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Abhishek
Dr. Y.S Parmar University of Horticulture and Forestry, Nauni, Solan, Himachal Pradesh, India

Shubham Ranaut
Dr. Y.S Parmar University of Horticulture and Forestry, Nauni, Solan, Himachal Pradesh, India

Krishan Kumar Raina
Professor & Head, Dr. Y.S Parmar University of Horticulture and Forestry Nauni, Solan, Himachal Pradesh, India

Corresponding Author:
Shubham Ranaut
Dr. Y.S Parmar University of Horticulture and Forestry, Nauni, Solan, Himachal Pradesh, India

Constraints of supply chain management of apple production in Kinnaur and Kullu districts of Himachal Pradesh (India)

Abhishek, Shubham Ranaut and Krishan Kumar Raina

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Abstract
Study was conducted to assess the impact of Constraints facing in Supply chain Management of Apple Production in Kinnaur and Kullu Districts of Himachal Pradesh, India using data for the period 2021-2022.To identify gaps and challenges in the supply chain of apple production and marketing, a sample of 400 respondents was interviewed through structured interview schedule. Garrett's ranking model and five point likert scales is used to identify the factors which were determining the constraints of the apple producers for supply chain management. The constraints in supply chain management were further classified in to six different sub components namely grading and packaging constraints, Packaging material constraints, Storage facilities constraints, Transportation constraints, Market information constraints, Malpractices constraints. Apple producers were not so aware about the constraints of the supply chain management Gaps can be reduced by the efficient supply chain management.

Keywords: Supply chain management, apple production, apple marketing constraints

Introduction
Supply chain management is a process of planning, implementing and controlling the operations of the supply chain with a purpose to satisfy customer requirements as efficiently as possible. Supply chain management spans over all movements and storage of the raw materials, work in progress inventory and finished goods from point of origin to point of consumption. (Recanati 2019) [7]. The entire supply chain management process is a value chain where bottlenecks, value adding factors and liability factors are identified and addressed. (Oliver and Webber 1982) [4]. The elevated demand for quality products backed by still or hard regulations has made fruit sector more specialized and dynamic (Behzadi *et al*. 2018) [1]. The demand of consumers for fresh fruits at low prices led to the globalization of the fruits markets. The management of fresh fruits is complex because of the quality changes in each successive unit of supply chain. Due to the perishable nature, the supply chain of fresh fruits from produce to the market place and customers is a complex process (Li *et al.* 2020) [3]. In India it is estimated that 70-80 per cent of the Indian apple growers markets their produce via organized marketing channels and approximately 80-90 per cent of this fruit is consumed fresh while the rest is exported, processed or wasted. Himachal Pradesh has emerged as the horticulture state of India, it has been recognized apple state of India for being adjudged as the best producer of quality apples. In the state of Himachal Pradesh, farmers are encouraged to grow the world's finest varieties of apple. The total area under fruits in Himachal Pradesh is about 226799 hectares with production of 928829 MT of all kinds of fruits. Apple is the major fruit accounting 46 per cent of total production (Kaur, 2002) [2]. In India, about 70 per cent of the apple fruits is transported and sold in the India's largest wholesale fruit and vegetable market at Azadpur fruit market in Delhi. There are number of markets channel in apple supply chain management, of which the pre dominant are:

a) Farmer- pre harvest contractor - commission agents - wholesaler - retailer - consumer
b) Farmer- forwarding agent - commission agent- wholesaler - retailer - consumer
c) Farmer- commission agent - wholesaler - retailer - consumer

The sale of apples through the pre harvest contractors is the most important system of marketing in supply chain management. Normally the small orchardists sell their crops at the flowering stage to contractors who organize all activities involved in supply chain management.

The medium and large orchardists prefer to market their produce through different channels. In Himachal Pradesh about 65 per cent of the total apple produced is marketed through 'farmer-forwarding agent-commission agents-wholesaler-retailer-consumer' and' farmer-commission agents-wholesaler-retailer-consumer' channels (Pereira *et al.* 2022) [5]. Some growers managed their produce through cooperatives and government controlled corporations primarily the Himachal Pradesh marketing and processing cooperation limited (hpmc) in Himachal Pradesh which are also involved in supply chain system of apple. However only 3.5 per cent of production is handled by grower cooperatives whereas Himachal Pradesh Marketing and Processing Corporation limited (hpmc) handled only about 2.5 per cent of the apple crop. In the primary market that is from producer to commission agents, apples typically move through several owners, including wholesaler, sub wholesaler and retailer before reaching the consumer (Pandey *et al*. 2009) [6]. Apple's peak season is between August and December. During the off season, apples are imported. Like most other things, Apple economy depends on demand and supply. At present, the demand for apple is more, but supply of local apple is less. The marketing of apple is a complex phenomenon. The marketing pattern of apple is different from other agricultural commodities. (Saxena *et al*. 2017) [8]

Methodology

Based on the set objectives, Gaps and Challenges in the supply chain of apple production and marketing, the garrett's ranking, five point likert scale, arithmetic mean and standard deviation was conducted among the Apple producers to know about the Constraints facing in Supply chain Management of Apple Production in Kinnaur and Kullu Districts of Himachal Pradesh (India). Among the respondents a sample size of 200 respondents belongs to Kinnaur district and 200 respondents belong to Kullu district was selected as respondents using preference sampling technique. Sample size was calculated at 5 per cent level of error term.

Garrett's ranking

It involves ranking system. The process involves allowing the respondent to rank for each category of the resource and services proposed to them and percentage position for each rank was calculated. Later the per cent position was converted into scores by referring to the Garrett ranking conversion table then, the scores of the individual respondents were added together and divided by the total number of respondents for whom scores were added. The resulted mean scores for all the factors were arranged in descending order and the most influencing factors were identified through the ranks assigned. The factors having the highest mean value score were identified and considered to be the most important resource and service used by the respondents in the study.

Five Point Likert Scale

Likert scale was used for studying the "Constraint in Supply Chain Management" with twenty-four number of dimensions. The studied parameter of expectations of stakeholders was further intervened through social dimensions and attributes of the respondents that is age, gender profile, education, occupation availability of forests in nearby approachable locations.

Sr. No.	Option	Point
1	Strongly Agree	5
2	Agree	4
3	Neutrality	3
4	Disagree	2
5	Strongly Disagree	1

Arithmetic Mean

The arithmetic mean has been applied to study the opinion of 400 sample respondents for different statements. By the use of arithmetic mean we can draw appropriate inferences from the responses collected from the respondents. The arithmetic mean has been calculated by assigning numerical values to the qualitative statements.

Standard Deviation

The standard deviation has been applied to measures the absolute dispersion of 400 respondents (or variability of distribution; the greater the amount of dispersion or variability), the greater the standard deviation, the greater will be the magnitude of the deviation of the values from their mean.

Results & Discussion

The constraints in supply chain management of Apple were further studied and classified in to six different sub components that is;

- Grading and packaging
- Packaging material constraints
- Storage facilities constraints
- Transportation constraints
- Market information constraints
- Malpractices constraints

All the above mentioned constraints were separately studied for Kinnaur and Kullu districts respectively and also on overall basis. The results are presented below.

Constraints in supply chain management of apple in Kinnaur

The constraints in supply chain management in apple for the respondents of Kinnaur are presented in table 1. It can be seen from the table that higher wages rate was the first ranked constraints followed by lack of technical knowledge. These two constraints are related to the constraints of grading and packaging. It can further be seen that non-availability of packaging material at desired places was the first ranked constraints followed by non-availability of packaging material during peak time. Thus two constraints were amongst the classification constraint of packaging material. In case of storage facilities the first and second rank was given to inadequate storage facilities and no storage facilities. Transportation is a major issue in supply chain management it was observed that high transport charges and lack of all weather roads were the first two ranked constraints. The late information and misleading information were considered as major constraints related to marketing information. Table further shows that deduction of undue charges and quoting of lower prices were the two major malpractices in supply chain management. The ranking was established through total score and calculations and establishment through standard deviation and mean.

Table 1: Constraints in supply chain management of apple in Kinnaur

Grading and packaging constraints in supply chain management											
S. No.	**Constrains**	**N**	**Mean**	**S. D**	**SA**	**A**	**N**	**D**	**SD**	**Score**	**Rank**
1	Shortage of skilled labour	200	2.17	1.13	64	76	33	16	11	766	III
2	Higher wage rate	200	2.06	1.12	72	81	21	15	11	788	I
3	Non-availability of resources	200	2.52	1.20	41	71	51	16	21	695	IV
4	Lack of technical knowledge	200	2.09	1.16	72	80	19	16	13	782	II
Packaging material constraints in supply chain management											
S. No.	**Constraints**	**N**	**Mean**	**S. D**	**SA**	**A**	**N**	**D**	**SD**	**Score**	**Rank**
1	Shortage of boxes and cartons	200	2.78	1.27	37	48	65	21	29	643	IV
2	Higher prices of packaging material	200	2.14	1.06	59	84	38	08	11	772	III
3	Non availability of packaging material during peak time	200	1.91	0.89	77	73	44	3	3	818	II
4	Non availability of packaging material at desired place	200	1.89	0.76	71	81	49	0	0	822	I
Storage facilities constraints in supply chain management											
S. No.	**Constraints**	**N**	**Mean**	**S. D**	**SA**	**A**	**N**	**D**	**SD**	**Score**	**Rank**
1	No Storage facilities	200	1.50	0.68	188	66	13	03	0	899	II
2	Inadequate storage facilities	200	1.21	0.48	165	28	07	0	0	958	I
3	Lack of cold storage	200	1.85	0.90	85	73	29	13	0	830	III
Transportation constraints in supply chain management											
S. No.	**Constraints**	**N**	**Mean**	**S. D**	**SA**	**A**	**N**	**D**	**SD**	**Score**	**Rank**
1	Lack of vehicle	200	2.95	0.82	3	64	73	60	0	610	V
2	Vehicle not available in time	200	2.92	0.83	0	74	72	50	4	616	IV
3	Villages not linked with metalled road	200	2.83	1.25	32	56	50	38	24	634	III
4	High transport charges	200	2.62	1.07	26	76	59	26	13	676	I
5	Lack of all-weather roads	200	2.82	0.98	14	72	52	59	3	635	II
Marketing information constraints in supply chain management											
S. No.	**Constraints**	**N**	**Mean**	**S. D**	**SA**	**A**	**N**	**D**	**SD**	**Score**	**Rank**
1	Late information	200	2.49	1.03	37	67	60	32	4	701	I
2	Limited information available	200	2.53	0.94	33	63	68	36	0	693	IV
3	Information limited to market only	200	2.53	1.04	36	65	60	35	4	694	III
4	Misleading information	200	2.51	1.02	35	68	61	32	4	698	II
Malpractices in supply chain management											
S. No.	**Constraints**	**N**	**Mean**	**S. D**	**SA**	**A**	**N**	**D**	**SD**	**Score**	**Rank**
1	Deduct more charges	200	2.19	1.04	62	63	54	16	5	761	IV
2	Partial payment	200	2.17	1.28	88	40	33	27	12	765	III
3	Deduct undue charges from producers	200	1.92	1.06	88	63	33	8	8	815	I
4	Quote lower than actual price	200	2.12	0.83	42	104	46	4	4	776	II

*S.D- Standard Deviation, SA*Strongly Agree,*A-Agree, N*-Neutral, D*- Disagree. **SD- Strongly Disagree

Constraints in supply chain management of apple in Kullu

It can be seen from table 2 shows that first and second rank was given to the problems of higher wage rate and lack of technical knowledge which together constitute related to grading and packaging the sampled respondents of Kullu has again ranked the non- Availability of packaging material at desired place and during peak time as major constraints related to packaging material. It can further be observed from table that indigenous storage facilities and no storage facilities were the major constraints. Transportation is a major issue in supply chain management it was observed that villages not linked with metalled roads and high transport charges were the first two ranked constraints. The late availability of market information and its limited availability in market only were the first two rank constraints related to the market information. The sampled respondent of Kullu further identified the constraints of undue charges quotation of lower price by the market agencies as the major malpractices in supply chain management.

Table 2: Constraints in supply chain management of apple in Kullu

Grading and packaging constraints in supply chain management											
S. No.	**Constrains**	**N**	**Mean**	**S. D**	**SA**	**A**	**N**	**D**	**SD**	**Score**	**Rank**
1	Shortage of skilled labour	200	2.15	1.16	66	79	27	14	14	769	III
2	Higher wage rate	200	2.00	1.08	74	84	19	13	10	799	I
3	Non-availability of resources	200	2.57	1.20	36	75	52	13	24	686	IV
4	Lack of technical knowledge	200	2.14	1.19	70	77	20	20	13	771	II
Packaging material constraints in supply chain management											
S. No.	**Constraints in supply chain**	**N**	**Mean**	**S. D**	**SA**	**A**	**N**	**D**	**SD**	**Score**	**Rank**
1	Shortage of boxes and cartons	200	2.81	1.29	38	45	64	23	30	638	IV
2	Higher prices of packaging material	200	2.21	1.09	54	85	40	07	14	758	III
3	Not availability of packaging material during peak time	200	1.83	0.88	86	70	39	02	03	795	II
4	Not availability of packaging material at desired place	200	1.87	0.75	71	83	46	0	0	825	I
Storage facilities constraints in supply chain management											
S. No.	**Constraints**	**N**	**Mean**	**S. D**	**SA**	**A**	**N**	**D**	**SD**	**Score**	**Rank**

1	No Storage facilities	200	1.53	0.68	112	72	13	03	0	896	II
2	Inadequate storage facilities	200	1.21	0.50	165	27	08	0	0	957	I
3	Lack of cold storage	200	1.80	0.89	90	73	24	13	0	840	III
Transportation constraints in supply chain management											
S. No.	**Constraints**	**N**	**Mean**	**S. D**	**SA**	**A**	**N**	**D**	**SD**	**Score**	**Rank**
1	Lack of vehicle	200	2.94	0.81	2	67	72	59	0	612	IV/V
2	Vehicle not available in time	200	2.94	0.87	0	73	71	53	5	612	IV/V
3	Villages not linked with metalled road	200	2.91	1.27	30	53	49	40	28	737	I
4	High transport charges	200	2.57	1.02	26	78	61	25	10	685	II
5	Lack of all-weather roads	200	2.80	0.99	15	73	51	58	3	639	III
Marketing information constraints in supply chain management											
S. No.	**Constraints**	**N**	**Mean**	**S. D**	**SA**	**A**	**N**	**D**	**SD**	**Score**	**Rank**
1	Late information	200	2.51	1.00	35	66	63	34	02	698	I
2	Limited information available	200	2.55	0.96	32	62	70	36	0	690	III
3	Information limited to market only	200	2.52	1.07	38	65	58	33	06	696	II
4	Misleading information	200	2.55	1.03	32	68	63	31	06	684	IV
Malpractices in supply chain management											
S. No.	**Constraints**	**N**	**Mean**	**S. D**	**SA**	**A**	**N**	**D**	**SD**	**Score**	**Rank**
1	Deduct more charges	200	2.25	1.06	58	63	55	18	06	749	IV
2	Partial payment	200	2.14	1.31	94	39	21	36	10	771	III
3	Deduct undue charges from producers	200	1.84	1.08	101	55	25	12	7	831	I
4	Quote lower than actual price	200	2.07	0.75	42	107	47	2	2	785	II

*S.D- Standard Deviation, SA*Strongly Agree,*A-Agree, N*-Neutral, D*- Disagree. **SD- Strongly Disagree

Constraints in supply chain management of apple in overall

On overall basis table 3 it was observed that higher wages rates and lacks of technical knowledge were the two major constraints related to grading and packaging. It can further be seen from table that non availability of packaging material during peak time and non-availability of packaging material at desired place was the major constraints followed by the higher prices of packaging material. The inadequate storage facilities and no storage facilities constitute major constraints related to storage facilities. Vehicles not available in time and high transportation charges were the two major ranked constraints related to transportation. It can further be seen from table 3 that on overall basis limited availability of information and misleading information were two major constraints related to marketing information. The sampled respondents on overall basis further argued that the deduction of undue charges and quotation of lower prices by the traders constituted major malpractices.

Table 3: Constraints in supply chain management of apple in overall study area

grading and packaging constraints in supply chain management											
S. No.	**Constrains**	**N**	**Mean**	**S. D**	**SA**	**A**	**N**	**D**	**SD**	**Score**	**Rank**
1	Shortage of skilled labour	400	2.16	1.14	130	155	60	30	25	1535	III
2	Higher wage rate	400	2.03	1.10	146	165	40	28	21	1587	I
3	Non-availability	400	2.55	1.21	77	146	103	29	45	1381	IV
4	Lack of technical knowledge	400	2.12	1.18	142	157	39	36	26	1553	II
Packaging material constraints in supply chain management											
S. No.	**Constraints**	**N**	**Mean**	**S. D**	**SA**	**A**	**N**	**D**	**SD**	**Score**	**Rank**
1	Shortage of boxes and cartons	400	2.80	1.28	75	93	129	44	59	1281	IV
2	Higher prices of packaging material	400	2.17	1.08	113	169	78	15	25	1530	III
3	Not availability of packaging material during peak time	400	1.87	0.89	163	143	83	5	6	1652	I
4	Not availability of packaging material at desired place	400	1.88	0.76	143	163	95	0	0	1652	I
Storage facilities constraints in supply chain management											
S. No.	**Constraints**	**N**	**Mean**	**S. D**	**SA**	**A**	**N**	**D**	**SD**	**Score**	**Rank**
1	No Storage facilities	400	1.52	0.68	230	138	26	6	0	1792	II
2	Inadequate storage facilities	400	1.21	0.49	330	55	15	0	0	1915	I
3	Lack of cold storage	400	1.83	0.90	175	146	53	26	0	1670	III
Transportation constraints in supply chain management											
S. No.	**Constraints**	**N**	**Mean**	**S. D**	**SA**	**A**	**N**	**D**	**SD**	**Score**	**Rank**
1	Lack of vehicle	400	2.95	0.82	5	131	145	119	0	1222	V
2	Vehicle not available in time	400	2.93	0.84	147	143	101	9	0	1628	I
3	Villages not linked with metalled road	400	2.87	1.26	62	109	99	78	52	1251	IV
4	High transport charges	400	2.60	1.05	52	154	120	51	23	1361	II
5	Lack of all-weather roads	400	2.82	0.99	29	145	103	117	6	1274	III
Marketing information constraints in supply chain management											
S. No.	**Constraints**	**N**	**Mean**	**S. D**	**SA**	**A**	**N**	**D**	**SD**	**Score**	**Rank**
1	Late information	400	2.50	1.02	72	133	123	66	6	1399	IV
2	Limited information available	400	2.54	0.96	65	125	138	172	0	1583	I
3	Information limited to market only	400	2.52	1.05	74	130	118	68	10	1490	III
4	Misleading information	400	2.53	1.02	97	136	124	63	10	1535	II

Malpractices in supply chain management											
S. No.	**Constraints**	**N**	**Mean**	**S. D**	**SA**	**A**	**N**	**D**	**SD**	**Score**	**Rank**
1	Deduct more charges	400	2.23	1.05	120	126	109	34	11	1510	IV
2	Partial payment	400	2.16	1.30	182	79	54	63	22	1536	III
3	Deduct undue charges from producers	400	1.89	1.07	189	118	58	20	15	1646	I
4	Quote lower than actual price	400	2.10	0.79	84	211	93	6	6	1561	II

*S.D- Standard Deviation, SA*Strongly Agree,*A-Agree, N*-Neutral, D*- Disagree. **SD- Strongly Disagree

Conclusions

In Kinnaur district, constraints in supply chain management of apple was recorded that highest rank (I) was found under higher wages rate and have lowest rank (IV) was found under non-availability of resources. In case of constraints in packaging material in supply chain management of apple was recorded highest rank (I) under non availability of packaging material at desired place and lowest rank (IV) was found under shortage of boxes and cartons. Storage facility constraints in supply chain management was found that highest rank (I) was recorded under Inadequate storage facilities and lowest rank (III) was found under lack of cold storage facility. In case of constraints transportation in supply chain management of apple was found that highest rank (I) was recorded under higher transport charges and lowest rank (V) was recorded under lack of vehicle. In Kullu district, Constraints in supply chain management of apple was recorded that highest rank (I) was found under high wages rate. In case of constraints in packaging material in supply chain management of apple was recorded highest rank (I) under not availability of packaging material at desired place. Inadequate storage facilities a constraint in supply chain management was found that highest rank (I). Village not linked with metalled roads facilities constraints in supply chain management was found that highest rank (I). Late information ranked (I) constraints in supply chain management was found that highest rank. Deduct undue charges constraints in supply chain management was found that highest rank (I). In Overall, Constraints in supply chain management of apple was recorded that Higher wages rates, Not availability of packaging material at desired place/Not availability of packaging material during peak time, Inadequate storage facilities, Vehicles not available at time, Limited information, Deduct undue charges was found that highest rank (I).

Future Scope

There is vast potential for entrepreneurship development amongst youth in the field of supply chain management. These opportunities must be identified and awareness may be created. The producers may be given trainings on value addition through different supply chain parameters. The identified constraints of lack of all-weather roads, untimely availability of transport facilities, lack of storage facilities, and high prices of packaging material intervened and improved by the government for improved market efficiency. The extension functionaries provide training on supply chain management so that this knowledge is disseminated to producers during different awareness camps.

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