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Research Article**SUPPLY CHAIN ANALYSIS OF CARP IN MAKWANPUR, CHITWAN AND NAWALPARASI DISTRICTS OF NEPAL****K. Adhikari, S. Rai*, D.K. Jha, and R.B. Mandal**

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ABSTRACT

Carp is the major fish produced and imported in Nepal. It is imperative to establish sustainable and effective supply chains of carp to develop aquaculture industry in Nepal. In order to assess role of key actors involved and to analyse the existing supply chains of carp, a study was carried out in Makwanpur, Chitwan and Nawalparasi districts of Nepal during May to September, 2016. A total of 102 respondents (20 grow out farmers, 3 middleman, 3 wholesalers, 3 retailers, and 5 consumers in each district) were selected randomly for household survey from all three districts. Data were collected by using set of pre-tested questionnaire by employing face to face survey with the respondents. Data were analysed by using One Way Anova followed by Duncan's Multiple Range Test. Findings revealed that grow out farmer, middleman, wholesaler, retailer and consumer are key actors to govern existing supply chains of carp. There are upto seven types of supply chains of fresh carp and four types of supply chains of live carp in three districts. Supply chain of live carp is comparatively shorter with three actors than fresh carp supply chain to minimize fish loss due to handling stress. Grow out farmers in Nawalparasi earned significantly ($p < 0.05$) higher profit of 156 ± 1 Rs/kg than Chitwan and Makwanpur, due to higher selling price and low variable costs incurred. In live carp supply chain, middle man received higher margin (34-36%) whereas in fresh carp chain, retailers earned higher profit in Makwanpur (50%) and Nawalparasi (56%), and middleman, in Chitwan (50%). Although supply chain of live carp is found to be more profitable, but it is risky and not sustainable at the moment. Therefore, supply chain of fresh carp needs to be strengthened.

Key words: Price, variable cost, profit, farmer, middleman**INTRODUCTION**

Nepal is not self reliant in fish production as the current production supplies only 3.01 kg fish to an individual in a year (DoFD, 2017). Total aquatic animal import has reached around Rs. 670 million per year, out of which over 70% is whole frozen fish from India whereas export value only Rs. 3 million, indicating a huge potential for aquaculture development (Bhujel, 2015). Aquaculture development relies on improved technology and well developed marketing system with efficient supply chains. Fish is an extremely perishable commodity and its marketing issues are of great concern to the government, farmers and consumers. Aggregate market performance is better understood by measuring effectiveness of the existing supply channels (i.e. testing whether the existing marketing channels offer proper service outputs or the right services in relation to consumer preferences), by analyzing price spreads (marketing costs, price margins and profitability) among the different marketing activities, and through studying the level of market integration that exists (Uchezuba, 2005).

Indian major carp (Rohu, Mrigal, Catla), Chinese carp (Silver carp, Bighead carp, Grass carp) and Common carp dominate fish market in Nepal. Fish markets in major cities are dominated by carp from India whereas carp produced in Nepal is either sold in the local market or in the pond site. In another words, farmers produced carp do not reach metropolitan markets. This has prevented fish farmers from getting market benefit in one hand and consumers from eating fresh fish on other hand. Farm gate price is low and highly variable from farmer to farmer (Rs. 150-250/kg) whereas market price of fish is comparatively higher and variable depending on species, size and state of fish (Rs. 200-350/kg) (Thapa, 2014). The lower price of carp has been disincentive for most farmers. The lower price received by the farmers means low income, which results in low investment in the pond and again reduced income. This has caused to deteriorate the productivity and the farmers are bound to fall in the vicious cycle of poverty (Gurung et al., 1996). There is a need to analyze existing carp supply chains to find the gaps so that an efficient supply chain from grow out farmer to consumer can be improved. Accordingly this study was done with the main objective to identify barriers to flow of products in both seed and table carp supply chain in Makwanpur, Chitwan and Nawalparasi districts.

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MATERIALS AND METHODS

The study was done in Makwanpur, Chitwan and Nawalparasi districts from May to September, 2016. The study covered Hadikhola, Hetauda Municipality, Sisneri Village Development Committee in Makwanpur district; Kathar, Kumrose, Piple, Shankarchowk and Chanauli (Chitaban Municipality), Tandri (Ratnanagar Municipality), Saradpur (Bharatpur Municipality) in Chitwan district; and Semari, Badahara, Jamunia, Prasauni, Sanaii, Kawasoti, Seri (Madhyabindu Municipality), Jahada, Parasi, (Ramgram Municipality) and Sunawal in Nawalparasi district. A total of 102 respondents were interviewed for primary data collection, among them 34 were from each of Makwanpur, Chitwan and Nawalparasi district in equal basis. Out of 34 respondents, there were 3 middleman, 3 retailers, 3 wholesalers, 5 consumers and 20 grow out farmers from each district. Secondary data were collected from published books, journals, proceedings, and unpublished reports, documents and training manuals, and also records of concerned office such as Agriculture and Forestry University, Directorate of Fisheries Development, District Agriculture Development Office, Community Based Organizations, Cooperatives and Farmer's self help groups. One way anova followed by Duncan's Multiple Range Test was used to compare means of price of carp, income from seed and table fish sale, variable costs and marketing margins of grow out farmer, middleman, wholesaler and retailer among three districts. Differences were considered significant at an alpha level of 0.05 ($p < 0.05$).

RESULTS

Carp is sold in fresh and live forms, so, supply chain was assessed in both forms. Carp supply chain actors included farmer, middleman, wholesaler, retailer, and consumer in both forms. Altogether seven supply chains in fresh carp and four in live carp have been identified from farmer to consumer in three districts (Figure 1 and Figure 2). Longest chain included farmer to middleman to wholesaler to retailer to consumer whereas shortest one included farmer to consumer. Small scale farmers sell carp directly to consumers at the pond site, particularly during festivals. Retailer and wholesaler buy both live and fresh carp directly from farmers and sell themselves to consumers. In some cases, wholesaler and retailer are found to use Mallah to harvest fish. Another chain included harvesting and selling by middleman without contacting wholesaler and retailer to the market.

Supply chain of fresh carp

Seven supply chains for fresh carp are found to exist in three districts which are shown below.

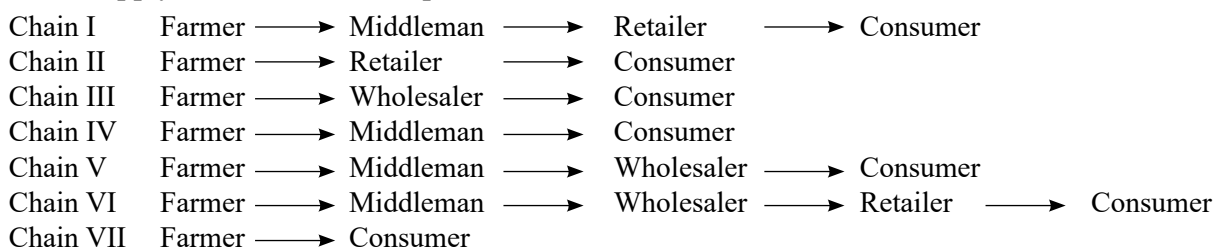


Figure 1. Supply chain for fresh carp in the study sites

Supply chain for live carp

Four types of supply chains for live carp are identified in three districts which are shown below.



Figure 2. Supply chain for live carp in the study sites

Average margin, or profit of grow out farmers in three districts is presented in Table (1). Farmers have been found to sell both fresh and live carp at same price. An overall cost incurred to grow fish was same for both live and fresh carp. It is only after the harvest transport cost increased total cost for live fish due to oxygen supply and mode of transport. If fish is to be sold alive, it has to be carried in a container with continuous oxygen supply which is not required for fresh fish. So, profit earned by farmers was also same from fresh and

live carp selling. Price of carp varied with species and size of fish. Rohu, Mrigal, Common and Grass carp are sold in higher price of Rs. 260/kg whereas Silver carp and Bighead carp are sold at lower price of Rs. 180/kg. Similarly, large size of fish fetched higher price. Price of carp as reported in this study is the average of different species price. Selling price, profit earned and variable cost of farmers differed significantly ($p < 0.05$) among districts. Selling price of carp was significantly ($p < 0.05$) higher in Nawalparasi (226 ± 3 Rs/kg) than Chitwan (200 ± 2 Rs/kg) and Makwanpur (200 ± 2 Rs/kg). Variable cost for one kilogram carp production was significantly ($p < 0.05$) higher in Chitwan (98 ± 1 Rs/kg); intermediate in Makwanpur (74 ± 1 Rs/kg), and lowest in Nawalparasi (70 ± 0 Rs/kg). The margin of grow out farmer was significantly ($p < 0.05$) higher in Nawalparasi (156 ± 1 Rs/kg), intermediate in Makwanpur (126 ± 1 Rs/kg) and lower in Chitwan (102 ± 0 Rs/kg) district.

Table 1. Profit earned by grow out farmers in the study districts

Grow out farmer			
District	Selling price(Rs/kg)	Variable cost(Rs/kg)	Profit (Rs/kg)
	Mean \pm SE	Mean \pm SE	Mean \pm SE
Makwanpur	200 \pm 2 ^b	74 \pm 1 ^b	126 \pm 1 ^b
Chitwan	200 \pm 2 ^b	98 \pm 1 ^a	102 \pm 0 ^c
Nawalparasi	226 \pm 3 ^a	70 \pm 0 ^c	156 \pm 1 ^a

The value of average marketing margin of middleman in three districts is presented in Table (2). Selling price, income, variable cost and profit of middleman for fresh carp varied significantly ($p < 0.05$) among districts. Income of middleman was significantly ($p < 0.05$) higher in Chitwan (60 ± 10 Rs/kg) than Makwanpur (20 ± 03 Rs/kg) and Nawalparasi (3 ± 01 Rs/kg) districts. The marketing margin of middleman was significantly ($P < 0.05$) higher in Chitwan (59 ± 1 Rs/kg) than Makwanpur (17 ± 0 Rs/kg) and Nawalparasi (2 ± 0 Rs/kg) district. Likewise variable costs of middleman was significantly ($p < 0.05$) higher in Makwanpur (3 ± 0 Rs/kg) than Chitwan (1 ± 0 Rs/kg) and Nawalparasi (1 ± 0 Rs/kg) district. In the case of live carp price, income, variable cost and margin did not vary among districts.

Table 2. Marketing margin of middleman in the study districts

(a) Fresh carp

Districts	Middleman				
	Selling price (Rs/kg)	Buying price (Rs/kg)	Income (Rs/kg)	Variable cost (Rs/kg)	Profit (Rs/kg)
	Mean \pm SE	Mean \pm SE	Mean \pm SE	Mean \pm SE	Mean \pm SE
Makwanpur	220 \pm 10 ^b	200 \pm 12 ^a	20 \pm 0 ^b	3 \pm 0 ^a	17 \pm 0 ^b
Chitwan	260 \pm 0 ^a	200 \pm 12 ^a	60 \pm 1 ^a	1 \pm 0 ^b	59 \pm 1 ^a
Nawalparasi	229 \pm 0 ^b	226 \pm 0 ^a	3 \pm 0 ^b	1 \pm 0 ^b	2 \pm 0 ^b

(b) Live carp

Makwanpur	350 \pm 0 ^a	200 \pm 12 ^a	150 \pm 12 ^a	3 \pm 0 ^a	147 \pm 12 ^a
Chitwan	350 \pm 0 ^a	200 \pm 0 ^a	150 \pm 0 ^a	3 \pm 0 ^a	147 \pm 0 ^a
Nawalparasi	350 \pm 0 ^a	226 \pm 0 ^a	124 \pm 0 ^a	3 \pm 0 ^a	121 \pm 0 ^a

Average marketing margin of wholesalers in three districts is presented in Table (3). Accordingly, selling price, buying price, income and profit of wholesaler for fresh and live carp did not vary significantly ($p > 0.05$) between districts, but variable cost differed significantly ($p < 0.05$). Variable cost of wholesaler for both fresh and live carp was significantly ($p < 0.05$) higher in Makwanpur (18 ± 2 Rs/kg) than Nawalparasi (11 ± 1 Rs/kg) and was at par with Chitwan (14 ± 0 Rs/kg) (Table 3).

Table 3. Marketing margin of wholesalers in the study districts**(a) Fresh carp**

Districts	Selling price (Rs/kg)	Buying price (Rs/kg)	Income (Rs/kg)	Variable cost (Rs/kg)	Profit (Rs/kg)
	Mean±SE	Mean±SE	Mean±SE	Mean±SE	Mean±SE
Makwanpur	283±6 ^a	225±14 ^a	58±9 ^a	18±2 ^a	40±8 ^a
Chitwan	265±22 ^a	230±15 ^a	35±8 ^a	14±0 ^{ab}	21±8 ^a
Nawalparasi	253±6 ^a	223±1 ^a	30±8 ^a	11±1 ^b	19±7 ^a

(b) Live carp

Makwanpur	350±0 ^a	200±11 ^a	150±11 ^a	18±3 ^a	132±11 ^a
Chitwan	350±0 ^a	200±11 ^a	150±11 ^a	14±1 ^{ab}	136±12 ^a
Nawalparasi	350±0 ^a	226±3 ^a	124±3 ^a	11±0 ^b	113±3 ^a

The value of average marketing margin of retailer in three districts is presented in Table (4). Buying price, income and profit of retailer for fresh and live carp did not vary significantly ($p>0.05$) among districts, but selling price of fresh carp and variable cost of fresh and live carp differed significantly ($p<0.05$). Variable cost of retailer for fresh and live carp was highest in Makwanpur (17±0Rs/kg); intermediate in Chitwan (8±0Rs/kg), and lowest in Nawalparasi (3±0Rs/kg). Selling price of fresh carp was higher in Makwanpur (333±0Rs/kg) than in Nawalparasi (263±0Rs/kg). However, selling price of fresh carp in Chitwan (283±26Rs/kg) was at par with Makwanpur and Nawalparasi (Table 4).

Table 4. Marketing margin of retailers in the study districts**(a) Fresh carp**

Districts	Retailer				
	Selling price (Rs/kg)	Buying price (Rs/kg)	Income (Rs/kg)	Variable cost (Rs/kg)	Profit (Rs/kg)
	Mean±SE	Mean±SE	Mean±SE	Mean±SE	Mean±SE
Makwanpur	333±0 ^a	260±20 ^a	73±21 ^a	17±0 ^a	56±22 ^a
Chitwan	283±26 ^{ab}	238±12 ^a	45±14 ^a	8±0 ^b	37±14 ^a
Nawalparasi	263±0 ^b	233±0 ^a	30±0 ^a	3±0 ^c	27±0 ^a

(b) Live carp

Makwanpur	350±0 ^a	200±12 ^a	150±12 ^a	17±0 ^a	133±11 ^a
Chitwan	350±0 ^a	200±12 ^a	150±12 ^a	8±0 ^b	142±11 ^a
Nawalparasi	350±0 ^a	226±0 ^a	124±0 ^a	3±0 ^c	121±0 ^a

Table (5) shows the distribution of profit among carp traders in fresh and live carp supply chains in Makwanpur, Chitwan and Nawalparasi districts. In fresh carp supply chain, middleman received higher profit (50%) in Chitwan and retailer in Makwanpur (50%) and Nawalparasi (56%) districts. In live carp supply chain, middleman received higher profit (34-36%) compared to retailer and wholesaler in all three districts.

Table 5. Percentage (%) distribution in profit of intermediaries in supply chain of fresh and live carp in the study districts

(a) Supply chain of fresh carp			
Districts	Makwanpur	Chitwan	Nawalparasi
	% of total profit	% of total profit	% of total profit
Middleman	15	50	4
Wholesaler	35	18	40
Retailer	50	32	56

(b) Supply chain of live carp			
Category/Districts	Makwanpur	Chitwan	Nawalparasi
	% of total profit	% of total profit	% of total profit
Middleman	36	35	34
Wholesaler	32	32	32
Retailer	32	33	34

DISCUSSION

Overall carp supply chain is regulated by farmer, middleman, wholesaler, retailer and consumer. Seven supply chains have been identified in fresh carp, and four supply chains in live carp from carp grow out farmer to consumer involving no to few intermediaries in between as revealed from this study. Study showed that farmers were found to sell both fresh and live carp to any one of middleman, wholesaler, retailer and consumer whosoever comes in their contact first and best price provided to them. Supply chain of live carp was shorter than that of fresh carp involving no to only one intermediary. The reason was to minimize handling stress and mortality of carp caused by increased handling and duration of transport. There was either a middleman or retailer or wholesaler between a farmer and a consumer. The reason was marketing risk increases with increased intermediaries in live commodity trade (Srivastava et al., 1985). Increased number of intermediaries in live carp supply chain obviously increases fish handling and also the duration of transport and both are fatal to live fish. Fish is a very sensitive commodity and transportation is more hazardous for fish than other agricultural products.

Grow out farmers in Nawalparasi earned significantly ($P < 0.05$) higher profit than Makwanpur and Chitwan which was due to higher selling price and lower variable costs incurred to production (Table 1). Feed cost was comparatively lower in Nawalparasi due to cheaper feed ingredients such as rice bran, mustard oil cake. They purchased feed ingredients from local mills in cheaper rate compared in Chitwan and Makwanpur that decreased feed cost to farmers in Nawalparasi.

Middleman of Chitwan district earned significantly ($p < 0.05$) higher profit by selling fresh carp than the middleman of Nawalparasi and Makwanpur districts due to high selling price of carp and low variable cost incurred (Table 2). In Chitwan, middleman was found to play multiple roles such as wholesaler, retailer, and supplier to maximize the profit. In addition, price was relatively stable in the district due to regulation of fish price by Chitwan branch of Fishery Association of Nepal. On the other hand, variable cost was significantly ($p < 0.05$) higher in Makwanpur district because middleman has been found to collect carp from Bara district that increased the transportation cost. Middleman of Chitwan and Nawalparasi districts collect the fresh carp from the same district, so, no extra transportation cost was incurred. In case of live carp marketing, profit was same in three districts due to same selling price and variable costs. Since consumers are willing to pay more for live fish than fresh fish, the price of live carp was high, fixed and similar and due to this reason profit did not differ in three districts (Table 2).

Fresh carp price was significantly ($p < 0.05$) higher in the retail market in Makwanpur which might be due to low carp production in the district compared to Chitwan and Nawalparasi. Agri-Business Promotion and Statistics Division of Ministry of Agricultural Development in (2015) reported that fish production was 16940 kg in Makwanpur, 1873450 kg in Chitwan and 1267010 kg in Nawalparasi in 2014. Selling price of fresh carp varied depending on species, size and state of carp as reported by Tiwari (2009) and Yousuf (2004) while that of live carp was relatively stable. Rohu, Mrigal, Common carp and Grass carp fetched higher price

over to Silver carp and Bighead carp. Similarly price of carp less than half kilogram was Rs. 180 at minimum and that of larger than half kilogram was Rs. 200 at minimum. From market safari it was found that retailers were found to sell stale carp in cheaper price due to lack of proper storage and post harvest technology. Common value chain activities included grading of fish by size, adding ice to fresh carp in plastic crates to increase shelf life of fish, and supplying oxygen to live carp in water filled plastic tank, dressing of fish.

Present study assessed role of actors in flow of carp from pond to plate and efficiency of existing carp supply chains in three districts. All the intermediaries involved in carp supply chain are found to receive profit. Among them, middleman is found to earn higher profit from carp marketing with lower investment. All traders are found to receive higher profit from live carp marketing over fresh carp and due to this reason traders are attracted towards this business despite higher risk involved. There is no effect of length of chain on profit to farmers but it certainly does to health of consumer because fish spoils quickly.

CONCLUSION

Carp is sold mainly as fresh fish in the market in Nepal. However, profit earned by traders is found to be higher in live carp supply chain than in fresh carp. In the existing situation, live carp supply chain is risky and expensive because requires improved technology and more energy for transportation and holding carp alive for long. Therefore, it is wise to promote fresh carp supply chain and improve management of existing fresh carp supply chain to benefit all stakeholders. Adding values to carp could be done to strengthen supply chain of carp and overall aquaculture industry in Nepal.

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