Research Article

Supply chain efficiency of Tomato in Kathmandu valley

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ABSTRACT

Past studies kept attention on the supply side or value chain aspects of tomato but not kept attention to the supply chain efficiency. To measure supply-side efficiencies in tomato sub-sector, this survey research organized an interview schedule with the randomly selected eighty households in Kirtipur, Chandragiri, Changunarayan, and Godawori municipalities of Kathmandu valley during April to June 2018 with semi structured questionnaire. Study estimated NRs 8,26,144/ha as net profit of tomato grown under tunnel was nearly 44% higher compared to open field condition. Further five types of marketing channels prevailed for tomato market were; channel first (producer-retailer-consumer), channel second (producer-wholesaler-retailer-consumer), channel third (produce-cooperative-retailer-consumer), channel fourth (producer-collector-wholesaler-retailer-consumer) and channel fifth (producer-wholesaler-processor-wholesaler-retailer-consumer) but most dominant was the fourth one since 45% of the fresh tomato supplied through it especially to save time and avoid all possible drudgery in the market. The marketing margin per kilogram of tomato was the lowest (NRs.16.55) in the third channel and the highest (NRs. 39.2) in the fifth channel while the highest market efficiency was 1.27 for the third channel. The producer's share was highest for the third channel (66.33%) and lowest for fifth channel (39.88%). followed by 1st channel (63.72%) and lowest in 5th channel (39.88%). In order to promote a coordinated and most efficient supply chain, the study suggested the most dominant, low marketing margin and highly efficient supply channel for tomato so that tomato producers would get a high share. Rather than a private one, either group marketing or cooperatives are suggested to involve in fresh tomato marketing.

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INTRODUCTION

Tomato (*Lycopersicon esculentum* L.) is one of the major commercial vegetable crops and is widely grown both in the plains and hills of Nepal. It is grown up to 2500 masl however best suited to terai region. The area under tomato cultivation in Nepal is 21,389 ha with total production 400674 MT and productivity is 19 MT/ha (MOALD, 2018). There is still a lack of institutions strongly dealing with market-related issues of perishable vegetables in Nepal. The

marketing situation is still in a rudimentary stage characterized by influences of supply and demand and price realization (Shrestha, 2008). Regarding agriculture marketing in Nepal, a general remark had been such that the traders usually tried transferring all sort of price risks to farmers and offered low prices to them by creating monopsonistic situation, debt-ties and cartel (Thapa et al., 1995). Tomato marketers usually move primary product without value addition. Due to perishable nature of the products and lack of cold chain storage farmers are compelled to sell fresh products at low price market. The promotion of new post-harvest technologies can provide a higher return to the farmers will be easily accepted by the farmers (Timsina and Shivakoti, 2018).

A supply chain is a system of organizations, people, activities, information, and resources involved in moving a product or service from supplier to consumer. The efficient supply chain requires strengthening all the levels of infrastructure such as input delivery, credit, irrigation, procurement, reducing post-harvest losses, creation of cold store chains, starting of processing units and marketing techniques, improving storage plants and marketing information (Chand, 2010). Adhikari et al. (2012) reported that due to lack of value-based outlook in the past development efforts of Nepal, the problem of oversupply existed. Same report also focused on mismatching consumers' expectations and uncoordinated supply chain of Tomato in Nepal. Value chain and supply chain studies in Nepalese context have focused supply perspective and value addition, but not kept attention in the supply chain efficiency considering collective actions (Timsina et al., 2016, Timsina et al., 2012a, b; Shrestha et al., 2012; Chapagain et al., 2011; FBC, 2008). This study focused to know different problems and constraints existing in tomato marketing and to identify the efficient channel of tomatoes marketing for its sustainability considering the market chain efficiency approach

METHODOLOGY

Selection of the study area

Researchers selected Kathmandu valley for the field survey because of increasing trend of both tunnel and open-field tomato production reported and productivity was also higher by 37% compared to national average of 19 MT/ha (MOALD, 2018). Study selected four municipalities of Kathmandu valley Kirtipur, Chandragiri, Godawori and Changunarayan purposely for the study (Figure 1), and respondents of these areas were randomly selected having at least one ropani of land for tomato cultivation. Of the samples, eighteen households were selected from Chandragiri, fourteen from Kirtipur, twenty-six from Changunarayan, and twenty two from Godawori municipality based on 5% of the respondents in the sampling frame.

Figure 1: **Study site**

Sampling procedure and data collection

The authors used a simple random sampling method in selecting 80 sample from the sampling frame. A survey was done from April to June 2018 to collect the primary data from the selected respondents using a semi-structured questionnaire, focus group discussion, and direct field observation. Using coordination schema, different variables were included in the questionnaire and checklist and held interview schedule by visiting each respondent in their home, office, and farm. Further data collection took place with 5 collectors, 3 processors, 5 cooperatives, 10 wholesalers, and 20 retailers as key informants of the same area. Secondary information was collected from the published sources.

Methods and techniques of data analysis

Collected data were coded and entered into MS excel sheet and analysis was done using Statistical Package for Social Science (V25 version) and MS-Excel.

RESULTS AND DISCUSSIONS

Ethnicity of the respondents

Table 1 depicts that respondents constitute four groups based on their caste, namely; Brahmin and Chettri, Janajati, Dalit, and Madhesi. Out of the total respondents; majority were janajaati (55%), followed by Bhramin and Kshetri (35%), Dalit (8.75%), and Madhesi (1.25%).

Table 1: Respondent's ethnicity

	Place	Brahmin & Kshetri	Janajaati	Dalit	Madhesi	Total
Municipality	Chandragiri	5	13	0	0	18
	Kirtipur	4	8	2	0	14
	Changunarayan	8	14	3	1	26
	Godawori	11	9	2	0	22
	Total	28(35)	44(55)	7(8.75)	1(1.25)	80

Note: Figures in parentheses indicate percentage   Source: Field survey, 2018

Profitability analysis
Table 2: Profit (NRs/ha) and B/C ratio analysis of tomato production

Items	Tunnel (A)	Open field (B)	Difference (A-B)
Total income	1873010±92943.39	1152939±90865.74	720070.8±22893.26[**]
Total cost	1046806±59613.52	687006.1±50018.28	359799.5±13214.08[**]
Net profit	826204±105433.7	465893.5±96479.46	360271.3±24781.21[**]
B/C ratios	1.79	1.68	0.11

Source: Field survey, 2018

Using two independent sample t-tests at 5 % level of significance net profit of tomato production in tunnel (NRs. 826204/ha) was found significantly higher compared to open field condition (NRs. 465893.5/ropani). B/C ratio also was higher in tunnel house (1.79) compared to open field condition (1.68) suggests cultivating in a tunnel house is comparatively profitable. The finding also supports by Abdalla, 2015 who found the B/C ratio of tomato production in a tunnel as 1.8. Cost of tomato production in tunnel includes depreciation cost of plastic tunnel and other fixed and variables costs as in open field conditions.

Marketing channels
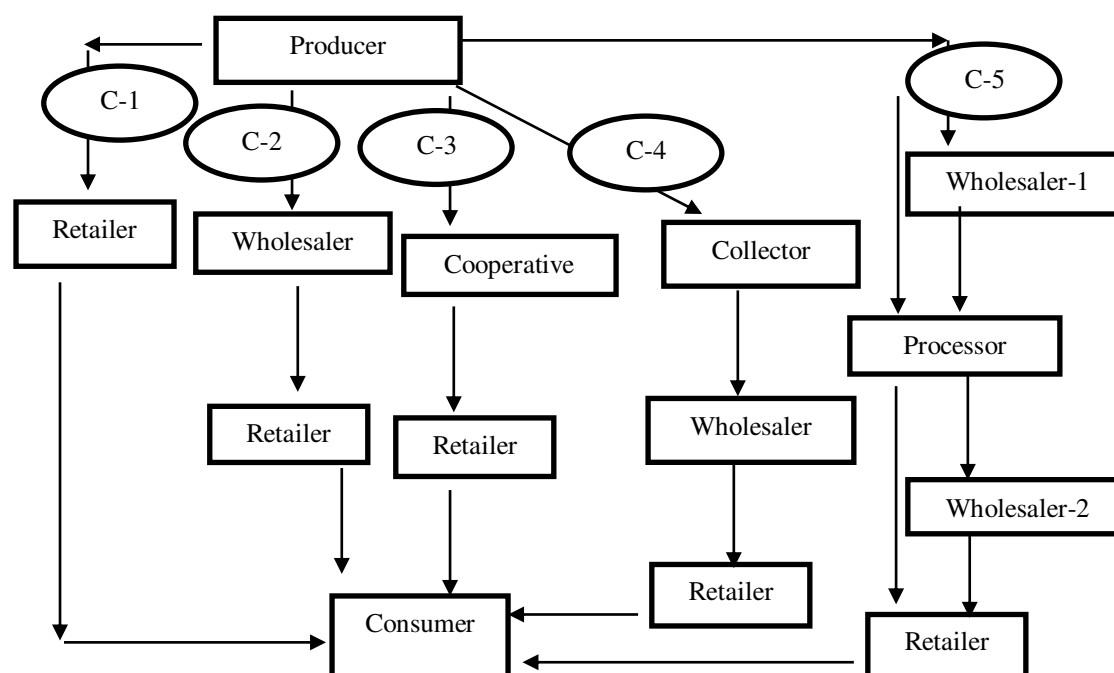
Figure 2: Tomato supply chain in the study area   Source: Field survey, 2018

Farmers primarily use five types of marketing channels as shown in Figure 2 and selling fresh tomato in the various market outlets. Constituted as channel 1 connecting Producer- retailer-consumer in Figure 2 was usual route for small quantity tomato suppliers. The second channel included producer-wholesaler-retailer-consumer had a relatively higher marketing margin compared to the first and third channels (Table 5). The third channel included producer-cooperative-retailers-consumers was the least dominant one since very few cooperatives were involved in tomato production and marketing. The dominant respondents unaware of marketing through agriculture cooperatives but whoever done had the lowest marketing margin through this channel. The fourth channel included producer-collector-wholesaler-retailer-consumers and the fifth channel included producer-processor-wholesaler - retailer-consumer.

Channel efficiency
Factors influencing marketing cost and marketing margin in different channels
Marketing cost per kg of tomato was found Rs. 9.91, 13.01, 9.03, 16.44 and 25.56 in channel-1, 2, 3, 4 and 5, respectively. The shorter the channel, the lesser the marketing costs and cheaper the commodity to the consumer (Scribid, 2010). Marketing margin included marketing cost and reward for risk-bearing. Marketing margin found lowest in channel 3rd followed by channel 1st and highest for channel 5th. The study showed marketing margin is directly proportional to the length of the marketing channel.

Table 3: Cost and margins of different marketing channels of tomato

Items	Channel- 1	Channel-2	Channel-3	Channel-4	Channel-5
Labor charge/wages	0.71	0.86	0.77	1.47	1.2
Room rent	0.64	0.98	0.98	1.09	1.01
Transportation	1.4	1.53	1.18	1.53	1.68
Implicit cost	4.55	6.75	4	9.05	8.3
Wastes	2.63	2.9	2.1	3.3	2.5
Bottling, ingredients	-	-	-	-	10.90
Marketing Cost	9.91	13.01	9.03	16.44	25.56
Reward for risk	7.42	9.77	7.52	12.06	13.64
Marketing Margin	17.33	22.78	16.55	28.5	39.2

Source: Field survey, 2018

Producers' share in consumers' price

The authors estimated producers' share in consumers' price 66.72%, 63.33%, 55.51%, 49.54%, and 39.88% for 1st, 3rd, 2nd, 4th, and 5th marketing channels respectively (Table 4). As length of channel increased net profit to the producer substantially decreased. This result is supported by Chand (2010) who found that the share of the farmer in the consumer price worked out to only 48 percent for vegetables. Our result also in line with the conclusion of Hailu (2016) who concluded the lowest producer share as more as marketing agents increased in the channel. Past research also reported similar results in cumulative vegetable value chain study in Gorkha, Dhading, Sindhupalchowk, and Kavrepalanchowk district (Bhandari, 2019).

Table 4: Producers' share in consumers' price in different channels

Items	Channel 1	Channel 2	Channel 3	Channel 4	Channel 5
Price received by farmers	30.44	28.42	32.60	27.73	26.00
Consumer price	47.77	51.20	49.15	55.98	65.20
producer share	63.72	55.51	66.33	49.54	39.88

Source: field survey, 2018

Marketing efficiency and factors influencing ME on different channels

Table 5 illustrates that the price receive by farmers was directly proportional to marketing efficiency but marketing cost and margin had an inverse relation with the marketing efficiency. The finding supports by Chand (2010); Marketing cost and marketing margin of the market channel has a negative influence on marketing efficiency. Marketing efficiency estimated higher in channel 3rd followed by channel 1st, 2nd, 4th, and 5th.

In channel 3rd, the study investigated the involvement of agricultural cooperatives in tomato marketing, an association of growers voluntarily to pool their production for sale. Direct selling may create a "healthy emulation" among farmers, leading to more production benefiting the cooperative. The cooperative facilitated collusion on the local market by making farmers softer competitors on that market. With marketing cooperatives, farmers had a much better price negotiation (Cakir & Balagtas, 2012) and had access to markets that they could not access individually (Camanzi et al., 2011). Around the world, farmers increasingly encouraged joint marketing cooperatives and cooperatives hold a significant market share in agricultural product distribution from farms to final consumers (Deller et al., 2009). Other advantages of cooperative marketing were: easy access to inputs, training provision within the cooperative communities, increase group credentials in getting subsidies over the individual enterprise.

Table 5: Average retail price, price spread, and marketing efficiency

S.N.	Particulars	Unit	Channels				
			C-1	C-2	C-3	C-4	C-5
1	Retailers sale price(RP)	Rs/kg	62.7	64.1	62.2	65.9	67.33
2	Total marketing cost(MC)	Rs/kg	9.91	13.01	9.03	16.44	25.56
3	Total margin of intermediaries (MM)	Rs/kg	17.33	22.78	16.55	28.25	39.2
4	Price received by farmers(FP)	Rs/kg	30.44	28.42	32.6	27.73	26
5	Value added by marketing system (1-4)	Rs/kg	32.26	35.68	29.6	38.17	41.33
	Marketing efficiency=4/(2+3)=		1.12	0.79	1.27	0.62	0.40

Source: Field survey, 2018

Volume of tomato supply through different channels

Figure 3 illustrates the volume of sell on various marketing channels. It was found that respondents used more than one channel to supply tomatoes in the markets. Out of total; 45 percent tomato was supplied in the market through the fourth channel followed by second channel (31%), first channel (17%), third channel (5%), and fifth channel (2%). The fourth channel was a dominant channel in the study area where collectors were actively involved in the tomato collection that avoided all possible drudgery of post-harvest losses of the growers. There were a few numbers of cooperatives in the research site so the quantity of supply via a third channel was reported lower even though it was an efficient channel. The main reasons for fewer numbers of agricultural cooperatives in the study site were due to a lack of cooperative awareness on collective action, and the lengthy and drudgery process of cooperative registration.
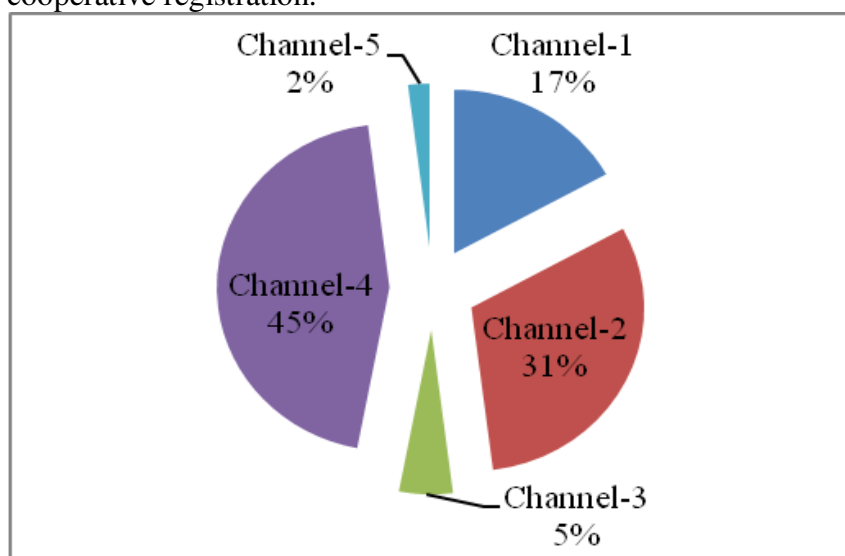
Source: Field survey, 2018

Figure 3: **Quantity of tomato supply with different channels**

CONCLUSION

Tomato cultivation was found profitable and potential agricultural enterprise and is a significant source of household economy. The gap between prices received by the farmers and those paid by urban consumers is large, reflecting inefficient marketing arrangements. Most producers were selling tomatoes through collectors especially to save time and avoid all possible drudgery of the markets. Tomato produce is mostly collected by market agents who sell it in organized or semi-organized markets. Unfortunately, these markets are often controlled by a few middlemen and operated in a highly non-transparent manner. For achieving a higher return from tomato, farmers should emphasize marketing as well as production. To increase supply chain efficiency, collective and cooperative marketing system should be strengthened. Farmers should be aware of the importance of collective action that can be done by agricultural cooperatives.

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Authors' contributions

H. Bhandari conducted research and wrote the paper. T. Bhandari, K. P. Timsina, H. K. Panta revised and finalized the paper.

Conflict of Interest

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

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