



Value chain mapping: A novel approach for market dynamics analysis in tomato (*Solanum lycopersicum*)

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ABSTRACT

The present investigation is an attempt to map the tomato (*Solanum lycopersicum* L.) value chains existing in the Champawat district of the Uttarakhand (during 2016–17) to know the market dynamics in it. Estimation of production dynamics showed an average cost of production of tomato as ₹ 80077/ha with an average net return of ₹ 158123/ha. Data collected from the study area revealed the existence of two marketing channels with different players and interconnection (C1: Producer- Retailers-Consumer and C2: Producer -Whole sellers – Retailers-Consumers) on which tomato farmers were dependent to reach the final consumers. Value chain mapping revealed that producers share in consumers' price in net benefit terms for C1 was 52.06% and for C2 was 27.06% though the value added for tomato till reaching the final consumers in both channels were apparently same. This showed the necessity of tactical policy integration in value chain procedural development in tomato. Reforms are also needed in the existing marketing mechanism to make a change in it, in an 'actor-activity-client oriented beneficial and profitable' direction.

Key words: Cost benefit analysis, Marketing channels, Value chain mapping

Tomato (*Solanum lycopersicum* L.) the favourite red gleaming fruit-vegetable introduced from Europe in the 16th century to Indian subcontinent looking on the market it could create among the Bengalis and Burmans, who were well known for the sour flavour food (Acharya, 1998) grabbed foremost positions in the production and productivity among other Indian vegetables (APEDA 2018). Though it is known for its nutri-dietary induced commercial value, the farm gate price for the crop is very volatile. Though, the tomato famers in India tend to gradually improve their production technologies by adoption of poly-house and green house technique, post-harvest practices still maintain as relatively traditional. Due to the supply-driven nature of the domestic market with poor infrastructure, the post-harvest loss associated with the tomato crop is in an alarming stage (Pila *et al.* 2010, Isaac *et al.* 2016). Inappropriate marketing structure (Prigojin *et al.* 2005), lack of price policy mechanisms and farmer supportive measures (Kitinoja and Al Hassan 2012), are used to create heaps of spoiled harvested produces in every year. At this juncture, value chain development (VCD) and value chain analysis (VCA) has gained considerable momentum in agriculture sector (FAO 2013, Nelson *et al.* 2015) and are viewed

through the lenses of profitability and postharvest losses reduction (FAO 2006).

Value chain is composed of all major and supporting actors, activities and interconnections (Pedro *et al.* 2016) in a commodity movement path. Majority of the value chain studies generally ends up with the sheer analysis of the marketing channels (Trond *et al.* 2015). The existing competitive scenario in agriculture sector wants not only the price-based study of commodities, but also needs in-depth analytical results where all the actors, activities and functional interactions considered as a single entity for the strategic planning and futuristic actions. The present study, therefore was conceptualized and conducted to capture the tomato value chains in a holistic way in the study area, to provide a knowledge and information ignition to understand the current status and exploring the strategic and policy based reforms to create 'actor-activity-client oriented beneficial and profitable' value chains in similar situations.

MATERIALS AND METHODS

Presence of large density of off-season tomato cultivation structures, KVK, marketing and processing infrastructures and existence of different agriculture-based firms motivated us to take the Champawat district of the Uttarakhand for value chain analysis of the tomato. Since the main objective of the work is to explore and swot up the interconnectedness and possible relations of the actors and activities among different value chains of tomato, a

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diagnostic cum descriptive research methods within the retrospective action framework of *ex-post facto* research design (Salkind 2010) was used in this study. From randomly selected 8 different villages of the Champawat district, total 80 farmers, 10 whole salers and 20 retailers were randomly sampled for the data collection purpose. Focus group discussions, group meetings and well defined and structured personal interview etc. were conducted among the farmers, middlemen, commission agents, and traders to get the information on different research variables considered for the study and to understand their underlying relations. PRA tools were also used for validating and triangulating the captured data. The different value chains identified were meticulously analysed in different segments for capturing the present performance level and efficiencies in terms of market margins, market cost, overall price spread, benefit cost ratio, etc. Marketing efficiency index (MEI) (Acharya and Agarwal 1987) and incremental benefit-cost ratio analysis (INCBEN) (Kuo-Lung Yang *et al.* 2004) were used in the quantitative analytical design in a well-documented manner. Value chain mapping technique (ILO 2015) with the visual illustration of agents, activities, value created, and their interconnectedness were also utilised in the results presentation of the present study. Price prevailed in the location at the time of investigation (during 2016-17) was used for cost benefit analysis.

RESULTS AND DISCUSSION

Build up of the tomato farmers' production cost and returns

Cost of production for the tomato in the selected study area was analysed as the outset of the value chain analysis methodology followed in the study. From the cross-sectional analysis results it was computed that the average cost of production of tomato in the study area as ₹ 80077/ha (Table 1). The maximum cost was incurred towards nutrient application (₹ 19500/ha) as most of the farmers were applying various forms of plant nutrients to harvest the best yield of tomato to sell it on commercial basis. This was followed by expenses on seed (₹ 18753/ha), machinery (₹ 11000/ha) and labour (₹ 10670/ha). Cost incurred in harvesting and irrigation was 10.80% and 7.35% of the total cost of production. Expenditure towards plant protection shared minimum proportion (7.01%) of the total cost.

Average yield assessment for the tomato at the study area has been done to estimate the Benefit Cost Ratio of the same at the farmer level. It was observed that an average yield of 198.50 q/ha was reported from farmer field level (Table 1) in each cultivation seasons. According to the farmers feedback an average price for the tomato in the study location was about ₹ 1200/q. In each planting season farmers were able to earn a gross income of ₹ 238200/ha and average net income from the tomato production in each season was estimated as ₹ 158123/ha. On an average, farmers are getting a profit of ₹ 7.96/kg of the tomato produced (Table 1). From the BC ratio (2.97:1) it is well

Table 1 Average cost of production of tomato (N=80)

Cost component	Amount (₹/ha)	Proportion to the total cost (%)
Labour	10670	13.32
Machinery	11000	13.74
Seed	18753	23.42
Nutrient application	19500	24.35
Pesticide	5616	7.01
Harvesting cost	8648	10.80
Irrigation cost	5890	7.36
Total cost of production ₹/ha		80077
Yield (q/ha)		198.50
Price (₹/q)		1200
Gross income (₹/ha)		238200
Net income (₹/ha)		158123
B:C Ratio		2.97:1

evident that tomato cultivation was a profitable venture at the farm level (Table 1) at the estimated production cost and market price. Similarly, a study (Vinod 2016) showed that an average cost of cultivation per hectare of tomato was ₹ 29233.17 which was much less than the cost of production observed in the present study. The same study showed that BC ratio for the same is about 3.87:1. A study by Shende and Meshra (2015) revealed that in Bhandara district of Maharashtra, BC ratio of tomato cultivation was about 1.85. An analysis of cost and return structure in tomato cultivation among small, marginal and large farmers in Amravati district of Maharashtra indicated production cost of ₹ 136110.00, ₹ 142778.00 and ₹ 148614.00 and net return of ₹ 6300.52, ₹ 14110.80 and ₹ 24202.70 per ha for small, medium and large growers, respectively (Jorwar *et al.* 2017). These results showed a huge difference from the results of the present study in cost and net return structure. Compared to Amravati district, cost of production of tomato in Champawat district of Uttarakhand was very less due to its reservoir of natural resources and which in turn lead to a high net income to the farmers.

Process mapping of tomato value chains

Value chain mapping of tomato has been performed in a detailed and logical way starting from identification of different processes to quantification of added value in each stage. Two distinct tomato value chains with different actors, marketing channels and marketing margins were identified from the project area (C1: Producer- Retailers-Consumer and C2: Producer -Whole sellers – Retailers – Consumers). Similar types of marketing channels along with one direct selling channel to the consumer in the tomato value chain were identified in a study conducted by Neupane *et al.* (2018) in Chitwan District of Nepal. Different processes involved in both of the identified value chains were input supplies, production, primary processing, wholesaling, retailing and consumption. Different consumption levels

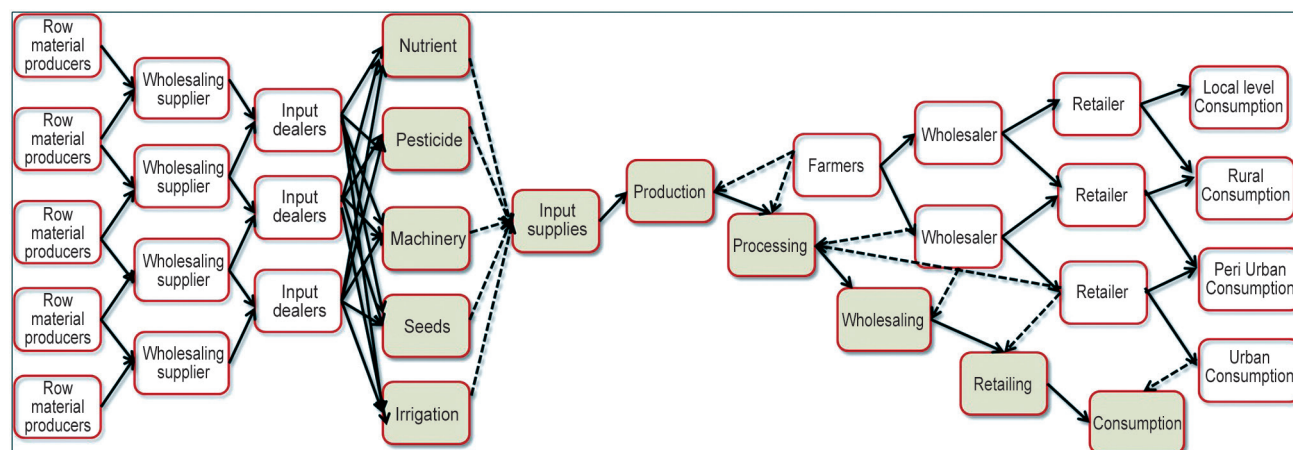


Fig 1 Process map in tomato value chains.

were also identified as farm level consumption, local rural consumption, peri urban and urban consumption including the consumers from the urban outskirts and from distantly separated cities (Fig 1).

found that for the process like procurement, collection, grading, packing, transportation and storage activities in the movement and disposal of the harvested tomato crops were mainly done with the assistance from the local private

Mapping of value chain governance and supporting activities

Supporting activities are very vital for the subsistence of value chains (Pila *et al.* 2010, Kristen *et al.* 2015). Tomato growers in the study area were depending on finance institutions for getting liquid cash for meeting the cost of production, research institutes and KVK like knowledge institutions for being updated with the technical know-how (varietal information, planting techniques, pest and disease control information, field level and primary processing practices, healthy transportation and storage of the produce till dispersion etc.), private input dealers to meet the hybrid seed demand and plant protection measures etc. Tomato is also being grown as an offseason vegetable in the Champawat district many of the farmers installed the greenhouse and poly house technologies. It was found that some of the farmers had frequent dialogues with the private company representatives for the infrastructure development though they were getting assistance from the government institutions and horticulture departments. It was

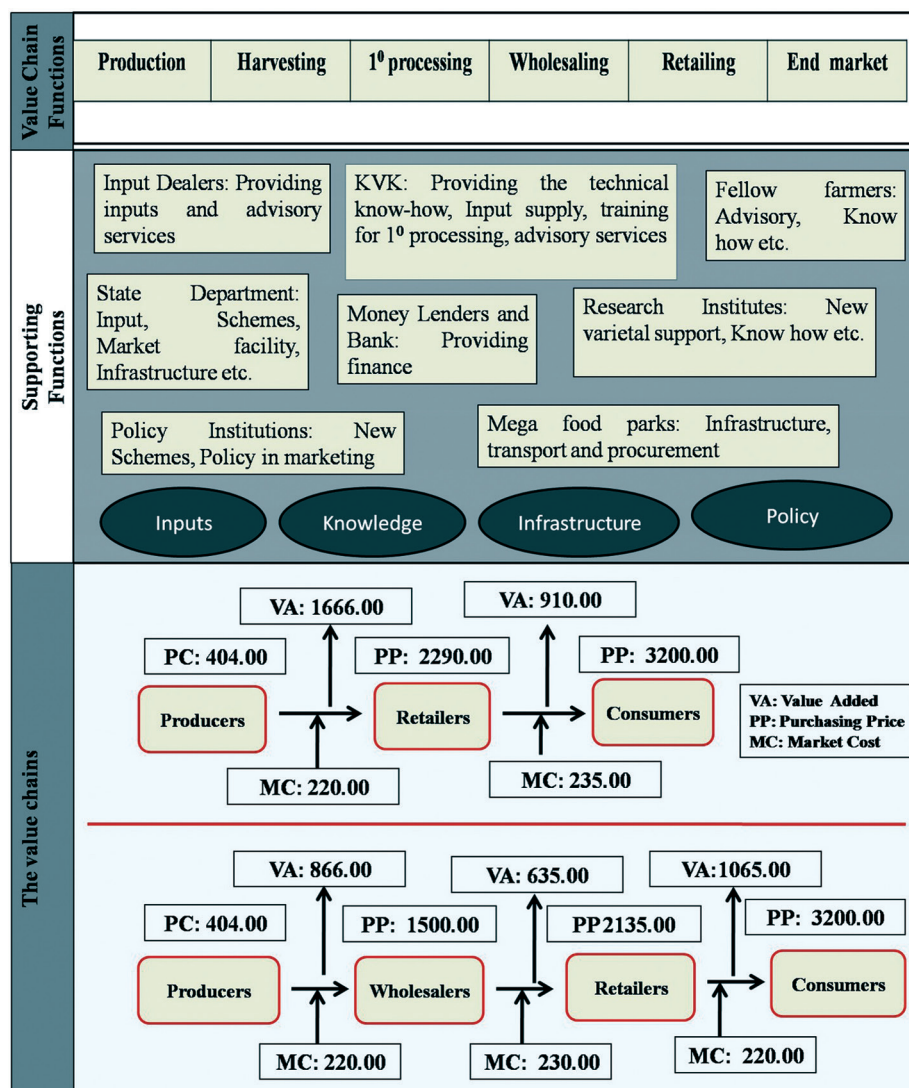


Fig 2 Comprehensive map of tomato value chains in Champawat district of the Uttarakhand.

players. Farmers who were in organised groups could also able to utilise some of the facilities provided by the industrial clusters and mega food parks. In the processing stage maximum numbers of actors were involved, i.e. fellow farmers, KVK, state department and research institutes as knowledge providers, private money lenders and banks as for providing financial support, wholesalers and retailers in do-how, mega food parks, KVK and state departments as infrastructure providers.

Quantitative analysis of value chain and its mapping

Cross sectional analysis of the value chains identified for the tomato in the Champawat district was carried out to indicate the proportional contribution of different activities in adding value to the products. Total marketing cost incurred by the tomato producers was ₹ 404.00/q (Table 2). Out of the different cost components involved in it, the highest share (45.45%) was for transportation (₹ 100/q). This was followed by cost on cleaning, grading and sorting (40.91%) which amounted ₹ 90.00/q followed by loading and unloading charges of ₹ 20.0/q at the *Mandi*. Other costs involved were relatively less as ₹ 5.00/q each

towards weighing and handling charges (Table 2). In this channel it was found that marketing cost of retailers was ₹ 235.00/q which was about 51.65 % of the total marketing cost in the particular channel. Major share (53.19%) of the retailers marketing cost was contributed by cleaning, grading and sorting (CGS) processes which costing about ₹ 125.00/q followed by transportation (42.55%). It was well evident from the same table (Table 2) that in channel 2 also producers incurred the same amount of marketing cost (₹ 220.0/q) as same as channel 1. But which made only 32.84% of the total marketing cost due to the increased number of actor nodes in it.

Marketing efficiency of the identified value chains were calculated with Acharya's marketing efficiency index ($MEI = PP / (MM + MC)$) (Acharya and Agarwal 1987) and it was evident from the Table 2 that channel 1 with less number of the players was with high efficiency index (0.54) as compared with the channel 2 (0.26) even though the marketing margin was less for this channel (₹ 2566/q) as compared with the channel 1 (₹ 2576/q). Analytical results showed that proportionately, producer had about an average 72% share in consumer price in case if he sales tomatoes to

Table 2 Cost estimation along the value chains of tomato

Particulars	C1: Producer-Retailer-Consumer		C2: Producer-whole salers-Retailers-consumers	
	Amount (₹/q)	Proportion (%)	Amount (₹/q)	Proportion (%)
Cost of production	404.00	-----	404.00	-----
Marketing cost of producer (M1)	220.00	48.35	220.00	32.84
Cleaning, grading and sorting	90.00	40.91	90.00	40.91
Weighing cost	5.00	2.27	5.00	2.27
Transportation charges	100.00	45.45	100.00	45.45
Handling charges	5.00	2.27	5.00	2.27
Loading & unloading charges	20.00	9.09	20.00	9.09
Whole saler purchase price	-----		1500.00	
Marketing cost of wholesaler (M2)	-----	-----	230.00	34.33
Cleaning, grading and sorting	-----	-----	90.00	39.13
Weighing cost	-----	-----	5.00	2.17
Transportation charges	-----	-----	100.00	43.48
Handling charges	-----	-----	5.00	2.17
Loading & unloading charges	-----	-----	20.00	8.70
Commission/Mandi charges	-----	-----	10.00	4.35
Retailer purchase price	2290.00		2135.00	
Marketing cost of retailer (M3)	235.00	51.65	220.00	32.84
Cleaning, grading and sorting	125.00	53.19	90.00	40.91
Weighing cost	5.00	2.13	5.00	2.27
Transportation charges	100.00	42.55	100.00	45.45
Handling charges	5.00	2.13	5.00	2.27
Loading & unloading charges	-----	-----	20.00	9.09
Consumer purchase price	3200.00		3200.00	
Marketing efficiency	0.54		0.26	

the consumers through retailers and retailers, in turn enjoy 100% share in consumer price (channel 1) in absolute value terms. In terms of net margin, however, producers and retailers had 52.06 % and 28.43% shares respectively in the consumers' price. However, if farmers had chosen channel 2 for the tomato marketing then farmers share reduced to about 27% in consumers' price in terms of net margin.

A complete depiction of tomato value chains identified in the Champawat district of the Uttarakhand is given in Fig 2. It was observed from the figure that the total value added in the channel 1 from the producer to final consumer was ₹ 2570/q and the same for channel 2 was ₹ 2566/q. Though the added value in two identified channels were not differed by a considerable amount the producers return was observed with huge difference, i.e. (₹ 2290/q in channel 1 and ₹ 1500/q in channel 2). For further clarity, the dynamics of value chain in popular market chain of vegetable tomato in terms of INCBEN in the study area was worked out. In both the channels cleaning, grading and sorting (CGS); and transportation (TRP) were the important value addition activities which were done by producer (PR), whole salers (WS) and retailers (RT) at their level to add value to the harvested produce. In channel 1 (Producer-Retailer-Consumer), the magnitude of cost incurred by producers over CGS and TRP were ₹ 90/q and ₹ 100/q with relative share of 40.91 % and 45.45 % respectively to the total marketing cost (Table 2). Proportionate benefits with respect to the cost involved in CGS and TRP to producer in the channel 1 were estimated as ₹ 936.84/q and ₹ 1040.81/q respectively. It was also observed that the incremental BC ratio of the producer due to CGS and TRP in the channel 1 was with the same magnitude (10.40). Retailers in the channel 1 incurred a cost of ₹ 90.0/q and ₹ 100.0/q towards CGS and TRP respectively. At the same time, they were recorded with a profit of ₹ 1702.0/q and ₹ 1361.60/q respectively. Incremental BC ratio for two groups of value addition activities was observed as 13.6. The same analysis conducted in channel 2 revealed that, producers (PROD), whole salers (WS) and retailers (RT) incurred ₹ 90.0/q towards CGS with relative shares of 40.91%, 39.13% and 40.91% respectively. Similarly, for TRP, the same amount was (₹ 100.0/q) observed with relative share of 45.45%, 45.45% and 43.48% respectively towards PROD, WS and RT. Proportionate returns on the value addition activities were also calculated with the same procedure. Producers, whole salers and retailers were observed with an incremental BC ratio of 6.81, 9.28 and 14.54 respectively for CSG and TRP.

Value chain analysis results of the present study revealed the scope of creating more action points in the existing value chains to increase the producers share in the consumers' price and to reduce the marketing margins consumed by different players. While devising and developing strategic action plans policy makers need to give much attention to reduce the length of the value chain to get maximum benefits to the farmers and to get fresh consumables at a reasonable price to the end users. It can be attained by providing infrastructure

facilities to the farmers for marketing and selling the produce and by imparting the knowledge of different value chain activities through capacity building programmes like trainings and demonstrations. Public and private extension agencies need to reorient their actions from a production led frame to post production and processing frame.

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