills only contribute moderately to total fish production (Budhathoki & Sapkota, 2018). The total national fish production is currently 83,897 mt, with capture fisheries accounting for 25% and aquaculture accounting for 75% (CFPCC, 2020). The annual per capita fish consumption in Nepal has increased from 0.33 kg in 1982 to 2.75 kg at present (Kunwar, 2020) but is far less than other Asian countries, for example, India (5 Kg), Bangladesh

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(12 Kg), Laos (15 Kg), Vietnam (20 Kg), Cambodia (25 Kg) and Thailand (30 Kg) (FAO, 2008); thus, increasing the consumption of fish will complement to staple grains as food security continues to pose challenges in Nepal. In addition to its value as a supplement to Nepalese diets, fish is also a desirable source of protein, essential biochemical such as vitamins A, B, omega-3, and other important minerals such as calcium and phosphorus (WorldFish Center, 2008). Bara district is the leading district in terms of fish production in the country which can be illustrated from the table below.

Rank	Districts	Fish Production (%)
1.	Bara	18.5
2.	Saptari	10.3
3.	Chitwan	8.6
4.	Dhanusha	8.6
5.	Rupandehi	8.4
6.	Rautahat	7.4
7.	Parsa	5.5
8.	Siraha	4.6
9.	Morang	3.6
10.	Sarlahi	3.5

Source: (Budhathoki & Sapkota, 2018)

The value chain is the most important phenomenon in fisheries such that the produced fishes by the farmers go through the various market intermediaries (wholesalers, retailers), processed in processing industries, and ultimately consumed by the consumers where at each stage value is added to the product (Nasr-Alla et al., 2012). Agricultural value chain analysis is guided by the major four concepts that are effective demand, production, value chain governance, and upgrading (process, product, function, and chain upgrading to minimize risks (Burns, 1986). The local fish markets development in Nepal plays a very important part in the development of the aquaculture sector and comprises 1681 markets registered for fish selling and 22,406 farmer's pond sites, and 69 live fish selling stalls for the selling of live fish in Nepal (Khanal et al., 2020).

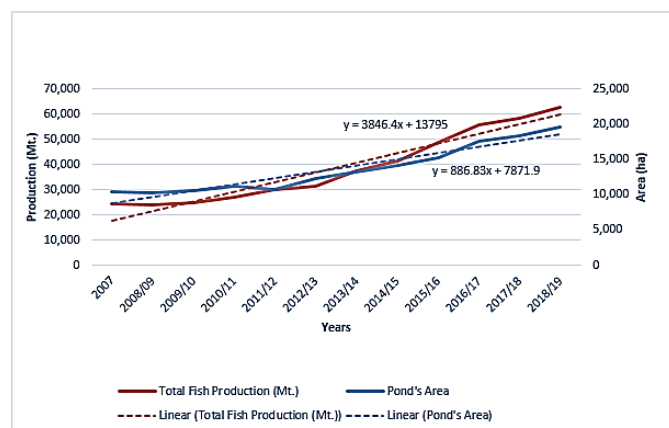


Figure 1: Trend analysis of area and production of fish in Nepal

Source: (MOALD, 2020)

Year	Pond's No.	Water Surface Area (Ha)	Total Fish Production (Kg)	Productivity Kg/Ha
2014/15	3485	995	5163560	5190
2015/16	3,576	1,077.34	5,819,314	5,402
2016/17	4126	1243	6717846	5,403
2017/18	4275	1363.67	7399909	5426
2018/19	4290	1488.67	7886702	5298

Source: (MoAD, 2014, 2018; MOALD, 2020)

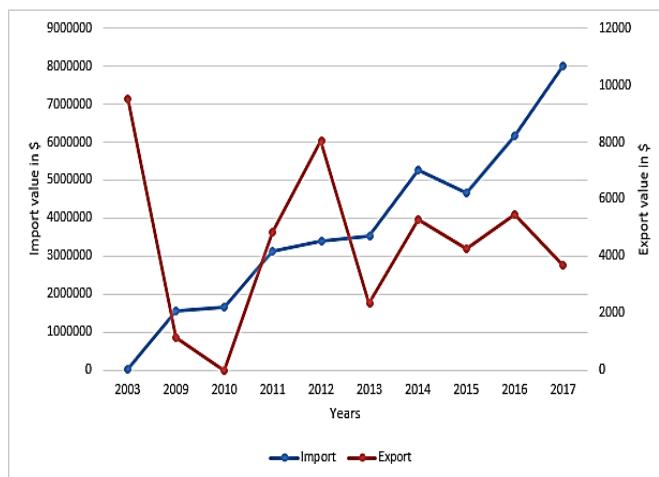


Figure 2: The trend of fish export and import in Nepal in terms of value in the US \$

Source: (TradeEconomy, 2021)

1.2 Statement of problem

Despite its great relevance in regional countries for food and food security, biodiversity protection underwater, governance, job prospects, and sustainability, the fisheries sub-sector in Nepal is one of the most overlooked aspects of agriculture (Gurung et al., 2011). The fish producers in the Bara district still use subsistence technology for production which limits the total yield and forced them to import from neighboring countries. Since fresh whole fish gets a significant market price, value addition through processing is not common (Kumari, 2015). The suppliers in the district buy at a low price from the farmers and fetch a high price in the market. Farmers seem unable to obtain fry and fingerlings from either private or government hatcheries reliably and cost-effectively. Due to low production, fish consumption in Nepal is towards the bottom relative to other Asian countries, at about 2.7 kg per person per year (FAO, 2018). Hence, the absence of modernized hatcheries, unorganized marketing, poor infrastructural facilities and networking, improper marketing channels, poor cold chain maintenance facilities are the major constraints hampering the value chain of fish in Nepal.

1.3 Rationale of the study

One of the important factors for the overall growth of the fish sub-sector is the link-up of various market intermediaries (wholesalers, processors, retailers) involved in the value chain and supplying through appropriate channels and at a fair price. Thus, if the awareness can be raised among value chain actors through extension, technical support, agricultural mechanization, and marketing security, the overall value chain map of fish can be managed and this district will be self-reliant in aquaculture and can reduce the import status within the next few years. Planners, policymakers, producers, and investors can utilize the study's findings to establish policy, strategy, and plans for the continued success of the fisheries sub-sector.

1.4 Objectives of the study

Broad Objective

To analyze the overall value chain of fish in the fish block at Karaiyamai Rural Municipality in Bara district.

Specific Objectives

- To identify and assess actors across the fish value chain and analyze the structure of the value chain map.
- To assess the economics of production and marketing of fish in Karaiyamai Rural Municipality.
- To assess various prospects and problems on the production and marketing of fish.

1.5 Scope and Limitation of the study

The study was carried out in the Karaiyamai rural municipality of Bara, which is the Fish Block area in the district under PMAMP. As Bara district is the leading fish-producing district in Nepal, this region has great potential to increase and improve its aquaculture with an increase in

production, cost reduction, and profit maximization; which could provide benefits for the country. It studies the socio-economic status of the farmers along with various marketing details about costs, returns, profitability, and production and marketing problems; thereby develops various strategies consulting with planners, policymakers, project implementers, and donors to formulate policy, strategy, and plan for the overall development of fisheries sub-sector.

The major limitation in my study is resulted due to the outbreak of the pandemic COVID-19 that reduces my exposure to the research site and limits the time of the survey. The amount of information that I wished to collect was not able to be taken due to the long-term ongoing lockdown in the country. Similarly, the coverage is limited for the research site; the conclusion drawn from the research may not be taken as a generalization for other areas of the district. The size of the sample taken may not be adequate. The information's validity is based on an assumption that the interviewees provided accurate information. Likewise, the non-response cooperation from farmers, stakeholders, and line agencies, political instability were some constraints to conduct its plans and programs efficiently.

2. RESEARCH METHODOLOGY

2.1 Selection of study area

As per the decision made by Agriculture and Forestry University, Rampur to involve the 8th-semester students of B. Sc. Ag in the Learning for Entrepreneurial Experience (LEE) program and accordingly on the agreement made with Prime Minister Agriculture Modernization Project (PM-AMP), I was provided with an opportunity to perform as Agri-intern in the Fish Block Implementation Unit, Bara, under PMAMP for 6 months period.

Among Nepal's 77 districts, Bara district located in Province 02, with a total area (1,190 km square) and a population of 687,708 people as of 2011 (Wikipedia, 2021). Climatically, the major area of Bara (86.6%) falls under the lower tropical zone (below 300 meters) while a small portion (13.4%) falls under the upper tropical zone (300 to 1000 meters) (Wikipedia, 2021). Among nine rural municipalities in the Bara district, Karaiyamai rural municipality is selected as the study area as it is the fish block in the Bara district.

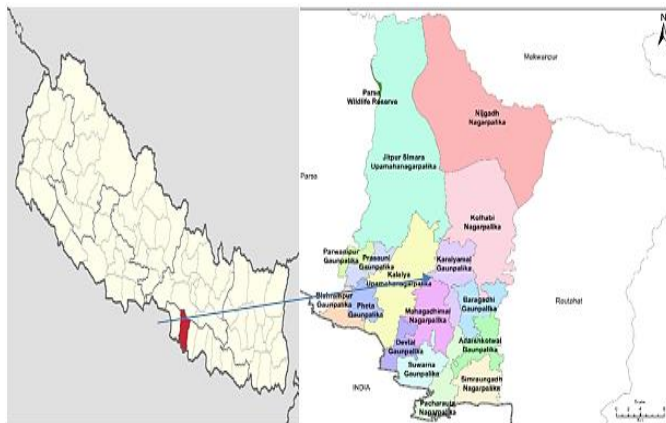


Figure 3: Map of the study area

Source: (Wikimedia, 2020; Wikipedia, 2017)

2.2 Preliminary Study

Generally, a preliminary study is an important source of gaining knowledge through direct observations and informal talk with the farmers and traders. It was done to know the feasibility of the research. It provided information on various aspects of fisheries that were helpful in the preparation of the questionnaire.

2.3 Research Instruments

2.3.1 Interview schedule

The interview schedule was prepared for gathering the information for value chain development from each commercial fish growing farmer and fish seller. The schedule script was prepared in the English language and questions were asked in the Nepali and Bhojpuri language.

2.3.2 Pre-testing of an interview schedule

To check the reliability and validity of the interview schedule, the pre-testing was done before the field survey and on that basis, necessary adjustments were made as per the requirements in the schedule. 5 percent of farmers in the field were administered the interview schedule.

2.3.3 Field Survey

The fish farmers at my research site were selected using a simple random sampling method. They were face to face interviewed to collect information on the production system, production problem, market system, market price, and market problems. During the survey, the growers and sellers were asked a series of open and closed-ended questions. 60 producers from Karaiyamai Rural Municipality were randomly selected from the population of 180 registered fish producers.

2.4 Data and Data types

The data was collected using both primary and secondary means. The primary data collection was done through the set of questionnaires for the household survey. The interview schedule was prepared and finally, the field survey undergoes once it was pre-tested. Similarly, the secondary data collection was done through the study of literature, related supportive documents, annual reports of the fish super zone at Simraungadh, Bara; publications from other institutions such as the Directorate of Fisheries Development (DOFD), Food and Agriculture Organization (FAO), Central Fisheries Promotion and Conservation Center (CFPCC), Agriculture and Forestry University (AFU) strategies, and plans, etc.

2.5 Data analysis techniques

The collected data was analyzed by using some of the scientific techniques such as MS-Excel and SPSS. Other descriptive statistics such as graphs, charts, and other tools were used for the analysis of data.

2.5.1 Economic Analysis

2.5.1.1 Total Cost of production

It is the total cost required for running an enterprise and can be computed as the sum of variable cost and fixed costs (Thakur, n.d.).

$$\text{Total Cost (TC)} = \text{Fixed Cost (FC)} + \text{Variable Cost (VC)}$$

2.5.1.2 Gross return/Net returns

Gross return or net sales is the amount of money generated from sales for the period (Bloomenthal, 2021).

It is computed as;

$$\text{Gross Return} = \text{Total quantity marketed (KG)} * \text{Unit price (NRs.)}$$

2.5.1.3 Gross margin analysis

Gross margin is the company's net sales revenue minus its cost of goods sold (COGS) (Bloomenthal, 2021). It is computed as;

$$\text{Gross margin} = \text{Net sales} - \text{Cost of goods sold}$$

2.5.1.4 Benefit-cost analysis

The benefit-cost analysis will be done after the calculation of the total variables cost and gross return from the fish production and marketing. It is computed as;

$$\text{B/C ratio} = \text{gross return} / \text{total cost}$$

2.5.1.5 Marketing margin

The marketing margin refers to the difference between the price at which a good is purchased from producers (price obtained by the producer) and the price at which it is sold to the consumer (price paid by the consumer) (Smyth, 2019).

It is computed as;

$$\text{Marketing Margin (Mm)} = \text{Retailer's price (Price paid by the consumer)} - \text{Farm Gate Price (Price obtained by the producer)}$$

2.5.1.6 Producer's Share

Producers' share is the proportion of the price received by the farmers that are paid by the consumer (Narasalagi & Shivashankar, 2018). Producers' share is computed as:

Producer's Share (Ps) = (Producer's net selling price/consumer's price)* 100

2.5.2 Indexing techniques

The various ranking questions were analyzed based on indexing. The index value was identified and based on that higher the index value, a high rank was given. Farmers' perceptions of the importance of production and marketing problems were analyzed by using a 5-point scale of problems such as very high, high, medium, low, and very low by using 5, 4, 3, 2, and 1, respectively. This total score indicates the respondent's frequency on each problem and by using the formula; the index of importance was calculated (Timsina & Shivakoti, 2018).

$$I_{imp} = \sum (S_i * f_i / N)$$

where I imp=Index of importance,

∑=Summation

S_i=Scale value

f_i=Frequency of importance given by the respondents

N= Total numbers of respondents

3. RESULTS AND DISCUSSION

This section includes the analysis of all the data collected through a field survey. Based on the analysis, the results are summarized and interpreted.

3.1 Socio-economic characteristics of respondents

Socio-economic characteristics of farmers include age, gender, religion, ethnic group, educational level, main and off-farm income occupation, marital status, family type, distribution of economically active population, pond possess, category, and distribution.

3.1.1 Age category of the respondents

During the survey, the majority of the respondents (35 percent) were 35 to 45 years while few were less than 25 and more than 65 years.

Age category farmers	Frequency	Percent
Less than 25 years	2	3.3
25-35 years	14	23.3
35-45 years	21	35.0
45-55 years	9	15.0
55-65 years	12	20.0
More than 65 years	2	3.3
Total	60	100.0

3.1.2 Gender of the respondents

Among 60 farmers selected for the household survey, the majority of information providers were male with 80 percent (48 respondents) and fewer were female with just 20 percent (12 respondents). This shows that there were high participation and dominance of male than female.

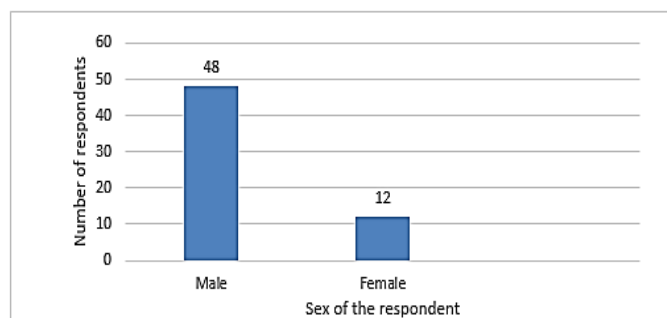


Figure 4: Bar diagram showing the participation of both sexes in farming

3.1.3 Religion of the respondents

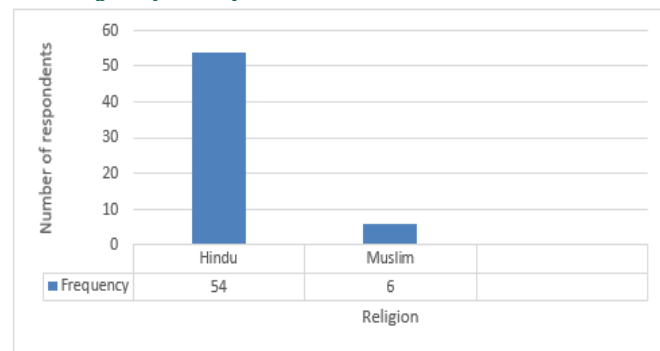


Figure 5: Religion followed by the farmers

The data shows that Karaiyamai Rural Municipality had a wide number of populations (about 90 percent) who follow the Hindi religion with a few about 10 percent who follow the Muslim religion. None of the people were found following Buddhism and Christianity.

3.1.4 Ethnicity of the respondents

Karaiyamai Rural Municipality, one of the major areas in the Terai region is highly crowded by people of varying ethnicity that includes Janjati/Indigenous, Dalit, and Madhesi. Our survey shows there were no Brahmins and Chhetries on the research site. It consists of 50 percent of the farmers from Janajati, 33.3 percent from Madhesi, and a few from the Dalit and Muslim communities. The people with major castes were Chaudhary, Sahani, Raut, Shah, Yadav, Kushwaha, Jaiswal, Dhama, Ram, Kanu, Ansari, and so on.

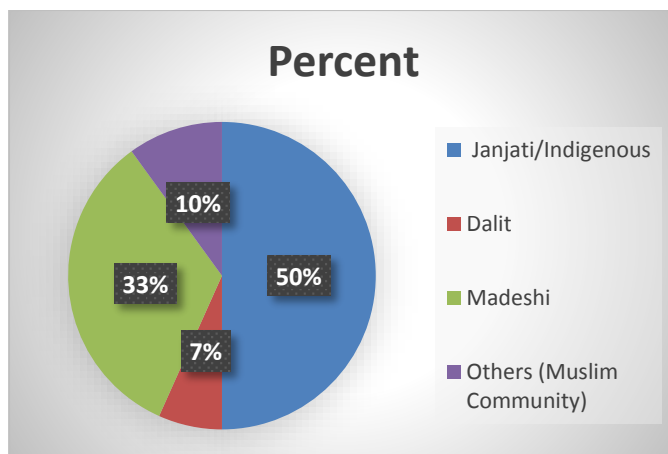


Figure 6: Pie-Chart showing the ethnicity/caste of the farmers

3.1.5 Level of education of the respondents

Survey data of 60 households shows that most of the farmers (more than 50 percent) were well educated since they had completed SLC and higher studies. Similarly, around 30 percent were able to read, write, gained primary and secondary studies up to 8, and less than 20 percent of the farmers were illiterate. From this data, it makes us clear that most of the farmers are well aware of fish farming techniques, commercialization, and arousing problems. For further enhancement of this sub-sector, the educational status must rise with zero illiteracy rate.

Level of education of the farmers	Frequency	Percent
Illiterate	11	18.3
Literate	7	11.7
Primary class up to 5	7	11.7
Lower Secondary up to class 8	3	5.0
SLC	23	38.3
+2/Certificates	6	10.0
Bachelors and above	3	5.0
Total	60	100.0

3.1.6 Occupation of the respondents

Occupation comprises the main occupation and off-farm income source occupation. Our household survey shows that the main occupation of farmers was agriculture with 93.3 percent involved in it. Similarly, the off-

farm income source occupation other than agriculture was business. According to them, relying only on agriculture won't satisfy their needs, and the majority of the farmers were involved in the business. Our survey shows 88.3 percent of the households were involved in the business (53).

Table 5: Table showing the occupation of the fish farmers

Main Occupation	Frequency	Percent	Off-farm income source	Frequency	Percent
Agriculture	56	93.3	Business	53	88.3
Business	2	3.3	Service	6	10.0
Service	2	3.3	Wage Labor	1	1.7
Total	60	100	Total	60	100

3.1.7 Marital Status of the respondents

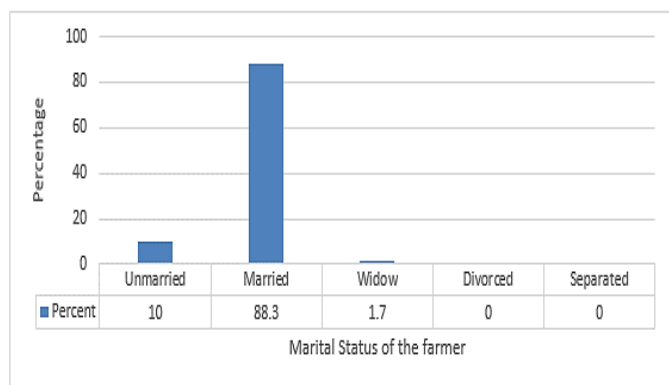


Figure 7: Bar diagram showing the marital status of the farmers

The survey shows that 88.3 percent i.e. 53 respondents were married, followed by 10 percent unmarried and only 1.7 percent widow (Figure 7). None of the respondents were found either divorced or separated. The married life was found successful with no cases of divorced and separation. The unmarried ones are at a good level of study and career.

3.1.8 Types of family and family size

Generally, there exist two different types or sizes of a family named a Joint family with a large number of family members (more than 4 family members) and a nuclear family with less than 4 family members. The survey shows that out of 60 families, 45 were joint and only 15 were nuclear. A large number of people in a family result lack of facilities with more mouth for consumption.

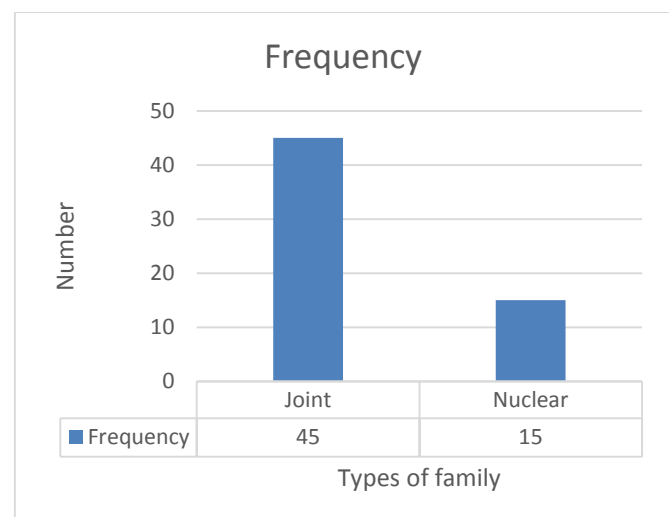


Figure 8: Bar diagram showing different types or sizes of family.

3.1.9 Distribution of economically active population

The age group of the farmers was categorized into 3 groups as below 16 years, 16 to 59 years (known as economically active population), and above 60 (Table 7). Our survey shows that 27.41 percent of the respondent family members were below the 16 years of age group, 57.86 percent of the respondent family members were economically active population and 14.72 percent of the respondent family members were above 60 years age group. As the economically active population was higher in number, there

seems to be a good future of fisheries business to be handled by the active populations.

Table 6: Distribution of economically active population

Age Group	Frequency	Total Frequency	Percentage
Below 16 male	53	108	27.41
Below 16 female	55		
Between 16 to 59 male	109	228	57.86
Between 16 to 59 female	117		
Above 60 male	29	58	14.72
Above 60 female	29		
Total	394	394	100

3.1.10 Pond possesses by the respondents

The study at Karaiyamai Rural Municipality shows that most of the farmers had their pond, few of them had both self and lease pond and minor of them had a pond on lease. It was found that 88.3 percent of the farmers have their land, 10 percent have both and only 1.7 percent have a pond on lease. Farmers who possess both types of ponds were highly business-oriented (Table 8).

Table 7: Pond possesses by the farmers

Pond possess by the farmers	Frequency	Percent
Self	53	88.3
Lease	1	1.7
Both	6	10.0
Total	60	100.0

3.1.11 Category of the respondents according to the pond holding size

Among the 60 farmers in Karaiyamai Rural Municipality at Bara district, there were all three categories of farmers as large scale, medium scale, and small-scale farmers. Those with 1 or more than 1-hectare pond area were called a large scale, with more than 0.5 to 1 hectare was called medium scale and with less than 0.5 hectares were called as small-scale farmers. There were 23 percent medium-scale and 25 percent large-scale farmers with the domination of small-scale farmers by more than 50 percent.

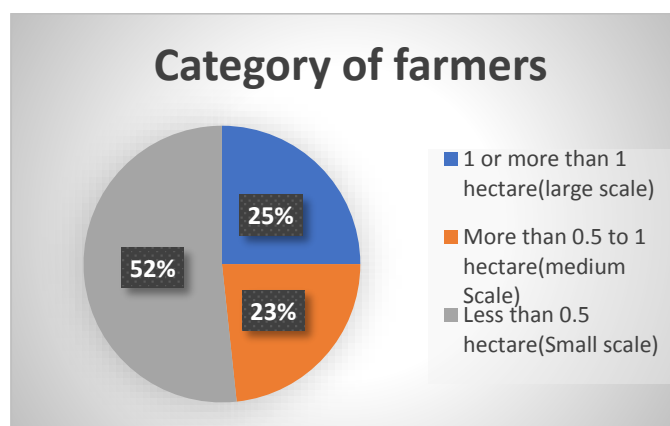


Figure 9: Category of the farmers according to the pond holding size

3.1.12 Respondent's experience in fish farming

Among the 60 farmers surveyed, the majority of farmers (40 percent) have experience of 5 to 10 years in fish farming, and the most experienced team of more than 20 years are limited in the research site which accounts for 13.3 percent of households. From this, it makes clear that the involvement of youths was increasing in this sector as most of them were in the early phase of gaining maximum experience.

Experience in fish farming	Frequency	Percent
0-5 years	10	16.7
5-10 years	24	40.0
10-15 years	9	15.0
15-20 years	9	15.0
More than 20 years	8	13.3
Total	60	100.0

3.1.13 Total pond area distribution

The average pond holding size of the sampled household was 0.99 hectares (medium scale). There was less area for nursery pond construction.

Description	Minimum	Maximum	Mean	Std. Deviation
Area of production pond (earthen) in ha	.06	12.00	.90	1.65
Area of nursery pond (earthen) in ha	.00	1.33	.09	.20
Total pond area in a hectare	.06	13.33	.99	1.85

3.2 Inputs and services

3.2.1 Source of water in the pond

Our research shows that the farmers at the fish block used four different sources of water in the pond as boring, deep tube well, rainfall, and canal/stream for the growth and development of fish. It was found that the majority 43.3 percent of households used boring and fewer than 10 percent used rainfall as a source of water in the pond.

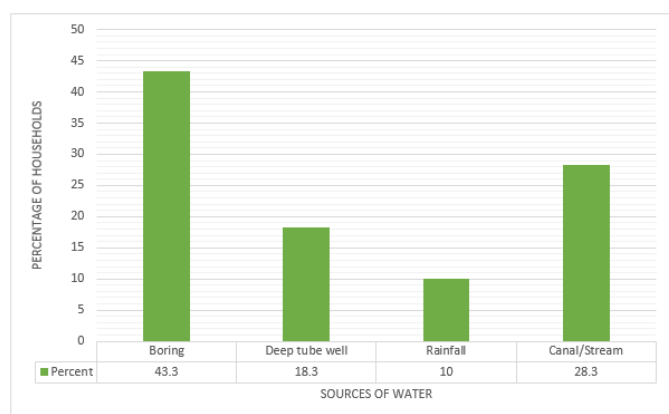


Figure 10: Bar diagram showing various sources of water for pond irrigation

3.2.2 Sources of fish seed

There were various sources of fish seed to purchase to start fish farming. The data among the sampled household shows that majority of the farmers purchased seed from the private hatchery (43.3 percent).

Sources	Frequency	Percent
Government hatchery	13	21.7
Private Hatchery	26	43.3
India	2	3.3
Gov and Pvt hatch	7	11.7
Gov and India	5	8.3
Pvt and India	4	6.7
All three hatchery	3	5.0
Total	60	100.0

3.2.3 Feed

3.2.3.1 Type and amount of feed

The household survey among 60 respondents shows that the type of feed ingredients provided to the fish in the Fish block consists of major proportions of mustard oil cake and rice bran. Almost all the household use the mixture of these two feeds. Together with it, very few of them used wheat flour and the use of cow dung was also found a good practice. Other feed ingredients such as Fish meal, maize flour, and soybean cake were not found to be used by any of the sampled households. The average amount of total feed ingredients given to fish per hectare per year in kg as per the survey was found to be 15828 Kg/ha/yr. The minimum and maximum amount of feed were found to be 2380 Kg/ha/yr. and 21500 Kg/ha/yr, respectively.

	Minimum	Maximum	Mean
Amount of feed-in kg/ha/yr.	2380.00	21500.00	15828.00

3.2.3.2 Use of commercial ready-made fish feed

From the survey, it was found that 83.33 percent don't use commercial ready-made fish feed. The main reason behind this according to farmers was: Costly (45 percent), Not available in time (21.7 percent), and not known to them (16.7 percent).

Do you use it or not? (Reasons for not use of Commercial ready-made feed)	Frequency	Percent
No (Costly)	27	45.0
No (Not available in time)	13	21.7
No (Not known)	10	16.7
Total	50	83.33
HH using ready-made feed	10	16.67
Total	60	100.0

3.2.3.3 Source of feed availability

The major source of feed was wholesalers for the majority of households.

Source of feed	Frequency	Percent
Mill	17	28.3
Wholesaler	28	46.7
Mill and shop	15	25.0
Total	60	100.0

3.2.3.4 Quantity of lime and manure used in a pond per hectare

The average quantity of lime and manure used in a hectare of the pond in a year was 281.05kg and 1790.20 kg respectively. Some of the farmers didn't use manure in their pond while every one of them used lime in their pond as it is of utmost necessity. The minimum and maximum amount of lime and manure used in a pond are elaborated in Table 15.

Amount	Minimum	Maximum	Mean
Quantity of lime used	90	600	281.05
Quantity of manure used per ha per yr. in kg	0	8000	1790.20

3.2.4 Availability of inputs, labor, and credit services

The following bar diagram shows that fertilizers, family labor, skilled and unskilled labor, banks, and cooperatives were regularly available. Similarly, seed, feed, lime, local money lenders, and finance company were not available regularly. Those that were regularly available were easily met by the farmers but they were suffering serious problems due to

irregular availability of major inputs for production such as seed, feed, and lime. Though the laborers were available regularly, they had not been mobilized due to the lack of beneficial inputs.

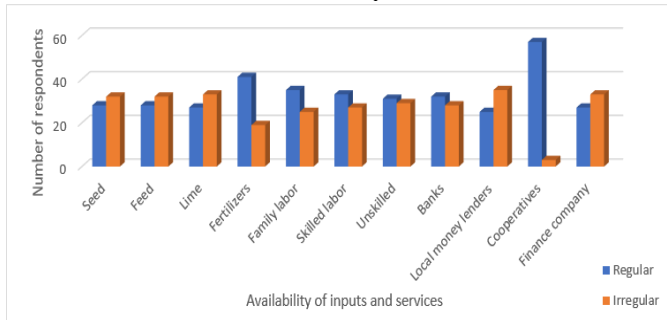


Figure 11: Bar diagram showing the availability of inputs and services

3.3 Institutions and Institutional support services

The various governmental institutions such as NARC and Directorate of Fisheries Development under Veterinary Hospital and Livestock Service Expert Center were involved in various types of support activities. The local institution in the research site named Small Farmers Agricultural Cooperatives Institution Limited; has provided a soft agricultural loan in the locality. Other institutions involve agro vets, feed industry, fertilizer dealers, etc. for seed, feed, and lime. All the institutions were linked to support services for acting as beneficiaries in the production of fisheries.

3.3.1 Infrastructural support

All types of support are helpful for the fish farmers such as financial support, household survey, solar pump funding, seed, lime, and fertilizer distribution; collection centers construction and tours, and visits. Among them, farmers felt most importantly financial support as the major one since monetary activities undergo during fisheries business in pace. Similarly, they were not found much interested in tours and visits.

Infrastructural support	Index	Rank
Finance	0.74	I
Household survey	0.61	II
Solar pump Funding	0.60	III
Seed, lime, and fertilizers distribution	0.60	III
Collection centers construction	0.53	V
Tours and visit	0.43	VI

3.3.2 Types of training demanded mostly by the farmers

Any training given to farmers is fruitful for successful fish production. Among all types of training, they felt the most important training was fish health camp where the water quality test is done to examine fish hygiene. Since fish kits were expensive for the farmers to purchase and keep in use; so, they didn't regard training on fish kits as a better option, instead urged for the government officials to use them by themselves and perform whenever necessary.

Types of training	Index	Rank
Fish Health Camp	0.78	I
Commercial Fish Farming Youths Training	0.66	II
Fish Lab specialist	0.49	V
Water quality test	0.57	III
Skillful training on using fish kits	0.44	VI
Quality handling	0.55	IV

3.4 Economics of fish production

3.4.1 Cost of finger-sized fishes

The average cost of fingerling-sized fish was the highest for Bhakur with NRs. 7.32/piece and lowest for Naini with NRs. 2.32/piece. Similarly, the cost of finger-sized silver carp, bighead carp, grass carp, rohu, and common carp was NRs. 2.76/piece, NRs. 4.02/piece, NRs. 5.18/piece, NRs. 2.54/piece and NRs. 4.93/piece (Table 18).

Fish Species	Average Cost (per piece)
Silver Carp finger	2.76
Bighead carp finger	4.02
Grass carp finger	5.18
Rohu finger	2.54
Naini finger	2.32
Common carp finger	4.93
Bhakur finger	7.32

3.4.2 Stocking Density of different fish species fingerlings size in a hectare pond area

The average number of fish species stocking density (SD) was found to be 8111 number/ha area of the pond. The maximum and the minimum number of fish species SD were 12900 and 4775 per hectare, respectively. People at Karaiyamai stocked the maximum number of Rohu and followed by Naini, Common carp, Bighead carp, silver carp, Grass carp, and the lowest SD was Bhakur (Table 19). Some farmers were not stocking Bhakur fingerlings as it is more expensive compared to others.

Fish species	Minimum SD	Maximum SD	Average SD
Silver Carp Fingerlings	200.00	2000.00	1006.00
Bighead Carp Fingerlings	200.00	2500.00	1126.00
Grass Carp Fingerlings	100.00	1500.00	481.00
Bhakur Fingerlings	.00	500.00	124.00
Rohu Fingerlings	250.00	4500.00	1917.00
Common Carp Fingerlings	100.00	3000.00	1419.00
Naini Fingerlings	200.00	7500.00	1903.00
Total number species	4775.00	12900.00	8111.00

3.4.3 Cost of production

The cost of production, gross return, benefit, and B/C Ratio are the major parameters to determine the success of any sector. From the survey, it was found that the total cost of production was NRs. 996516.92/hectare.

Items	Average variable cost (NRs. /ha)
Seed	40287.42
Feed	660683.33
Pond Maintenance	33208.33
Lime	5750.00
Manure	3923.23
DAP	28179.82
Urea	8909.50
Labor	126261.67
Medicine	17735.00
Fuel	61644.00
Miscellaneous	10000.00
Total Cost of Production	996516.92

3.4.4 Amount of production of fish

It was found that the average production in 2020, was 7024.42 Kg/ha. Similarly, the highest production was of Rohu (NRs. 1724.17 Kg/ha) followed by Naini (NRs. 1580.58 Kg/ha), Common carp (NRs. 1267.17

Kg/ha), Bighead carp (NRs. 1009.50 Kg/ha), Silver Carp (NRs. 927.75 Kg/ha), Grass carp (NRs. 400.75 Kg/ha) and the lowest average production was Bhakur (NRs. 114.50 Kg/ha).

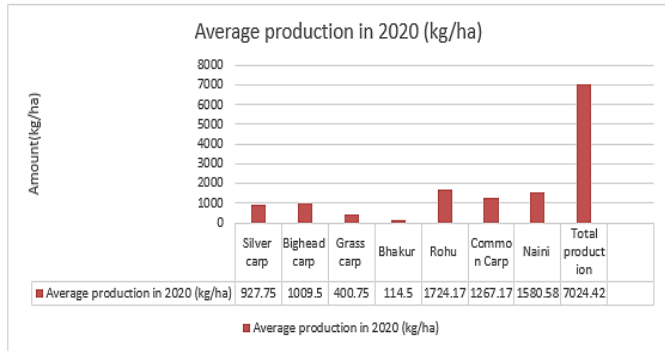


Figure 12: Amount of fish production in 2020

3.4.5 Farm Gate Price of different fish species

The average farmgate price of Bhakur was the highest (NRs. 465.50/Kg) followed by Grass carp (NRs. 352.92/Kg), Common Carp (NRs. 339.25/Kg), Bighead carp (NRs. 297.33/Kg), Rohu (NRs. 284.33/Kg), Naini (NRs. 240.75/Kg) and silver carp (NRs. 222.67/Kg).

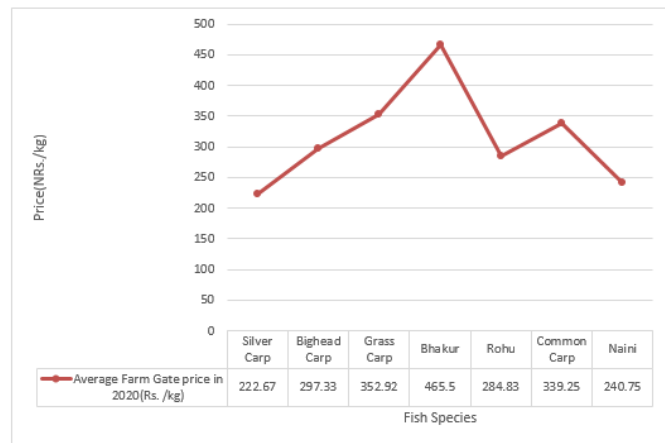


Figure 13: Average farm gate price of different species

3.4.6 Average Gross Return and Gross Margin

It was found that the average gross return was NRs. 2002976.56/ha (Table 21) and the total variable cost of production was NRs.996516.92/ha (Table 20). The gross margin was NRs. 1006459.64/ha.

Gross Margin = Total Gross Return – Total Cost of Production

= NRs. 20,02,976.56 – NRs. 9,96,516.92

= NRs. 10,06,459.64/ha

Fish Species	Production of fish in 1 ha pond (a)	Average selling price by farmers (NRs./kg) (b)	Total Gross Return (a*b)
Silver Carp	927.75	222.67	206582.09
Bighead Carp	1009.5	297.33	300154.63
Grass Carp	400.75	352.92	141432.70
Bhakur	114.5	465.5	53299.75
Rohu	1724.17	284.83	491095.34
Common Carp	1267.17	339.25	429887.42
Naini	1580.58	240.75	380524.63
Total	7024.42		2002976.56

3.4.7 Benefit/Cost Ratio

The B/C Ratio was 2.01 which showed that fisheries business is economically viable and profitable business.

Benefit/Cost Ratio = Gross return / Total Cost = 2002976.56 / 996516.92 = 2.01

3.4.8 Marketing Channel

The following marketing channels were analyzed from a survey identifying various market intermediaries.

Channel 1. Input Suppliers → Producers → Wholesalers → Distant Retailers → Distant Consumers

Channel 2. Input Suppliers → Producers → Local Retailers → Local Consumers

Channel 3. Input Suppliers → Producers → Local Consumers

Channel 4. Input Suppliers → Producers → Neighbors

The major was sold through channel 1 as most of the wholesalers buy in bulk visiting the farmers while the least was sold through channel 4 as neighbors purchase if there is no fish in their pond, otherwise, almost everyone in the village set up the fish farming activities.

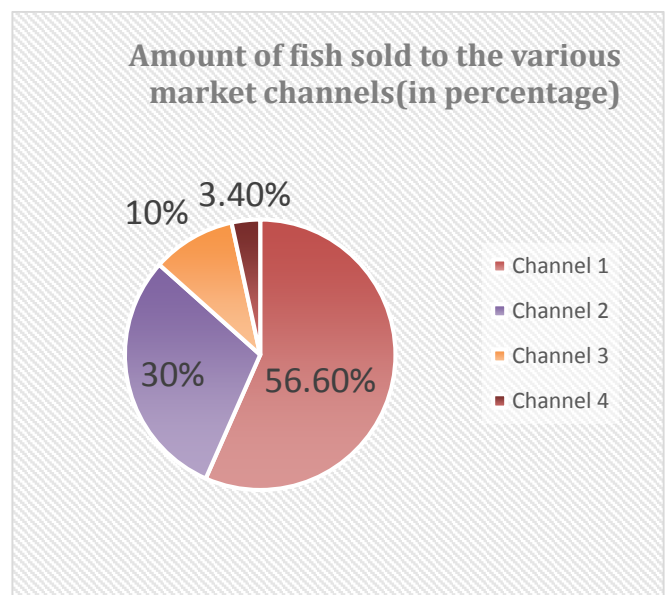


Figure 14: Pie Chart showing the amount of fish sold to the various market intermediaries

3.5 Market margin and producer's share of the fish block area

The efficiency of the marketing system can be evaluated by the marketing margin and producer share. Lower marketing margin and higher producer share on retail prices indicate an efficient market system. The marketing margin and producer's share in the table below clearly show an efficient marketing system since the producer's share was found more than 50 percent in all cases.

Fish Species	Farm Gate Price (Pf)	Retailer's Price (Pr)	Market margin (Mm)	Producer's share (Ps)
Silver Carp	222.67	250.83	28.16	88.77
Bighead Carp	297.33	340.08	42.75	87.43
Grass Carp	352.92	370.25	17.33	95.32
Bhakur	465.5	494.17	28.67	94.20
Rohu	284.83	316.25	31.42	90.06
Common Carp	339.25	369.17	29.92	91.90
Naini	240.75	250.42	9.67	96.14

3.6 Decision on various marketing actions

3.6.1 Mode of selling

More than 50 percent of the produced fish product was sold to directly both retailers and wholesalers. Similarly, about 33.3 percent of farmers sold to the wholesalers only, and about 13 percent sold to retailers only (Table 23). Mostly the large-sized fishes were purchased by wholesalers.

Players	Frequency	Percentage
Retailer	8	13.3
Wholesaler	20	33.3
Retailer and Wholesaler	32	53.33
Total	60	100.0

3.6.2 Means of transportation for selling fish

It was found that the major means of transportation was pick up van. Since the majority of the sellers were wholesalers and they purchased more quantity of fish and used for long-distance markets, thus nearly 58 percent used pickup vans as a means of transport. The sellers who used motorcycles and bicycles were the local retailers who purchase few amounts and used plastic crates. The bus was used as a means for a distance market with high chances of diseases and loss.

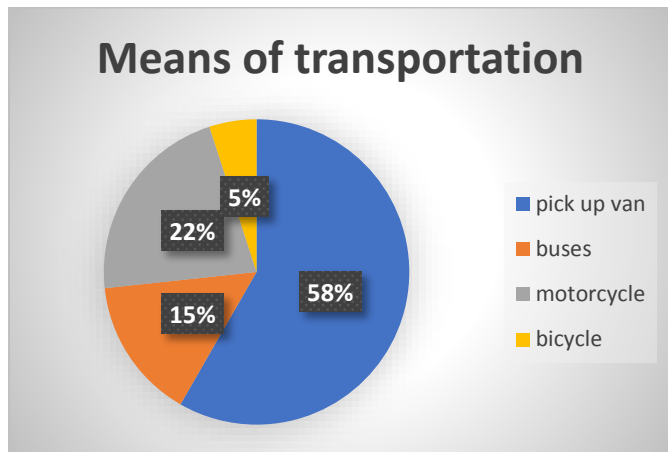


Figure 15: Pie chart showing means of transportation used for selling

3.6.3 Means of market information

It was found that the major means of market information was a radio/FM that accounts for 48.3 percent of households (Figure 16). Other than radio, television and website account for more than 30 percent of the market information. As there was a huge impact on radio in the village, we could say that they were lagging in new technologies.

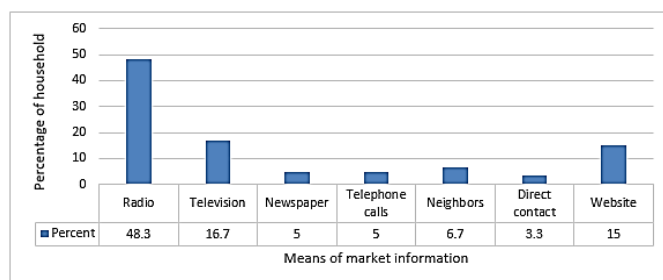


Figure 16: Bar diagram showing various means of market information

3.6.4 Ways to market the products

It was seen that 85 percent of household products were marketed by the collectors and traders coming to collect the products while 15 percent of the households sold their products by themselves (Table 24).

Ways to market products	Frequency	Percent
By yourself	9	15.0
Collectors/traders come to buy	51	85.0
Total	60	100.0

3.6.5 Price satisfaction, factors determining the price, and major players for price determination

3.6.5.1 Level of Satisfaction of farmers with price

During the household survey at Karaiyamai Rural Municipality, it was found that more than 65 percent were moderate to highly satisfied with the price while about 30 percent were not satisfied or less satisfied.

Level of satisfaction	Frequency	Percent
No satisfaction	7	11.7
Low	13	21.7
Medium	14	23.3
High	13	21.7
Very High	13	21.7
Total	60	100.0

3.6.5.2 Factors governing the price of fish in an area

As yes/no questions were asked among the respondents to find out the major factors governing the price of fish and it was found that the size of fish, market and market information, and transportation facilities (mostly road) were found the major factors. Similarly, their bargaining power doesn't symbolize the fish price while the season and availability have little impact on fish price.

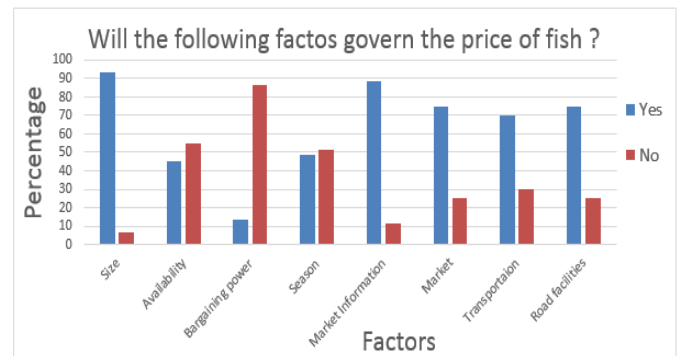


Figure 17: Bar diagram showing Factors governing the price of fish in an area

3.6.5.3 Major players determining price in an area

The household survey shows that the major players involved in determining the price of fish were wholesalers as their role is 65 percent, followed by local collectors at 31.7 percent and exporters at 3.3 percent.

Players	Frequency	Percent
Local Retailers	19	31.7
Wholesalers	39	65.0
Exporters	2	3.3
Total	60	100.0

3.7 Description of Fisheries Market Survey

A market survey was carried out at two places in the Bara district at Jeetpur and Simara. During our survey, 15 sellers were asked a series of questions about market and marketing systems. All sellers were local retailers or local sellers or local collectors who go directly to the farmer's pond, purchase fish, and bring them to the market for sale. Most of the sellers were from Ramauli-08, Bara, a few from Jeetpur, and a few from Baruwatadi, Parsa district. They purchased fish from Karaiyamai, Simraungadh, Bodhban, Ramauli, Chhipaharmai, Gadimai, in the Bara district.

3.7.1 Capital investment in selling fish

The average capital investment for fish business was NRs. 27500/HH ranging from NRs. 6000 to NRs. 100000 (Table 27). The initial investment

was done especially for weighing machines, plastic crates, and others as per the necessity.

Table 26: Number of person involved and capital invested in selling fish

Description	Minimum	Maximum	Mean
Capital investment (NRs.) in the shop	6000	100000	27500

3.7.2 Fish purchased and sold in 2020

The average amount of fish purchased was 17941.67 kg per year while the amount sold was 17233.33 kg per year. According to them, the purchase and sell amount is less as compared to the previous year due to the ongoing lockdown in the country by the spread of COVID-19. The purchase amount is more than sold since few amounts are lost due to storage conditions. It was found that the average post-harvest loss of fish species was 1875 Kg per year.

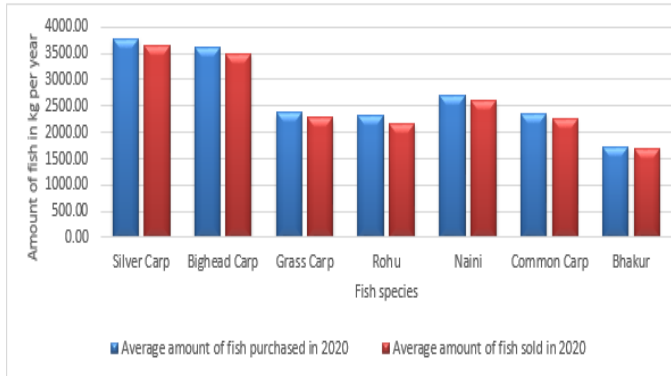


Figure 18: Bar diagram showing amount of fish purchased and sold in 2020

3.7.3 Purchase price and selling price of fish

The purchase and buying price of all the fish species was found by analyzing the data collected from the survey and presented in Table 28.

Table 27: Purchase price and selling price of fish species

Fish Species	Average Purchase price	Average selling Price
Silver Carp	207.08	250.83
Bighead Carp	240.00	340.08
Grass Carp	281.67	370.25
Bhukur	415.83	494.17
Rohu	267.50	316.25
Common Carp	305.41	369.17
Naini	200.83	250.42

3.7.4 Total amount of fish sold in different seasons

The average sale of fish in the summer season and winter season in 2020 was found as 10087.50 Kg and 32958.33 Kg, respectively. It was found that the major consumption of fish was in the winter season.

Table 29: Amount of fish sold in different seasons

Season	Minimum sell (Kg)	Maximum sell (Kg)	Average sell (Kg)
Summer season in 2020	3650.00	36500.00	10087.50
Winter season in 2020	9000.00	75000.00	32958.33

3.7.5 Cost of selling

The cost of selling is presented in Table 30 and the total cost was Rs. 325125.

Table 28: Cost of selling of fish

Description	Average Cost
Storage Cost	92416.67
Transportation cost	107500.00
Cost of rent	63500.00
Labor cost	.00
Grading cost	.00
Marketing Cost (polythene bags)	51708.33
Other Costs	10000.00
Total Cost	325125.00

3.7.6 Condition if all bought for sale is not sold in a day

From the survey, it was found that in case all the fish bought for sale weren't sold; 60 percent of the store in ice (none of them use refrigerator for storage) while 40 percent of them sold at a purchased price and avoided the risk of losses.



Figure 19: Condition if all brought for sale is not sold in a day

3.7.7 Post-harvest Activities

3.7.7.1 Grading and Packaging Practices

The sellers don't use grading practices but use various packaging materials. It was found that the majority of the sellers used plastic crates (73.3 percent) as a major material for fish packaging.

Table 29: Materials used for fish packaging

Packaging materials	Frequency	Percent
Plastic crates	11	73.3
Bamboo baskets	3	20.0
Insulated Thermo boxes with ice	1	6.7
Total	15	100.0

3.8 Consumers and consumer preference

3.8.1 Type of Customers

Most of the customers that come to buy the fish were regular customers that account for 80 percent and a few were new customers that account for 20 percent (Figure 20).

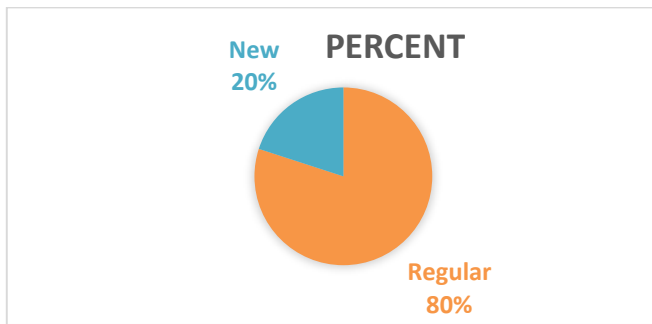


Figure 20: Types of customers

3.8.2 Consumer preference of fish species

It was found that most of the consumers prefer Rohu while few of them prefer silver carp.

Fish species	Frequency	Percent
Silver Carp	1	6.7
Bighead Carp	4	26.7
Rohu	6	40.0
Common Carp	2	13.3
All equally	2	13.3
Total	15	100.0

3.8.3 Consumer preference for the weight of fish

Commonly, 40 percent preferred 0.1-0.5 Kg weight of fish followed by 26.7 percent preferred 1.0-1.5 Kg size, 20 percent preferred 0.5-1.0 Kg weight, and 13.3 percent preferred 1.5-2.0 Kg weight of fish. In conclusion, mostly the local consumers preferred to consume small size fishes and they rarely consume the fish of the bigger size. The bigger sizes are taken away by the wholesalers.

Size of fish	Frequency	Percent
0.1-0.5 Kg	6	40.0
0.5-1.0 Kg	3	20.0
1.0-1.5 Kg	4	26.7
1.5-2.0 Kg	2	13.3
Total	15	100.0

3.9 Problems in production and marketing

3.9.1 Determining factor constraints

The respondents felt timely availability of inputs as the major determining factor constraint followed by quality of input and produce, technological support services, technical know-how, labor shortage, and price with index values 0.77, 0.68, 0.60, 0.57, 0.46, and 0.42 respectively. There was no problem with price as there was no price fluctuation while selling farm gate and no more price difference in purchasing inputs. Since most of the inputs come from outside and there lacks the availability of inputs on time, thus regarded as a major constraint.

Determining factor constraint	Index	Rank
Timely availability of inputs	0.77	I
Quality of input and produce	0.68	II
Technical Knowhow	0.57	IV
Technological support services	0.60	III
Labor shortage	0.46	V
Price	0.42	VI

3.9.2 Production Problems: Supporting Infrastructure Constraints

Some infrastructure that supports fish production includes water supply units, road, and transport, collection centers, credit availability, lab, and market. These produce certain challenges in the site such that production activities are widely affected. They felt water supply units as the major problem since they were facing problems in adding water in ponds. The boring, canal, and deep tube well were not sufficient to provide them water facility. The least problem they felt was the lab. It was because they were not aware of the benefits of laboratory tests and almost all the farmers hadn't done lab tests such as pH, ammonia level, and DO tests.

Supporting Infrastructure constraints	Index	Rank
Water supply units	0.69	I
Road and transport	0.61	II
Collection centers	0.59	III
Credit availability	0.56	IV
Lab	0.49	VI
Market	0.55	V

3.9.3 Problems in marketing

There exist various problems in marketing. But the sellers felt storage problems as the major one followed by transportation, disease incurred, prices, and lack of research with index values as 0.84, 0.72, 0.49, 0.48, and 0.47. Depending on ice for storage throughout the whole experience of fish sell, wanted to be modernized with modern storage facilities but were not familiar with them. Thus, regarded as the major problem in marketing. The losses were increasing due to a lack of storage facilities (Table 36).

Problems in marketing	Index	Rank
Transportation Problems incurred in marketing	0.72	II
Storage Problems incurred in marketing	0.84	I
Diseases incurred in fish	0.49	III
Price Problems as a result of a fish sale	0.48	IV
Lack of research about the market of fish	0.47	V

3.10 Value Chain Map of fish

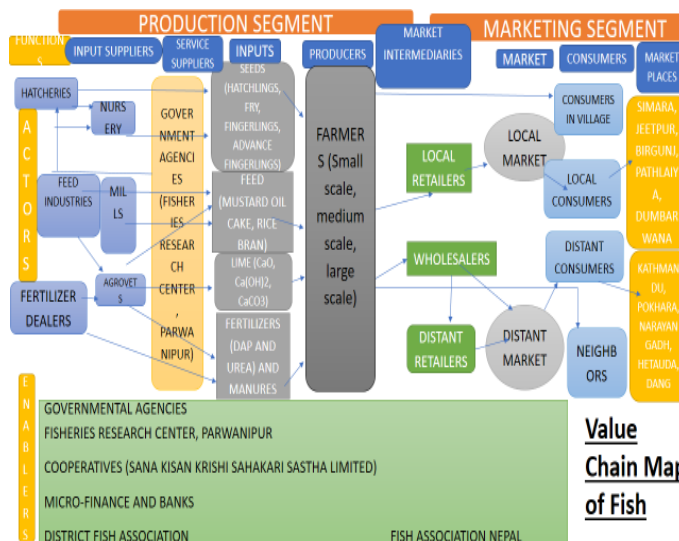


Figure 21: Value Chain Map of Fish

Finally, after analyzing all the actors and their various activities involved in the value chain; the value chain map was drawn to locate the complete package of a particular commodity (here in our case fish sub-sector). The map is the complete sketch of all the activities from input suppliers to the

ultimate consumers along with their value chain functions and enablers involved in value chain analysis. The developed value chain map was not possible until the analysis of all the above-mentioned value chain actors. Three channels were required to develop a value chain map. It consists of value chain functions, value chain actors, and value chain enablers. All the activities of the three channels were well illustrated in Figure 21.

3.11 Factors governing the success of fisheries business

The respondents were asked to rank for the major factors governing the success of fisheries business and they felt timely availability of inputs as the first success factor with an index of 0.79 and the least important success factor as land with an index value of 0.47. In conclusion, without inputs, there is no chance of business, so they prioritized it at the top. Similarly, most of them possess self-land and without land, no one will ever think of business; so, the land was given the lowest success or priority factor of fisheries business.

Table 35: Ranking on Factors Governing success of fisheries business using indexing techniques

Factors Governing success of fisheries business	Index	Rank
Timely availability of inputs	0.79	I
Quality of inputs and produce	0.67	II
Technical Knowhow	0.52	IV
Technological Support services	0.57	III
Land	0.47	VI
Market access	0.48	V

3.12 Commercialization of fish

The question was asked among the farmers about the possibility of commercialization of fish and the results were found as 43.3 percent thought there is a possibility with some condition, 36.7 percent thought there is a possibility and even if there are some bad years and 20 percent thought there is no any possibility of commercialization of fish under no condition (Figure 22). From this, we conclude that there is a good possibility of fish as a commercial business and youths should be highly encouraged.

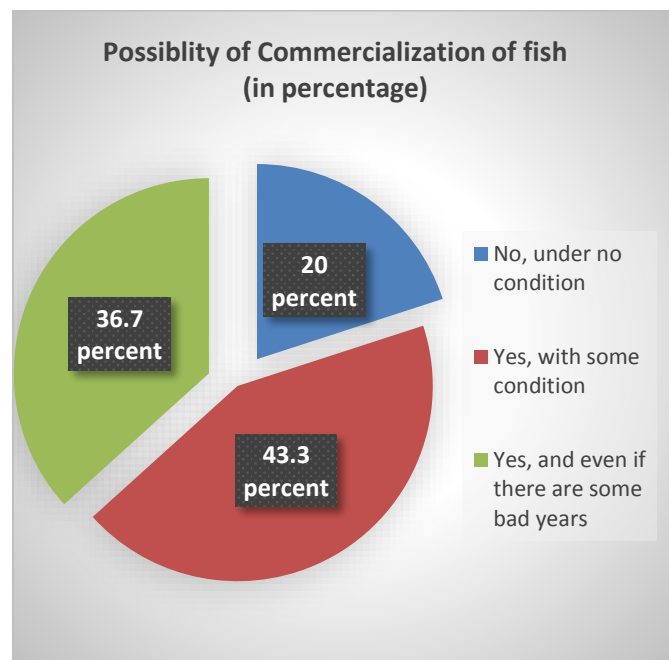


Figure 22: Possibility of commercialization of fish

3.13 Impression and Prospects of fisheries sub-sector

From the survey, it was found that almost all the farmers were highly impressed with the benefits being provided by the fisheries business. Farmers thought fisheries business is risky but profitable. Similarly, on analyzing the prospects or potentialities of fisheries, it was found highly potential (45 percent).

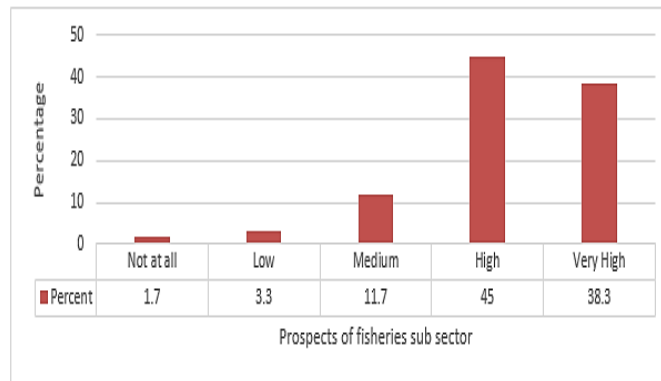


Figure 23: Bar diagram showing prospects of fisheries sub-sector

4. CONCLUSION

Fisheries are a global phenomenon and have a great impact on the economy of the country. Value chain analysis of fisheries is an important area to study the various actors involved in it; starting from input suppliers to producers followed by market intermediaries (wholesalers, retailers), and finally to the ultimate consumers. The research on this field gives an expression of all the value chain actors, their functions, and value chain enablers involved in it. The private hatcheries being the source of seeds fetching a high price for the purchase. The average productivity of fish in the study area was the highest (7024.42 Kg/ha) than the national average productivity (4920 Kg/ha), provincial average (4965 Kg/ha), and district average (5298 Kg/ha). The average cost of production was NRs. 996516.92/ha. The average gross return was NRs. 2002976.56/ha. Despite various production and marketing problems, the fish production in the study area was seen as a profitable business and the B/C Ratio was 2.01 and a high gross margin value (NRs. 1006459.64/ha). Since the major part of the produce was sold to the wholesalers, the marketing channel of input suppliers – producers – wholesalers – retailers – consumers was found effective. There was a low marketing margin and higher producer share on a retail price that indicates an efficient marketing system. At last, the study of various value chain actors and finding the best marketing channel indicated a good future of fisheries business with commercialization and risky but profitable enterprise.

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