Agricultural Economics Research Review 2019, 32 (Conference Number), 149-163
DOI: 10.5958/0974-0279.2019.00024.7

Value chain analysis of buffalo meat (carabeef) in India

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Abstract This paper maps and analyses value chains for buffalo meat (carabeef) in India. The chain actors involve farmers, peri-urban and urban dairies, aggregators, traders/sub-traders, retailers, restaurants/ roadside stalls and export-oriented abattoirs. The quantitative mapping shows that aggregators constitute the main link between farmers and live animal markets and account for 72% of the total flow of buffaloes to livestock markets. Sub-traders/traders ship the bulk of the flow (94%) from markets to abattoirs. Of the total meat produced, 71% is shipped directly to importing countries and the rest to local markets; retailers take away 87% and restaurants 13%. Of the total value added, traders in the domestic value chains and export-oriented units capture a significant share.

Keywords Buffalo meat, value chain analysis, India

JEL classification Q13, Q18

1 Introduction

In India, buffaloes are reared primarily for milk. Their meat is an adjunct; often, male calves and unproductive males and females are utilized for meat production. Given the ban on cattle slaughter in most Indian states, demand has risen for buffalo meat or carabeef in domestic and international markets. From 2002-03 to 2016-17, carabeef production in India grew at 13.75% per annum whereas the production of other meats grew at 11.31% per annum. The share of carabeef in total meat production increased from about 15% in 2009-10 to 21% in 2014-15. In 2016-17, carabeef contributed 94% to India's total export of meat in value terms. With a share of 18% in global beef exports, India was the second largest exporter of beef (including carabeef) in 2018. The increasing demand for carabeef points towards the potential of buffaloes in augmenting farmers' incomes. However, there is a clear dualism in the meat industry: the organized sector caters to the export demand and the unorganized sector meets the domestic requirement, but both sectors source animals from smallholder producers, who often own two to three animals and occasionally sell the unproductive ones in the local market or to local traders or aggregators (Landes et al. 2016).

Rearing and selling buffaloes for meat is typically a residual activity, not a planned farm business (FICCI 2013), and there is no systematic linkage among producers, traders and processors to respond to the changes in meat demand. Hence, it is important to study the structure and governance of carabeef value chains. Efficient value chain management is crucial for delivering products in a safe, timely manner especially as developing-country demand grows for high-value food commodities (Rich and Narrod 2005). Most of the literature on livestock value chains in India focuses on dairy value chains (Birthal et al. 2009; Sharma et al. 2009; Kumar 2010; Kumar et al. 2011; Wani et al.

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2014; Birthal et al. 2017); there is hardly any systematic study on meat value chains, especially for large ruminants. A recent qualitative study of carabeef value chains for domestic and export-oriented markets did not attempt a quantitative mapping of value chains (FICCI 2013).

This paper aims to identify and characterize different actors in carabeef value chains and map the linkages among them; and assess the economic performance of value chains in terms of transaction costs and distribution of benefits among chain actors. The findings are likely to help chain actors to improve the governance and competitiveness of each segment of the chain and help it function efficiently.

2 Methodology

2.1 Study area

The study was conducted in Uttar Pradesh, a state in India that has a larger buffalo population (306 lakhs in 2012) than any other state and contributes more than half (52.53% in 2015-16) of the total carabeef production in the country; 61% of the abattoirs and meat processing plants in the country are concentrated in the state. The primary survey of value chain actors was carried out in Bareilly district, which has a total buffalo population of 6.37 lakhs. There are two export-oriented slaughterhouses in the district – Marya Frozen Agrofoods, which is entirely export-oriented and has the capacity to slaughter 1,000 buffaloes per day, and Marya Frozen Agrofoods Products, a recently established public-private enterprise with the capacity to slaughter 600 buffaloes per day for the international market and an additional 100 for the domestic market.

2.2 Sampling and data

There are multiple actors in the carabeef value chain – farmers, peri-urban and urban dairies, aggregators, traders/sub-traders, transporters, slaughterhouses, butchers, hotels/ restaurants, retailers and exporters. We gathered information from 19 rural buffalo owners, 8 aggregators, 5 sub-traders, 1 trader (there are 5 registered traders/suppliers in Bareilly city), 13 buffalo meat retailers, 18 peri-urban/ urban dairies and 13 restaurants/roadside food stalls serving carabeef.

We visited market agents at seven livestock markets to understand how these markets function and identify the chain actors. Five of these markets are located around Bareilly city (Rithora, Faridpur, Saidpur and Devchaura) and one in Shahajanpur district (Katra). We also covered two distant markets – Jubairganj in Faizabad district and Khalilabad in Sant Kabir Nagar district. We held informal focus group discussions with various chain actors. We held one formal focus group discussion each at Marya Frozen Agrofoods and Marya Frozen Agrofoods Products, where the informants included veterinarians, laboratory technicians and butchers. We also held a formal focus group discussion with retailers at ICAR-Indian Veterinary Research Institute, Izatnagar (Uttar Pradesh). The aim of these focus group discussions was to validate the description of the value chains in terms of actors; process/product flows; information on prices and quantities produced, marketed and consumed; and governance mechanisms. The number of animals transacted in each market is presented in table A1 in the appendix.

2.3 Analytical framework

The following sections present in details the analytical approaches adopted in this study.

2.3.1 Cost and return structures

2.3.1.1 Farmers, peri-urban and urban dairies

Buffaloes are reared mainly for milk and for meat as an adjunct. This makes it difficult to estimate the costs of maintaining and rearing meat buffaloes only; in fact, this information is practically non-existent. In this paper, we estimate the cost of rearing buffaloes for milk.

The maintenance cost of buffaloes was computed by utilizing the specifications as given in a report on 'Cost and returns in milk production - Developing standardized methodology and estimates for various production systems' by ICAR-NDRI (2015), which presents the standardized approaches to analyse the cost and returns in milk production. The overall cost of rearing animals is an aggregate of the expenditure incurred on the fixed and variable items. The fixed costs include depreciation on durable assets like animal sheds, equipment, buildings and the animal itself. The depreciation on sheds and equipment was worked out using the straight-line method considering the useful life of the asset concerned.

Assuming that dairy animals have a productive life of 10 years, the depreciation rate was worked out as being 10% per annum. Similarly, the depreciation rate for other fixed assets was taken as 5% for pucca buildings and 10% for chaff cutters based on appropriate assumptions regarding their productive lives (20 years for pucca buildings and 10 years for chaff cutters). The interest on fixed capital (like value of animal, shed, store and equipment) was calculated at 12% per annum. The components of variable cost include the cost of feed and fodder, labour expenses and expenditure on veterinary and health care. For apportioning of joint costs, standard animal units of the bovine stock were derived for each farm household as per the specifications given in Kumbhare et al. (1983) (see table A2 in the appendix).

The owners of peri-urban and urban dairies were observed to sell their animals directly to abattoirs. They costs they incurred in the movement and transport of animals were added to the production costs.

2.3.1.2 Aggregators

The aggregators collect the animals from villages and transport them to livestock markets for onward sale to sub-traders. We computed the daily cost incurred by the aggregators based on the number of animals bought and sold. The cost components for aggregators include transport cost, market fees, labour expenditure and miscellaneous expenses.

2.3.1.3 Sub-traders/traders

The registered traders who supply buffaloes to abattoirs do not directly procure animals; they contract with sub-traders, who buy animals from the market and transport them to abattoirs on the registered trader's behalf for a nominal fee based on the live weight of the animal. The costs incurred by traders include transport costs, abattoir fees, miscellaneous expenditure and payments to sub-traders.

2.3.1.4 Retailers

The costs to retailers are comprised of the fixed cost of their establishments, utensils and equipment including refrigerators, air conditioners, etc. The variable costs include transport costs of carcasses/meat cuts from abattoirs to the retail outlets, wages and miscellaneous expenses.

2.3.1.5 Restaurants

Restaurants and roadside food stalls are the only units that sell value-added carabeef products. Their cost components are the fixed costs of their establishments, utensils and equipment; and their variable costs include the costs of fuel, labour and services and the costs of ingredients used in cooking.

2.3.1.6 Export-oriented abattoirs

The establishment cost of an abattoir with the capacity to handle 1,000 animals per day is calculated using the information in table A3 in the appendix. The operational costs are computed using both primary and secondary data. The cost components are the fixed cost of establishment (including civil works, plant and equipment work, refrigeration plant, effluent treatment plant, rendering, biogas and other miscellaneous assets), and the variable costs consist of wages/salaries and costs associated with transport, electricity, packaging and certification. The cost components are calculated utilizing the primary data collected from the abattoirs, but for the certification and packaging costs we relied on estimates given in FICCI (2013).

2.3.2 Distribution of benefits

Demand for carabeef is derived demand, as the products demanded by consumers are fresh and processed carabeef products and not the buffaloes. Therefore, we converted the live body weight of animals into carcass weight assuming a dressing percentage of 55%. The live body weight of buffaloes depends on their age group. Based on the number of animals of different weight groups and their respective body weights, the average carcass weight was arrived at 153.9 kg per transacted animal. The details of group wise market values are presented in table A4 in the appendix. The average price received from sale of buffalo / buffalo meat by chain actors and the costs incurred by them are used to assess the net margins accrued to them.

Net margin = realized price - unit cost (including transaction costs)

where, transaction costs include communication, market fees, commission charges and personnel time.

3 Results and discussion

3.1 Mapping of value chain

We map the carabeef value chain utilizing information from key informants and group discussions and following the framework in Alarcon et al. (2017) (figure 1). Farmers and local peri-urban and urban dairies are the main suppliers of buffaloes for meat. Farmers sell their male calves and unproductive female buffaloes mostly to aggregators who, in turn, sell these in local livestock markets. A major share of the market arrivals happens through aggregators, and the rest by farmers. There are 150-250 aggregators in Bareilly city. An aggregator brings about 18 animals each week to a market on average. Farmers and aggregators agree to a price based solely on the body weight of animals.

There are 350-450 peri-urban and urban dairies in and around Bareilly city, and these sell male buffalo calves and unproductive dairy animals directly to abattoirs. On an average, each dairy supplies 1-2 animals per month to the abattoirs. Price settlement is on the basis of body weight.

There are 200-250 sub-traders operating on behalf of the five registered traders. The sub-traders procure animals from markets and transport them directly to abattoirs. Most of them bring animals directly from markets to abattoirs. A small share of the buffaloes that sub-traders procure from markets are sold in other livestock markets too; other sub-traders procure these for transfer to abattoirs. Each sub-trader procures 20 animals on average per trip on each visit to the market. Facilitating agents, or transporters – not sub-traders or

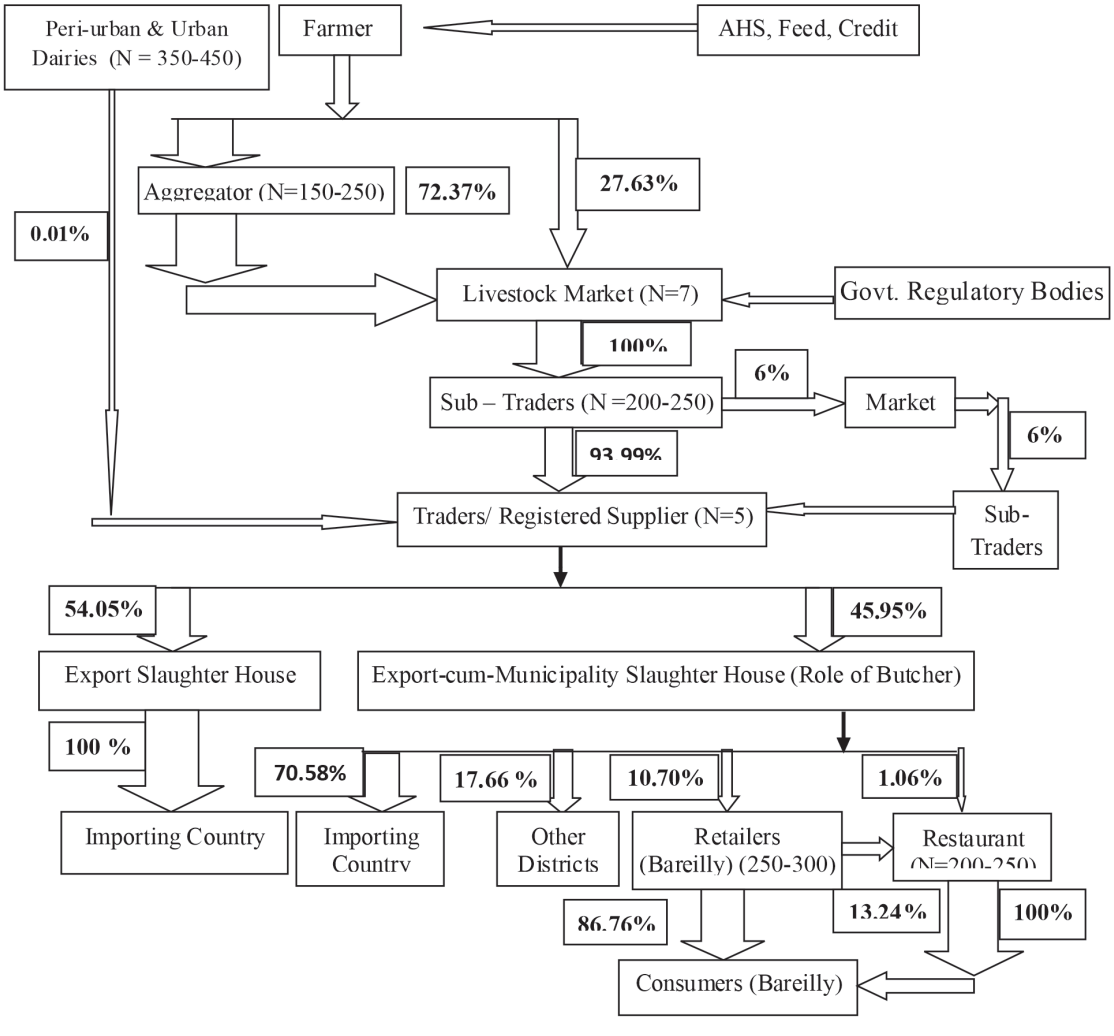

Figure 1. Buffalo meat (carabeef) value chain

traders – own the vehicles in which the animals are transported. Price is determined mainly on the basis of the live body weight of animals. Each abattoir receives 900 to 1,500 animals on average per day per trader.

About 54% of the animals are brought to the export-oriented abattoir and 46% to the export-cum-domestic abattoir. Frozen, boneless meat (pack sizes of 18 kg, 20 kg, 25 kg and 28 kg) is the main item of export to Algeria, Egypt, Saudi Arabia, Vietnam, Syria, Iraq, Mauritius, Jordan, Muscat, the UAE, Yemen and Kyrgyzstan. The export-cum-domestic abattoir has the mandate of supplying the meat of 100 animals to the domestic market.

The animals are slaughtered in the night and the carcasses are hung in air-conditioned rooms; these are sold to retailers in the following morning. Prices are negotiated with traders (sellers) at the abattoir. Each retailer procures 50 kg of meat per day from the abattoir on average. Three or four retailers together rent a vehicle to transport the carcass to their retail outlets.

A retailer sells 36 kg of meat on average and stores the leftover meat in refrigerators. They sell most of the fresh meat to consumers and the rest to restaurants/ roadside stalls that make and sell carabeef biryani, minced meat curry and meat curry. These restaurants also procure meat directly from the slaughter-house.There are about 200-250 restaurants and 50 roadside food stalls in Bareilly city; a restaurant procures 27 kg of meat daily from a slaughterhouse on average and 11 kg from retailers.

3.2 Spatial dimension of the value chain

Figure 2 presents geographical routes through which live animals are supplied to the slaughterhouses in Bareilly. These are transported from livestock markets as far as Sant Kabir Nagar and Faizabad districts. Along this route lie the other major livestock markets – Rithora, Katra and Faridpur. The geographical route for supply of carcasses / meat cuts from slaughterhouses to various retail outlets is shown in figure 3. The distance from slaughterhouses to retail outlets in Bareilly averages 15 km.

Table 1 shows the temporal variation in the transaction of buffaloes and carcasses. Although there is no seasonal variations in the number of animals transacted, but it increases substantially during festivals like Eid. Aggregators raise procurement by 53%, traders by 63% and retailers by 73%.

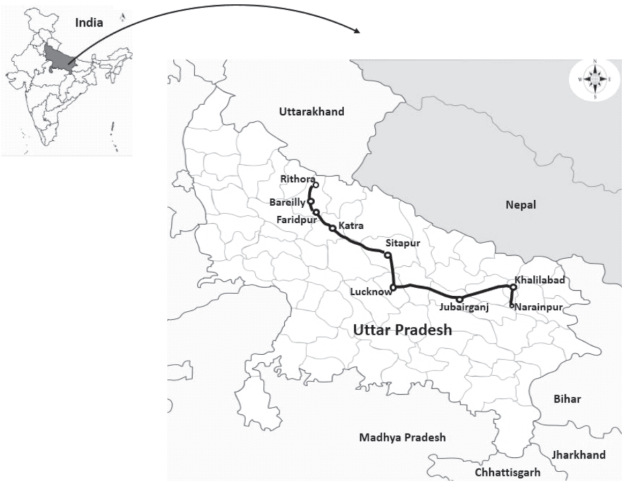

Figure 2. Geographical route for transfer of buffaloes to Bareilly

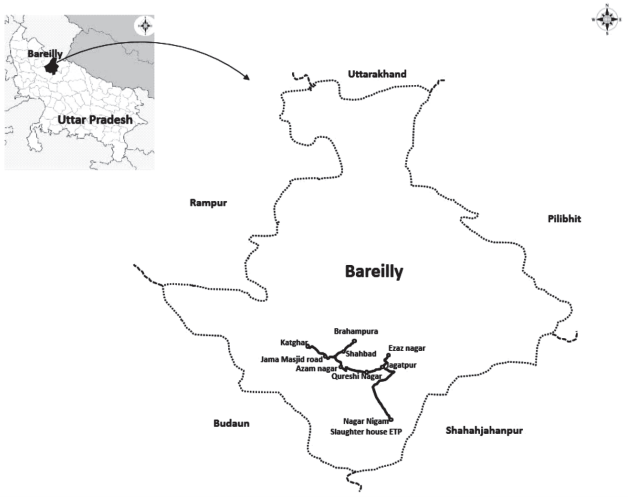

Figure 3. Geographical route for transport of carcass/ meat cuts from slaughter house to retail hubs in Bareilly

3.3 Cost structure for chain actors

3.3.1 Farmers and peri-urban & urban dairies

Table 2 shows the average maintenance costs of rearing buffaloes of different age groups. The maintenance cost per adult female buffalo is estimated at Rs. 306 per day. For male calves younger than a year, it works out to Rs. 64.56 per day, and for calves older than a year Rs. 119 per day. Variable costs account for 88% to 92% of the total cost. The proportion is similar for milk (Meena et al. 2010; Mahajan et al. 2010; Baral and Bardhan 2012). Feed and fodder account for more than 75% of the total variable cost, a finding in consonance with Aitawade et al. (2005) and Khoveio et al. (2012).

Table 1. Increase in procurement of animals/carcasses during festivals

Stakeholders	Procurement of during normal season (per market)	Procurement of during festivals (per market)	% increase in procurement during festivals
Aggregators(No. of animals)	9	14	52.78
Traders(No. of animals)	20	32	63.26
Retailers (kg.)	50	85	70.76

Source: Authors' calculations based on field survey (2018)

Table 2. Maintenance cost of rearing buffalo

(Rs per animal per day)

Particulars	Adult female buffalo (n=16)	Male calf (<1 yr) (n=6)	Male calf (>1 yr) (n=4)
Fixed costs			
IFC	13.49	2.62	6.19
	(4.41)	(4.06)	(5.18)
Depreciation	19.31	3.87	8.72
	(6.31)	(5.99)	(7.30)
Total fixed costs	32.8	6.49	14.91
	(10.72)	(10.05)	(12.48)
Variable costs			
Feed & fodder costs			
Dry fodder	110.07	29.07	69.02
	(35.96)	(45.03)	(57.76)
Green fodder	67.08	10.98	12.72
	(21.92)	(17.01)	(10.64)
Concentrate	60.70	9.98	12.25
	(19.83)	(15.46)	(10.25)
Total feed & fodder cost	237.85	50.03	93.99
	(77.71)	(77.49)	(78.65)
Veterinary expenses	9.61	1.31	0
	(3.14)	(2.03)	
Labour expenses	25.81	6.73	10.60
	(8.43)	(10.42)	(8.87)
Total variable costs	273.27	58.07	104.59
	(89.28)	(89.95)	(87.52)
Total cost	306.07	64.56	119.5

Source: Authors' calculations based on field survey (2018); Figures in parentheses indicate percentage of total costs

In peri-urban and urban dairies, it costs about Rs. 225 per day on average to maintain an adult female buffalo, Rs. 47 for a male calf younger than a year and Rs. 53 for a male calf older than a year (table 3). Again, the variable costs account for a major share of total cost, the feed being the main item of cost.

Table 4 presents the average costs associated with the sale of buffaloes by owners of peri-urban and urban dairies to the abattoirs. Transport cost is the major component of marketing costs (83%).

3.3.2 Aggregators

Table 5 presents the average costs of procurement and sale of buffaloes by aggregators. For one kg of carcass, the average cost is estimated Rs 147, of which 99.57% is for the purchase of the live animal.

Table 3. Maintenance cost of rearing buffaloes in peri-urban and urban dairies (Rs per animal per day)

Particulars	Adult female buffalo (n=495)	Male calf (<1 yr) (n=11)	Male calf (>1 yr) (n=7)
Fixed costs			
IFC	13.73(6.10)	2.65(5.60)	6.22(11.64)
Depreciation	18.86(8.38)	3.12(6.60)	7.46(13.96)
Total fixed costs	32.59(14.48)	5.77(12.20)	13.68(25.60)
Variable costs			
Feed & fodder cost			
Dry fodder	39.95(17.75)	8.37(17.69)	11.60(21.70)
Green fodder	22.74(10.11)	4.50(9.51)	5.92(11.08)
Concentrate	108.76(48.33)	24.01(50.75)	14.47(27.08)
Total feed & fodder cost	171.45(76.19)	36.88(77.95)	31.99(59.86)
Veterinary expenses	3.26(1.45)	0.55(1.16)	1.66(3.11)
Labour expenses	17.72(7.87)	4.11(8.69)	6.11(11.43)
Total variable costs	192.43(85.52)	41.54(87.80)	39.76(74.40)
Total cost	225.02	47.31	53.44

Source: Authors' calculations based on field survey (2018); Figures in parentheses indicate percentage of total costs

Table 4. Costs incurred by peri-urban and urban dairies in selling of buffaloes (Rs)

Particulars	Per animal	Per kg carcass weight
Marketing costs		
Transportation cost	0.77	0.02 (83.33)
Labour expenses	0.18	0.004 (16.67)
Total marketing cost		0.024

Source: Authors' calculations based on field survey (2018)
Figures in parentheses indicate percentage of total transaction costs

3.3.3 Traders

A trader pays Rs. 154 per kg of carcass weight (Table 6) on average including marketing and transport charges; only 1% is marketing and transaction costs. Kadigi et al. (2013) report similar findings from Tanzania.

3.3.4 Retailers

Table 7 presents the average cost incurred by retailers in procuring carabeef for domestic consumers and distributing it to them. Procurement costs retailers Rs. 183 on average per kg of carcass; about 4.4% is spent on transport and transaction costs.

Table 5. Costs incurred by aggregators in procurement and marketing of buffaloes (Rs)

Particulars	Per animal	Per kg carcass weight
Purchase price of animals	20,625.00	146.11
Marketing and transaction costs		
Transportation cost	41.38 (37.93)	0.30 (47.62)
Market fees	20.18 (18.50)	0.14 (22.22)
Labour expenditures	41.82 (38.33)	0.16 (25.40)
Miscellaneous expenses	5.72 (5.24)	0.03 (4.76)
Total marketing & transaction cost	109.10	0.63
Total cost		146.74

Source: Authors' calculations based on field survey (2018); Figures in parentheses indicate percentage of total transaction costs

Table 6. Costs incurred by traders in procurement and selling of buffaloes (Rs)

Particulars	Per animal	Per kg carcass weight per day
Purchase price of animal	25,879.13	150.09
Marketing and transaction costs		
Transportation cost	64.31	0.37
	(9.65)	(8.79)
Slaughter house fees	400	2.65
	(59.99)	(62.95)
Miscellaneous expenses	29.99	0.19
	(4.50)	(4.51)
Fees paid to sub-traders	172.47	1.00
	(25.86)	(23.75)
Total marketing & transaction cost	666.77	4.21
Total cost		154.30

Source: Authors' calculations based on field survey (2018)
Figures in parentheses indicate percentage of total transaction costs

Table 7. Costs incurred by Retailers in procurement and selling of carcasses/meat cuts (Rs)

Particulars	Per animal	Per kg carcass weight
Carcass price	8,750	175
Fixed cost		
IFC	1.43	0.03
		(0.38)
Depreciation	1.14	0.02
		(0.25)
Total fixed cost	2.57	0.05
Marketing & transaction costs		
Transportation cost	187.69	4.07
		(50.89)
Labour expenditures	152.56	3.41
		(42.63)
Miscellaneous expenses	24.10	0.52
		(6.50)
Total marketing & transaction cost	364.35	8.00
Total cost		183.05

Source: Authors' calculations based on field survey (2018)
Figures in parentheses indicate percentage of transaction costs

3.3.5 Restaurants / roadside stalls

Table 8 shows the components of costs in the preparation of one plate of 100 gm of meat curry and minced meat curry. Table 9 shows the cost components of preparing one plate of 250 gm carabeef biryani. In both cases, the fixed cost is a small proportion of the total costs; the expected purchase price accounts for the highest share. The net returns from the sale of meat curry and minced meat curry are almost similar. For biryani, the net return realization is higher for roadside stalls.

3.3.6 Export-oriented abattoirs-cum-meat processing plant (1,000 buffaloes/day capacity)

It costs about Rs. 605.5 million to set up a modern, export-oriented abattoir and meat processing plant that

Table 8. Per plate (100 gm) cost and returns in preparation of cooked beef items (Restaurants) (Rs)

Particulars	Minced meat curry	Meat curry
Fixed Cost		
IFC	2.06	0.84
	(9.45)	(3.70)
Depreciation	0.43	0.35
	(1.97)	(1.54)
Total fixed cost	2.49	1.19
	(11.42)	(5.24)
Variable cost		
Purchase price of carabeef (60 – 70 gm)	13.1	11.22
	(60.09)	(49.36)
Cost of cooking	4.05	8.41
	(18.58)	(37.00)
Labour cost	2.16	1.91
	(9.91)	(8.40)
Total variable cost	19.31	21.54
	(88.58)	(94.76)
Total cost	21.80	22.73
Selling price	31.90	32.50
Net Return	10.10	9.77

Source: Authors' calculations based on field survey (2018)
Figures in parenthesis indicate percentage.

Table 9. Per plate (250 gm) cost and returns in preparation of cooked beef items (Biryani) (Rs)

Particulars	Restaurant	Roadside stall
Fixed cost		
IFC	0.35	0.007
	(1.19)	(0.03)
Depreciation	0.07	0.002
	(0.24)	(0.01)
Total fixed cost	0.42	0.009
	(1.43)	(0.04)
Variable cost		
Purchase price of carabeef (50 – 60 gm)	11.27	9.5
	(38.29)	(35.34)
Cost of cooking	17.44	17.27
	(59.26)	(64.25)
Labour cost	0.30	0.10
	(1.02)	(0.37)
Total variable cost	29.01	26.87
	(98.57)	(99.96)
Total cost	29.43	26.88
Selling price	40.00	40.00
Net Return	10.57	13.12

Source: Authors' calculations based on field survey (2018)
Figures in parenthesis indicate percentage.

can slaughter 1,000 buffaloes a day (table A3 in the appendix). Civil works comprise the major cost item – followed by refrigeration; machinery and equipment; and rendering and blood processing facilities.

Table 10 shows the components of operational costs. The operational cost per kg of carcass weight works out to Rs 176.65, of which the variable costs account for an overwhelming share (98.96%); and the acquisition of live animals comprises 90.38% of the variable costs. Transport, packaging and wages/salaries account for the rest.

3.4 Returns

Table 11 shows the returns. The weighted export price, considering the volume of carabeef sold to eight countries, is about Rs 200 per kg. As such, return from sale of buffalo meat is Rs 30.8 million per day. Returns from sale of red offal is Rs 0.83 million per day. Returns from other by-products, viz. trimmings, brain, tail and hide is about Rs 0.9 million per day. The total return for the modern abattoir comes Rs 32.5 million per day. Given the operational cost of Rs 25.6 million (including of fixed cost), the net return per day is Rs 5.1 million.

3.5 Distribution of value addition across chain actors

Table 12 shows distribution of benefits across the fresh buffalo meat value chain in the domestic market, for animals procured by aggregators and supplied by peri-urban & urban dairies directly to abattoirs. The net margin is the highest for traders (retaining 57% of total value added), and followed by retailers (accounting for 37% of value added). In case of peri-urban and urban dairies selling directly to the abattoirs, the trader's share in value added is 63%.

Table 13 presents distribution of benefits in case restaurants/roadside stalls buying meat from retailers. The net margins for restaurants/roadside stall ranges

Table 10. Operational cost structure for an Export Unit (1,000 buffaloes / day slaughtering capacity) (Rs/day)

Particulars	Per animal (Rs)	Per kg carcass weight (Rs)	Total cost for the unit (Rs in '000)
Fixed cost			
Interest on fixed capital	199.07	1.29	199.07
Depreciation			
Civil works	21.92	0.14	21.92
Main plant & equipment	20.55	0.13	20.55
Refrigeration plant	16.44	0.11	16.44
ETP	4.38	0.03	4.38
Rendering	9.86	0.06	9.86
Bio gas	2.05	0.01	2.05
Miscellaneous fixed assets	8.90	0.06	8.90
Total fixed cost	283.17	1.83	283.17
Variable cost			
Purchase price of buffalo	24,330.42	158.00	24,330.42
Wages / salaries			
Deboning / Slaughtering butchers (250 Nos. @ Rs 12000/head)	100.00	0.65	100.00
Packaging staff (100 Nos. @ Rs 8000/month)	26.67	0.17	26.67
Inspectors / Checkers (20 Nos. @ Rs 10000/month)	6.67	0.04	6.67
Animal attendants / Sanitation staff / By-products handlers (50 Nos. @ Rs 6000/month)	10.00	0.06	10.00
Salaries for VO's / Microbiologists / Quality Managers (40 Nos. @ Rs 40000/month)	53.33	0.35	53.33
Total wages / salaries	196.67	1.27	196.67
Certification charges			
SGS Certification Body			
ISO			
FSS	0.55	0.004	0.55
HACCP			
FSSAI	0.14	0.001	0.14
APEDA	0.14	0.001	0.14
Microbiological & Chemical testing centre	2.74	0.02	2.74
Water & meat testing lab (NABL accredited) charges	0.27	0.002	0.270
Total certification charges	3.84	0.06	3.84
Packaging costs	308.00	2.00	308.00
Transportation cost	2,063.47	13.40	2,063.47
Electricity cost	13.70	0.09	13.70
Total variable cost	27,116.61	174.82	27,116.61
Total cost	27,399.78	176.65	27,399.78

Source: Authors' calculations (2018)

Table 11. Returns from an export oriented slaughterhouse (1,000 buffaloes / day slaughtering capacity) (Rs / day)

Particulars	Weight (Kg)	Price / Kg (Rs)	Returns / animal (Rs)	Total returns (Rs in '000)
Average carcass weight / slaughtered animal	153.99	200.00	30,798	30,798.00
By-products				
Red offals				
Liver	5.00	80.00	400.00	400.00
Kidney	0.50	80.00	40.00	40.00
Heart	1.50	60.00	90.00	90.00
Tongue	1.50	200.00	300.00	300.00
Rumen / reticulum	3.00	-	-	
Brain	0.50	-	60.00	60.00
Trimmings	2.00	55.00	110.00	110.00
Tail	0.90	200.00	180.00	180.00
Hide	-	-	550.00	550.00
Total return	-	-	32528	32,528.00
Net return	-	-	5128.22	5,128.22

Source: Authors' calculations based on field survey (2018)

Table 12. Costs and returns across the fresh meat value chains for domestic consumers of fresh/raw meat

Costs and returns (Rs per kg carcass weight) across the fresh meat value chains (when animals are procured from farmers by aggregators)				Costs and returns (Rs per kg carcass weight) when urban/ peri-urban dairies sell directly to abattoirs			
	Price	Cost	Net Margin		Price	Cost	Net Margin
Farmers				Dairy			
↓	146.11	-	-	↓	150.00	0.02	-
Aggregators				Traders			
↓	150.09	146.74	3.35	↓	175.00	154.30	20.70
Traders				Retailers			
↓	175.00	154.30	20.70	↓	195.00	183.05	11.95
Retailers				Consumers			
↓	195.00	183.05	11.95				
Consumers							

Table 13. Costs and returns (Rs per kg carcass weight) across the value added buffalo meat value chains (for Restaurants / Roadside stalls procuring meat from retailers)

	Restaurant (Biryani)			Roadside Stall (Biryani)			Restaurant (minced meat curry)			Restaurant (meat curry)		
	Price	Cost	Net Margin	Price	Cost	Net Margin	Price	Cost	Net Margin	Price	Cost	Net Margin
Farmers												
↓	146.11	-	-	146.11	-	-	146.11	-	-	146.11	-	-
Aggregators												
↓	150.09	146.74	3.35	150.09	146.74	3.35	150.09	146.74	3.35	150.09	146.74	3.35
Traders												
↓	175.00	154.30	20.70	175.00	154.30	20.70	175.00	154.30	20.70	175.00	154.30	20.70
Retailers												
↓	190.00	183.05	6.95	190.00	183.05	6.95	190.00	183.05	6.95	190.00	183.05	6.95
Restaurant												
↓	257.17	230.17	27.00	282.80	227.20	55.60	275.43	252.14	23.29	269.50	247.60	21.90
Consumers												

Table 14. Costs and returns (Rs per kg carcass weight) across the value added buffalo meat value chains (for Restaurants procuring meat from abattoirs)

	Restaurant (Biryani)			Restaurant (minced meat curry)			Restaurant (meat curry)		
	Price	Cost	Net Margin	Price	Cost	Net Margin	Price	Cost	Net Margin
Farmers									
↓	146.11	-	-	146.11	-	-	146.11	-	-
Aggregators									
↓	150.09	146.74	3.35	150.09	146.74	3.35	150.09	146.74	3.35
Traders									
↓	175.00	154.30	20.70	175.00	154.30	20.70	175.00	154.30	20.70
Restaurant									
↓	244.16	215.16	29.00	266.43	237.14	29.29	258.50	232.60	25.90
Consumers									

Table 15. Costs and returns (Rs per kg carcass weight) across the export-oriented buffalo meat value chains

	Price (Rs/kg carcass weight)	Cost (Rs/kg carcass weight)	Net Margin (Rs/kg carcass weight)
Farmers			
↓	146.11	-	-
Aggregators			
↓	150.09	146.74	3.35
Traders			
↓	158.00	154.30	3.70
Export unit			
↓	200.00	177.95	22.05
Importing country			

between Rs. 22 to Rs. 56 per kg of carabeef. Among the cooked items, the share of restaurants / roadside stalls in the total value added is the highest. Traders share 24% to 39%, followed by retailers (8% to 13%) and aggregators (4% to 6%).

Table 14 presents the price spread in the domestic carabeef value chains where the fresh meat is procured by restaurants directly from the abattoirs. The net margin ranges between Rs. 26 to Rs. 29. The restaurants retain the highest share, (52% to 55%), followed by traders (39% to 41%).

Table 15 presents the price spread for the export-oriented value chain. The net margin earned by exporters is Rs. 22 per kg followed by traders (Rs. 4 per kg) and aggregators (Rs. 3 per kg). In other words, more than three-fourths of the value addition is captured by exporters.

4 Conclusions and implications

The study shows how the major carabeef value chains – domestic chains for fresh meat and value-added cooked meat products, and the chains for international markets – function. However, all the chains originate from the same, highly fragmented back end – smallholder, mixed-crop farming systems and peri-urban and urban dairies. Producers in the study area have practically no market choice, because there are only two slaughterhouses, both primarily export-oriented and both having the same set of registered traders and procurement systems; and animal slaughter is banned at retail outlets. In the value-added domestic chains and export chains, traders, restaurants and export units garner the major share of benefits; they do not pass on the price premium to the producers. This points towards the overall lack of systematic linkage across the value chains.

Overall, this study identified structural deficiencies and vulnerabilities and provided the framework for intervention policies that can improve system efficiency. These may be streamlining the animal preservation acts in the country to promote scientific practices of meat animal production, rejuvenating the scheme on salvaging and rearing of male calves for meat production and implementation of integrated and inclusive contract farming system for meat buffalo production. Future research areas in this field can be application of systems dynamics model to assess the multidimensional effects of such policy interventions throughout the value chains as given by Rich et al. (2011), Dyzee et al. (2017) and Lie et al. (2018).

Acknowledgement

The paper is based on findings from ICAR Network Research Project 'Policy imperatives for promoting value chain of agricultural commodities in India' with ICAR-National Institute of Agricultural Economics and Policy Research (NIAP), New Delhi, as the lead centre.

References

Aitawade, M.S., Waykar, K.R., & Shinde, H.R. (2005). Crossbred cows in Akola district of Maharashtra state. *Indian Dairyman*, *57*(1), 48-52.

Alarcon, P., Fevre, E.M., Murungi, M.K., Muinde, P., Akoko, J., Dominguez Salas, P., Kiambi, S., Ahmed, S., Hasler, B. & Rushton, J. (2017). Mapping of beef, sheep and goat meat system in Nairobi - a framework for policy making and identification of structural vulnerabilities and deficiencies. Agricultural Systems, 152, 1-17.

Baral, Shibashish, & Bardhan, D. (2016). Multivariate typology of milk producing households in Uttarakhand hills, explaining profitability in dairy farming. Indian Journal of Agricultural Economics, 71(2), 160-175.

Birthal, P.S., Awadhesh, K. Jha., Marites, M., Tiongeo, & Clare Narrod. (2009). Farm-level impacts of vertical coordination of the food supply chain, evidence from contract farming of milk in India. Indian Journal of Agricultural Economics, 64(3), 481-95.

Birthal, P.S., Chand, R., Joshi, P.K., Saxena, R., Rajkhowa, P., Khan, M.T., Khan, M.A., Chaudhary, K.R. (2017). Formal versus informal, efficiency, inclusiveness and financing of dairy value chains of Indian Punjab. Journal of Rural Studies, 54, 288- 303.

Dyzee, K., Baker, D. & Rich, K.M. (2017). A quantitative value chain analysis of policy options for the beef sector in Botswana. Agricultural Systems, 156, 13-24.

FICCI. (2013). Overview of the Indian buffalo meat value chain, Agricultural Division, Federation of Indian Chamber of Commerce and Industry, New Delhi.

GOI. (2015). Basic animal husbandry statistics. Department of Animal Husbandry, Dairying and Fisheries, Ministry of Agriculture and Farmers Welfare, New Delhi.

GOI. (2017). Basic animal husbandry statistics. Department of Animal Husbandry and Dairying, Ministry of Agriculture and Farmers Welfare, New Delhi.

Kadigi, R.M.J., Kadigi, I.L., Laswai, G.S., & Kashaigili, J.J. (2013). Value chain of indigenous cattle and beef products in Mwanza region, Tanzania, market access, linkages and opportunities for upgrading. Academia Journal of Agricultural Research, 1(8), 145-155.

Khoveio, Michael, L.L., Jain, D.K., & Cauhan, A.K. (2012). Economics of milk production and its constraints in Nagaland. Indian Journal of Dairy Science, 65(6), 526.

Kumar, A. (2010). Milk marketing chains in Bihar, implications for dairy farmers and traders. Agricultural Economics Research Review, 23(347-2016-16945), 469-478.

Kumar, A., Staal, S.J., & Singh, D.K. (2011). Smallholder dairy farmers' access to modern milk marketing supply chain in India. Agricultural Economics Research Review, 24(2), 243-253.

Kumbhare, S.L., Sharma, K.N.S., & Patel, R.K. (1983). Standardization of bovine units. Indian Journal of Animal Science, 53, 547.

Landes, M., Melton, A., & Edwards, S. (2016). From where the buffalo roams: India's beef exports. Economic Research Service Report (LDPM-264-01), United States Department of Agriculture. Available at https://www.ers.usda.gov/webdocs/publications/37672/59707_ldpm-264-01.pdf.

Lie, H., Rich, K.M., van der Hoek, R., & Dyzee, K. (2018). An empirical evaluation of policy options for inclusive dairy value chain development in Nicaragua, a system dynamics approach. Agricultural Systems, 164, 193-22.

Mahajan, S. (2010). Economic analysis of rural and peri-urban dairy farms in Ludhiana district of Punjab. M.V.Sc Thesis, National Dairy Research Institute (Deemed University), Karnal, Haryana, India.

Meena, G.L., Jain, D.K., & Chandel, B.S. (2010). Economic analysis of milk production in Alwar district of Rajasthan. Journal of Dairying Foods and Home Sciences, 29(1), 1-7.

ICAR-NDRI (National Dairy Research Institute). (2015). Costs and returns in milk production, developing standardized methodology and estimates for various production systems. Final project report submitted to Department of Animal Husbandry, Dairying and Fisheries, Ministry of Agriculture, Government of India.

Rich, K.M., Brent Ross, R., Derek Baker, A., & Negassa, A. (2011). Quantifying value chain analysis in the context of livestock systems in developing countries. Food Policy, 36, 214-222.

Rich, K.M., & Narrod, C.A. (2005). Perspectives on the supply chain management of high-value agriculture, the role of public-private partnerships in promoting smallholder access. In: Proceedings of the international conference 'public-private partnerships for harnessing the potential of rainfed agriculture'. Federation of Indian Chambers of Commerce and Industry, New Delhi, India, 19 October.

Sharma, V.P., Kaplesh Kumar, & R.V., Singh. (2009). Determinants, costs, and benefits of small farmer inclusion in restructured agrifood chains, a case study of dairy industry in India. In: Proceedings of the 19th Annual World Forum and Symposium. International Food and Agribusiness Management Association, Budapest, Hungary, 20-23 June.

Wani, S.A., Shaheen, F.A., Baba, S.H., Naqash, F. & Manzoor, M. (2014). Value chains for livestock products in Himalayan Mountains, studies from Jammu and Kashmir. Indian Journal of Agricultural Economics, 69(3), 280-289.

Table A1. Market-wise distribution of animals transacted (for supply to Bareilly city) across different weight groups

Market	Total No. of animals transacted per day	Weight group (Kg)		
		100-200	200-300	300-400
Rithora	184	35	84	65
Saidpurpur	25	5	11	9
Faridpur	9	2	4	3
Devchaura	25	5	11	9
Katra	34	6	16	12
Juberganj	100	19	45	36
Khalilabad	50	9	23	18
Total No. of animals	427	81	194	152

Source: Authors' calculations based on field survey (2018)

Table A2. Specifications of Standard animal unit (SAU)

Description	Score
Local cow	1.00
Crossbred cow	1.40
Buffalo	1.30
Bullock	1.00
Crossbred heifer (> 2 year)	1.00
Crossbred heifer (> 1 year)	0.75
Buffalo local heifer (> 2 year)	0.75
Buffalo local calves (> 1 year)	0.50
Other calves (< 1 year)	0.33

Source: Kumbhare et al. 1983

Table A3. Establishment cost of a modern abattoir cum meat processing plant (1,000 buffaloes / day capacity)

Particulars	Cost (Rs in lakhs) (Approx.)
Site development cost	
Cost towards land levelling & land scalping, roads, boundary wall security office, gates etc. (This cost depends upon the land area)	250.00
Cost of civil works/buildings	
For lairage, main slaughter area, dressing hall with all required utility services, chillers, processing hall, fresh & frozen packing area along with required utilities and cold store. The total built up area is estimated around 10,000 sq m for the project.	1,600.00
Main plant & equipment (Erected cost)	
Slaughter line capacity: 70 Nos. buffalo per hour	1,000.00
Total cost towards main plant & equipment including chiller lines (4 Nos.), meat processing, packing & freezing including cold store, offal processing equipment.	
Refrigeration plant (Erected cost)	1200.00
ETP (Civil + mechanical) (Erected cost)	
For 450 KLD.	320.00
Rendering & blood processing plant (Erected cost)	720.00
Bio gas plant (Mechanical) (Erected cost)	
To handle dung and ingesta	100.00
Miscellaneous fixed assets	
Office furniture & equipment, electrical sub –station of 1,500 KVA including all electrical installations, DG sets, lab equipments, fire-fighting equipments, CCTV camera, water distribution system, water treatment plant, drainage system, storage water tanks, weigh bridge, refrigerated vans etc	650.00
Pre-operative expenses like establishment, DPR preparation, insurance	100.00
Fees for PMC works	60.00
Contingencies	50.50
Total project cost	6,050.50

Source: G.K. Sen Associates

Table A4. Average value of animals across different weight categories

Weight category (kg)	Average price of animal (Rs in '000)
100-200	12.37
200-300	21.00
300-400	30.08