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Research Article

Determinants of gross income from carp production in Bara district, Nepal

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ABSTRACT
A study was conducted from March to June 2020 to analyze the determinants of gross income from carp production in the Bara district of Nepal. Altogether, 90 carp producers, 45 each from Simraungadh and Pachrauta municipality in equal basis were sampled by using cluster sampling technique. Primary information was collected through a pre-tested semi-structured interview-based schedule while secondary information was collected reviewing the relevant publications. Data was entered in SPSS 25 and analyzed using STATA 12.1. The results revealed that the cost of labor, cost of feed, assistances and services, and training had significant positive effect on gross income from carp prodcuiton. Furthermore, lack of quality inputs was identified as the most severe production problems whereas Dhalta to be given was recognized as the most severe marketing problems. Thus, encouraging the carp producer to manage the cost of labor and cost of feed deliberately, rationally providing the assistance and services and strengthening the skills and knowledge of producer through training could significantly increase gross income from carp production.
Keywords: Polyculture, Cluster sampling, Determinants, Marketing problems

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INTRODUCTION

Aquaculture is one of the most crucial sectors of the Nepalese economy contributing 1.13% to Gross Domestic Product (GDP) and 4.18% to AGDP in 2075/76 (CFPCC, 2018/19). It gives livelihood service to more than 3% of the total population which almost includes 741,000 individuals. Due to aquaculture, around 138,439 people have received employment opportunities (FAO, 2019). Being opulent in terms of water resources makes Nepal a country with potential fish farming. Out of nearly 12500 ha of such area available in the country, approximately 1225 ha are recently being used for fish farming (Budhathoki & Sapkota, 2018). There are 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 to more than 10,718 ha with the total fish production reaching 91832 metric tonnes in the fiscal year 2075/76 (CFPCC, 2018/19). On top of that, Bara district has the total pond area of 1916 Ha with productivity of

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of 5.3 mt/ha just above the national productivity. Due to the presence of a plethora of freshwater habitat, there is potential for the different fisheries and aquaculture activities in Nepal.

The Government of Nepal has suggested at least 30 g per day animal protein or fish diet to each man, women, adolescent girls, and boys (DFTQC, 2012). Recently the amount of fish protein in common people diets is increasing compared to the early 1990s when the Nepalese standard food intake had a very small amount of fish in their diet (Nestel *et al*., 2015). The per capita consumption of fish is 3.1 kg (2017/18) which is higher compared to the consumption rate of 2.1 kg during 2003/04. This recommends that fish production, affordability, availability, purchasing capacity, and awareness might have accelerated consumption, inferring that the role of fisheries in food and nutritional security is becoming indispensable and increasing. Coinciding with these facts, the Agriculture Development Strategy (2015–2030) has comprised fisheries as one of the most promising sub-sectors in agriculture.

Carp polyculture is by far the most common and popularly used method of fish rearing in Nepal and has been adopted in the majority of fish farming communities. Seven species of carp are cultured in the same pond such that the efficient utilization of resources could be done (Adhikari et al., 2019). However, difficulty to manage the stocking density of different species of carp had been a severe problem till date. In Nepal, 252 fish species are available in various aquatic ecosystems among them 236 are indigenous and 16 exotic fish species (Shrestha, 2015). At present, seven commercially valuable carp species are bred and cultured in Nepal. It has provided a new dimension in commercial fish farming in Nepal. So, aquaculture is an important sub-sector of agriculture and it plays a pivotal role in elevating the socioeconomic life of rural people.

Carp producers have not fully realized its production potential due to the various problems and technical glitches involved in the sub-sector. Few obstacles like the absence of postharvest centers, cold storage, and processing center have been hindrance in increasing the profitability of farmers (Bhudhathoki & Sapkota, 2018). Additionally, the factor like cost of seed, cost of fingerlings, cost of feed , cost of labor, and cost of electricity and fuels have a significant positive effects on carp production (Adhikari *et al*., 2019). However, the scenario is contrary due to the inefficient use of resources. Similarly, the presence of a large number of middlemen in the marketing of fish, farmers are getting minimum price while consumers are compelled to pay a higher amount. Lack of knowledge of consumer's preference among farmers has made them unable to produce fishes as par the consumer's demand. These series of problems are the hurled due to which the gross income from carp production could not be realized as expected. Thus, this study aimed to identify the major determinants of carp production. Furthermore, this research would help the policy makers and researchers in identification of potential area for intervention as well.

METHODOLOGY

The study was conducted in Bara district (which was selected as the Fish Super zone under Prime Minister's Modernization Project since its establishment in 2016) from March to June 2020. Simraungadh and Pachrauta municipalities fish production pockets of the district were selected randomly. Altogether 90 households (HHs) 45 HHs from Simraungadh Municipality,

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and 45 HHs from Pachrauta Municipality were selected randomly from the population of 301 registered carp producers in the Fish Super zone, Bara.

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 of Agriculture Knowledge Center (AKC) Bara, Agriculture Information and Communication Centre (AICC), Central Bureau of Statistics (CBS), Nepal Agriculture Research Council (NARC), Prime Minister Agriculture Modernization Project (PM-AMP), Ministry of Agriculture and Livestock Development, various NGO's/INGO's, journals, proceedings, books, and websites. Descriptive analysis was done using SPSS version 25 and qualitative analysis was done in STATA 12.1. To analyze the significant difference between mean, a sample t-test was employed (Dhakal, 2015).

For estimating the determinants of gross income from carp production, regression analysis was carried out. Various items of variable cost, assistances & services received and training received by carp producers were considered as the independent variable and gross income as the dependent variable.

To study the relationship between gross income and the independent variables, the following regression equation was applied (Adil, 2004).

$Y=\beta_0+ \beta_1X_1 + \beta_2X_2 + \beta_3X_3 + \beta_4X_4 + \beta_5X_5 + \beta_6X_6 + \beta_7X_7$ Equation 1

Where Y = Gross income (NRs/ha), β_0= Intercept; X_1= cost of pond maintenance (NRs/ha), X_2= cost of fry/fingerlings (NRs/ha), X_3= cost of labor (NRs/ha), X_4= cost of feed (NRs/ha), X_5= cost of fertilizer and medicine, X_6= Training received, X_7= Assistances and services received

The multiple ties between independent/explanatory variables i.e. multicollinearity was tested through the estimation of Variance Inflation Factor (Vu *et al.*, 2015). The VIF value of 10 is recommended as the maximum value.

To measure the relative severity of production and marketing constraints/problems, a five-point scaling technique was employed. According to the farmer's perception of the importance given to the different production and marketing constraints, a five-point scale of constraints/problems indicating major problem (1) and minor or least severe (0.2) were analyzed and ranked.

The index was calculated using the following formula:

$I = \sum \frac{S_i f_i}{N}$ Equation 2

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 by Bhattarai *et al.* (2020) to identify the problems in coffee production, Subedi *et al.* (2019) in potato production and Shrestha and Shrestha (2017) in maize seed production.

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RESULTS AND DISCUSSION

Socio-economic characteristics of respondents

Among the major socio-economic variables age of respondents, the education status of respondents, training duration, and training received was found statistically significant at either 1 percent or 5 percent or 10 percent level of significance. The majority of respondents in the study premises were male (86.7%) and female (13.3%). The majority of HH have belonged to Hindu (78.9%) ethnicity and Muslim (21.1%) ethnicity. The majority of respondents among carp producers of Simraungadh and Pachrauta municipalities were found to studied up SLC (33.3%) followed by below SLC (28.9%), Intermediate (20%), Bachelor (13.3%), Illiterate (3.3%), and Master (1.1%) and result were found statistically significant at 5 percent level of significance. The majority of HHs was found to have an annual income of more than NRs 400000 (57.7%) from carp production followed by between NRs 300000-400000 (22.2%), between NRs 200000-300000 (15.6%), and between NRs 100000-200000 (4.4%). Majority of HHs among carp producer of Simraungadh and Pachrauta municipalities were found to have received training (62.2%) and 37.8% were found to have no training and results was statistically significant at 10 percent level of significance.

Table 1: Socioeconomic and demographic characteristics among municipalities wise carp producer (categorical)

Variables	Simraungadh (n=45)	Pachrauta (n=45)	Overall (N=90)	Chi-Square
Gender				
Male	40(88.9)	38(84.4)	78(86.7)	0.38
Female	5(11.1)	7(15.6)	12(13.3)	
Ethnicity				
Hindu	37(82.2)	34(75.6)	71(78.9)	0.60
Muslim	8(17.8)	11(24.4)	19(21.1)	
Education status				
Illiterate	0(0)	3(6.7)	3(3.3)	12.14**
Below SLC	10(22.2)	16(35.6)	26(28.9)	
SLC	13(28.9)	17(37.8)	30(33.3)	
Intermediate	11(24.4)	7(15.6)	18(20.0)	
Bachelor	10(22.2)	2(4.4)	12(13.3)	
Master	1(2.2)	0(0)	1(1.1)	
Annual family income (NRs)				
Between 100000-200000	3(6.67)	1(2.20)	4(4.4)	2.25
Between 200000-300000	8(17.78)	6(13.3)	14(15.6)	
Between 300000-400000	9(20)	11(24.5)	20(22.2)	
More than NRs 400000	25(55.56)	27(60)	52(57.7)	
Training				
Yes	31(68.9)	25(55.6)	56(62.2)	2.95*
No	14(31.1)	20(44.4	34(37.8)	

*Notes: Figures in the parentheses indicate percent. ** and * indicate 5% and 10% levels of significance respectively.*
Source: Field survey 2020

The average age of respondents in the study area was 42.27 years. The average age of respondents of Pachrauta municipality (44.82 years) was statistically higher as compared to the Simraungadh municipality (39.71) at a 1% level of significance. The average years of experience of the respondent were 7.77 years. The average duration of training of respondents in the study premise was 4.82 days. The average duration of training of

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respondents in Simraungadh municipality (5.48 days) was statistically higher as compared to the average duration of training of respondents in Pachrauta municipality (4 days) at a 10 percent level of significance.

The average own land area and leased land area under carp production were 1.58ha and 1.86 ha respectively in the study area. The average leased land in Simraungadh municipality (2.92 ha) was statistically higher as compared to the average leased land in Pachrauta municipality (1.05 ha) at a 1% level of significance. The average total land under carp production was 3.02 ha in the study premises. The average total land under carp production in Simraungadh municipality (3.49 ha) was statistically higher as compared to the Pachrauta municipality (2.56 ha) at a 5% level of significance.

Table 2: Socioeconomic and demographic characteristics of respondents by municipalities wise carp producers (continuous)

Variables	Simraungadh (n=45)	Pachrauta (n=45)	Total (N=90)	Mean Differences	t-value
Age of respondents (years)	39.71(10.26)	44.82(10.67)	42.27(10.24)	-5.11***	-3.76
Years of experience (years)	8.27(4.624)	7.27(3.798)	7.77(4.237)	1	1.12
Training duration (days)	5.48(4.14)	4.00(2.39)	4.82(3.52)	1.48*	1.735
Pond Area (hectare)					
Own land	1.59(1.34)	1.57(1.06)	1.58(1.20)	0.176	0.068
Leased land	2.92(2.82)	1.05(1.57)	1.86(2.37)	1.86***	3.62
Total land	3.49(2.442)	2.56(1.615)	3.02(2.11)	0.934**	2.14

*Notes: Figures in the parentheses indicate standard deviation. ***, ** and * indicate 1%, 5% and 10% levels of significance respectively.*
Source: Field survey 2020

Determinants of gross income from carp production

Before running regression analysis, a test for multi-collinearity among the explanatory variables was conducted through the estimation of Variation Inflation Factor (VIF), the mean VIF of 1.45 revealed significantly low multicollinearity and thus permitted the inclusion of explanatory variable in the model.

The coefficient of determination (R^2) was 0.69, indicates that the model as fitted explains 69% of the variability in gross income from carp production was due to explanatory variables considered in the model. The value of adjusted R^2 was 0.663 indicating that after taking into account the degree of freedom 66.3% of the variation in the dependent variable was explained by the explanatory variables included in the model. The F-value was found to be 26.09, which is highly significant ($p<0.01$) that depicts all the explanatory variables included in the model that were important for explaining the variation in gross income obtained from carp production in the study area. The finding was aligned with Mkong, *et al*. (2018), who reported cost of feed, cost of labor had positive and significant association with profitability of fish farming in Cameroon. A similar finding was found by Adhikari *et al*. (2019), who reported positive and significant association of cost of feed, cost of labor to gross return from Chhari and marketable-size carp in Bara district. The finding was in line with Olagunju *et al*., (2007).

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Table 3 shows that cost of labor has positive and significant effects on gross income from carp production at 1% level of significance. The coefficient of cost of labor amounted to 0.292, it indicates an increase in the unit cost of labor amounted to NRs 0.292 increase in gross income ($p< 0.01$) held all other factors in the model constant. The finding was aligned with the finding from Mkong, *et al*., (2018) where a unit increase in labor cost had led to a 0.49% increase in net profit from marine fishing. A similar finding was found by Adhikari *et al*., (2019), where he reported 100% increase in the cost of labor increase the income by 13.7% in Chhari and marketable-size carp. The finding was also in line with finding concluded by Singh., (2007), who reported unit increase in the cost of hired labor increase the fish production by 0.916 in West Tripura district of Tripura. The coefficient of cost of pond maintenance amounted to 0.081 however, it has no significant effect in gross income. Similarly, the coefficient of cost of fry/fingerlings amounted to -0.123 but has no significant effect in gross income from carp production.The coefficient of cost of feed amounted to 0.182, it indicates each additional unit of cost of feed increase the gross income by NRs 0.24 ($p<0.05$) all other factors held constant. This finding was in line with finding concluded by Singh., (2007), who reported unit increase in the cost of feed increase the fish production by 0.050 in West Tripura district of Tripura. The finding was also aligned with Mollah *et al*., (1991). Assistances and services received through different institutions had a positive and significant effect on gross income from carp production at 1 percent level of significance. The study revealed that the gross income among carp producers who had received assistance and services was 0.254 unit more than carp producers who were devoid of assistance and services, all other factors held constant.

Table 3: Determinants of gross income from carp production

Gross income (NRs/ha)	Coefficient	Standard error	t-value	P > | t |
Constant	8.894***	3.516	2.53	0.01
Cost of pond maintenance (NRs/ha)	0.081	0.0607	1.34	0.185
Cost of fry/fingerlings (NRs/ha)	-0.123	0.241	-0.51	0.610
Cost of labor (NRs/ha)	0.292***	0.092	3.18	0.002
Cost of feed (NRs/ha)	0.128**	0.0516	2.49	0.015
Cost of fertilizer & medicine (NRs/ha)	-0.115	0.091	-1.26	0.212
Assistances & services [a]	0.254***	0.034	7.46	0.000
Training [a]	0.209***	0.0335	6.24	0.000
Observation				
F (7,82)	26.09***			
R – squared	0.690			
Adj R – squared	0.663			

*Notes: *** and ** indicates significance level at 1% and 5% respectively and 'a' dummy variable.*
Source: Field survey 2020

The assistance and services were provided by the Agriculture Knowledge Centre (AKC), Prime Minister's Agriculture Modernization Project (PMAMP), and Cooperatives. The assistances and services include subsidy in water pump set, subsidy in newly pond construction & hatcheries, subsidy in electric motor, etc. Participation in training provided by different institutions had a positive and significant effect on gross income at 1% level of

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significance. The study revealed that the gross income among carp producers who had received training was 0.209 unit more than carp producers who were devoid of training, all other factors held constant. The finding aligned with Bhattarai et al., (2020), who reported training had positive and significant association with productivity of coffee production in Arghakhanchi and Gulmi District of Nepal. The finding was consistent with Dahal and Rijal, (2019), who reported 47.89% higher profitability of potato cultivation in large scale farmer who received training. This might be due to the fact, producers who had received training would might be technically sound and would better apply the modern techniques learned through the training program.

Production constraints of carp production

Five of the major problems in carp production were identified from focus group discussion, key informant interviews, and field visits. Carp producers 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 production problems.

Lack of quality inputs viz quality feed ingredients, quality of fingerlings was identified to be the most daunting problem in the study area which has posed an unfortunate imperil in the desired production of carp with an index value of 0.90. The second major problem as ranked by the carp producer was found to be a lack of technical knowledge with an index value of 0.72. Lack of technical knowledge basically regarding estimation of stocking density, estimation of feed requirement, and liming dose have further imperiled the production of carp. Similarly, the third major problem was identified to be the prevalence of the disease with an index value of 0.5. The major disease identified in the study area were bacterial infection viz. fin rot and fin dropsy, white spot disease, EUS (epizootic ulcerative syndrome). The disease prevalence had sometimes led to a drastic decline in the production as reported by carp producers in the study area.

The fourth major problem identified was a flood during the rainy season and scarcity of water during the summer season with an index value of 0.46. Carp producers have sometimes faced great economic devastation due to the unfortunate circumstances brought by the seasonal flood. Due to floods, the ponds were occasionally swamped.

Table 4: Production constraints for carp production

Production constraints	Index value	Ranking
Lack of quality inputs	0.90	I
Lack of technical knowledge	0.72	II
Disease prevalence	0.5	III
Flood during rainy seasons & scarcity of water during summer	0.46	IV
Lack of capital	0.34	V

Similar, misfortunes were brought about due to the scarcity of water during the summer. The scarcity of water, degrades the health condition of carp when they are whacked by the severe heat. Water is the key and must be regularly changed however, due to the occasional unavailability and drying of water sources during summer the situation becomes predicaments. The fifth major problem was identified to be a lack of capital with an index value of 0.34. Due to the absence of a perennial source of income, some of the carp producers

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in the study area were destined to face this problem. Borrowing the capital from the bank is also considered a daunting task due to the exorbitant interest rate and lack of collateral to display. Thus, some of the carp producers in the study area were facing this problem.

Marketing and markets constraints of carp production

Five major problems in carp marketing and markets were identified according to the focus group discussion and interaction with the producer and five points scaling techniques (1, 0.8, 0.6, 0.4, and 0.2) were used to evaluate and rank the seriousness of those problems. Dhalta to be given (the amount is given to the buyer in addition to the actual amount bought) was identified to be the first major constraint in the marketing and markets as ranked by the carp producer in the study area with an index value of 0.91. Followed by this, the indices revealed a monopoly of the middle man (0.82), high cost of marketing (0.62), low market price (0.35), and Indian market dependent (0.26) were the latter serious constraints as ranked by the carp producer in the study area.

Table 5: Marketing and markets constraints for carp production:

Problems in marketing & market	Index Value	Ranking
Dhalta to be given	0.91	I
The monopoly of middleman	0.82	II
The high cost of marketing	0.62	III
Low market price	0.35	IV
Indian market dependent	0.26	V

Dhalta= the amount is given to the buyer in addition to the actual amount bought (Nowsad, AKM., 2016)

CONCLUSION

This study showed that the gross income of carp producers was significantly and positively affected by the cost of labor, cost of feed, assistance and services received through institutions, and participation in training. Thus, through the findings, it could be generalized that training facilitation, assistance and services, use of labor and feed should be encouraged and intensified to assured higher gross income from carp production. Lack of quality inputs, lack of technical knowledge, disease prevalence, flood during rainy seasons and scarcity of water during summer, and lack of capital were identified as the major constraints of production. Besides, Dhalta to be given, monopoly of middleman, high cost of marketing, low market price, and Indian market dependent were identified as the major marketing and market constraints of carp production. Thus, there is an immediate need to overcome such problems and it must be felt by concerned authorities and institutions. Only then sustainable economic benefits could be realized through carp production.

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Authors' contribution

S. Bhandari: Design and performed experiment, analyzed data, manuscript prepared and edited,
A. Shrestha: Performed experiment and assisted in data recording
B. Sapkota: Performed experiment and assisted in data recording
C. Bhattarai: Assisted in experiment and data analysis
S. Rijal: Helped in experiment and data recording
S. Pokhrel: Assisted in data recording and edited paper
D.K. Jha: Supervised entire research work and manuscript preparation

Conflict of authors

The authors declare that there is no conflict of interest regarding the publication of this paper.

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