

## Critical issues in the Supply Chain Management of Kashmiri Apple: An Exploratory Study

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### ABSTRACT

*Apple production is the main occupation and highly profitable economic activity in the Kashmir valley (India). The state is exporting apple and its products to almost all the major apple markets in India and other countries particularly to Middle East. In the current competitive global market, the pressure on organisations to find sustainable strategies for delivering value to its stakeholders has grown even stronger. In developing countries particularly India the supply chain of agricultural products is traditional and involves value loss at different stages of supply chain of apple products which escalates the cost of the final product. The present paper intends to focus on "missing values" and the critical issues of supply chain of fresh apples in the study area. Sustainable production, commercialisation and market development are not possible without curbing the different missing values in the whole supply chain of apple. The research highlights different missing values in the supply chain of apple, right from input stage to output stage. With the overcome of these missing values, growth and development of apple sector and subsequently economic development of Kashmir is quite possible.*

**Keywords:** Critical issues, Supply Chain Management, Apple, Missing Values, Kashmir.

### INTRODUCTION:

The Apple (Botanical Name of Apple is *malus domestica*\*) is one of the principal fruits, grown in temperate region of the world. It has colorful appearance, crispy flesh, pleasant flavor and sweet taste that attract the consumers and fetch good price. Apple is a rosaceous fruit tree, belonging to genus *Malus* and is the most widely grown fruit tree having high economic value. However, growth and vigor are best in rich sandy loams, but apple also grows well in heavier clay soils as long as they are well drained (Fiala, 1994). Major part of the production is consumed fresh and smaller part of the production is processed in juices, jellies and other jam items. Mostly the Indian apples are grown in three regions- Jammu & Kashmir, Himachal Pradesh and Uttarakhand where they are cultivated at an altitude of 4000 to 11000 feet. Jammu & Kashmir and Himachal Pradesh have roughly equal production area for apple, but J&K has the higher average yield (output), which accounts to 67 percent of total apple production in India. (Anonymous, 2003). Jammu and Kashmir is the major apple producing state which produces about 1.33 million tons per year. (Anonymous, 2009) and it exports apple to Middle East, Gulf and East Asian countries through state marketing intermediaries (Javid & Banerjee, 2003). Its cultivation is done in all the districts of Kashmir valley and major share to the apple production comes from Baramulla, Shopian, Pulwama, Kulgam and Anantnag.

In developing countries, agriculture holds major roles in deciding the economic stability of the country and also acts as the backbone of their economy and same is the case with J&K state. As reported the agriculture sector is the key for the rural development over the world (Arinquez et al, 2007) and acts as a source of employment for the millions of people over the world (Kalchschmidt & Normansyah Syahrudin, 2011). Agriculture is the most

important sector of Indian Economy. In 2013-14 Indian agriculture sector accounts for 18 percent of Gross Domestic Product(GDP) and provides direct employment to 50 percent of the workforce in India (Arjun, 2013).In the state GDP of J&K agricultural share is 19.35 percent in the year 2011-12, whereas share of apple industry to GSDP was 8 percent in 2013-14 (Anonymous, 2013).

In India under the medicinal value category, the apple murraba is widely used as a stimulant for heart and acts as purgative. It also prevents constipation, reduces incidence of dental caries, helps to control obesity and supplies extra energy for heavy exercise (Mitra & Rathore, 2004). The old saying "an apple a day keeps the doctor away" has been reconfirmed as the pulp of apple fruit has been found to be the second richest source of phytochemicals like quercetin, catechin, phloridzin and chlorogenic acid, all of which are very strong antioxidants and reduces the risk of some cancers, cardiovascular diseases, asthma and diabetes (Block, Patterson, & Subar, 1992).In the early 1990's, researchers examined well over one hundred epidemiological studies relating to diet and cancer, and in 128 of 156 dietary studies, fruits and vegetables had a significant protective effect against a variety of different cancers (Ibid). They found that those who consumed low amounts of fruits and vegetables were twice as likely to have cancer compared to those who ate high amounts of fruits and vegetables.

Apple consumption has been inversely linked with asthma and has also been positively associated with general pulmonary health. In a recent study involving 1600 adults in Australia, apple and pear intake was associated with a decreased risk of asthma and a decrease in bronchial hypersensitivity (Woods et al, 2003). The phytochemicals present in apples may inhibit cancer cell proliferation, regulate inflammatory and immune response, and protect against lipid oxidation (Liu, 2003). They prevent oxidative stress and delay ageing (Ibid)

Not only may apples help decrease the risk of heart disease, cancer, and asthma, but apple consumption may also be associated with a lower risk for diabetes. In the Finnish study of 10,000 people, a reduced risk of Type II diabetes was associated with apple consumption (Knekt P et al, 2002). Higher quercetin intake, a major component of apple peels, was also associated with a decreased risk in type II diabetes (Ibid). Pectin, one of the most potent components in apples, acts as a detoxifier of the body by supplying an inordinate amount of galacturonic acid (Ibid) This helps to remove harmful wastes from the bloodstream and can lower the diabetic's insulin requirements. It is also helpful for both depression and weight loss and is considered a negative calorie food, as it takes more calories to digest them than they provide to the body. Apple and pear intake has been associated with weight loss in middle aged overweight women in Brazil (De Oliviera et al, 2003). They release certain chemicals into the body which helps in the synthesis of glutei acid and controls the destruction of various nerve cells. (Boyer & Liu, 2004).

The percentage composition of various ingredients from apple fruit is listed in the following table:

**Nutritional value per 100g**

Ingredients	Value	Percentage (%)
Energy	50 Kcal	2.5
Carbohydrates	13.81 g	11
Protein	0.26 g	0.5
Total fat	0.71 g	0.5
Cholesterol	0 g	0
Dietary fiber	2.40 g	6
Niacin	0.091 mg	1
Pyridoxine	0.041 mg	3
Riboflavin	0.026 mg	2
Thiamin	0.017 mg	1
Vitamin A	1.12 mg	2
Vitamin C	4.6 mg	8
Vitamin E	0.18 mg	1
Vitamin K	0.36 mg	2
Potassium	107 mg	2
Sodium	1 mg	0.001
Calcium	6 mg	0.6
Iron	0.12 mg	1
Magnesium	5 mg	1
Zinc	0.04 mg	0.0001
Phosphorus	11 mg	2

**Source:** USDA National Nutrient Database (2009)

The area under apple has increased significantly and in result there has been higher production. The cultivation and production of apple for the last 16 years are as follows:

**Cultivation and production of apple in Kashmir valley (India):**

S.No.	Year	Apple cultivation (000 Ha)	Apple production (000 MT)	Percentage increase (area wise)	Percentage increase (production wise)
01	2000-01	88.15	751.31	00 (base year)	00 (base year)
02	2001-02	90.08	909.58	2.19	21.06
03	2002-03	94.87	953.95	7.62	26.97
04	2003-04	100.70	1041.54	14.24	38.63
05	2004-05	107.93	1093.28	22.44	45.52
06	2005-06	111.88	1151.71	26.92	53.29
07	2006-07	119.04	1222.18	35.04	62.67
08	2007-08	127.80	1311.85	44.98	74.61
09	2008-09	133.19	1332.81	51.09	77.40
10	2009-10	138.19	1372.97	56.77	82.74
11	2010-11	141.72	1852.41	60.77	146.55
12	2011-12	154.72	1756.19	75.52	133.75
13	2012-13	157.28	1348.15	78.42	79.44
14	2013-14	160.87	1647.69	82.50	119.31
15	2014-15	163.43	1170.30	85.40	55.77
16	2015-16	164.12	1966.41	86.18	161.73

**Source:** Directorate of Horticulture, Planning and Marketing, J&K, (2014)

There was continuous progress of area under apple cultivation in Jammu and Kashmir State from 88.15 (000) hectares in 2000-01 to 164.12 (000) hectares in 2015- 16. The main reason for the increasing trend was mainly comparative advantage of this crop over the other commercial crops grown in high altitude region in the state. During the year 2000-01 the production was worth 751.31 (000) metric tons. The production marked highest growth during 2010-11 worth 1852.41 (000) metric tons. But the production decreased during 2012-13 because of untimely rainfalls in the state. There was once again sudden decrease in the production in the year 2014-15. This was due to low temperature and unexpected rains followed by flood in most parts of the Kashmir valley.

**Varieties of Apple in Kashmir:**

**Ambri:**

Ambri is the most popular and considered to be the indigenous production of apple in India grown in Himalayan hills. It is widely famous for its crispiness, aroma, flavor and attractiveness. Generally this kind of Apple is fully ripe in month of October and stays fresh for a long period. Ambri Apple is blush red, slightly striped, medium in size and conical in shape. Lawrence in his famous book 'Valley Of Kashmir'(1895) has mentioned this apple as the most popular fruit found in the valley. It used to be the fruit of Choice of Kashmiris at that time. Unfortunately its production has dwindled over the years on account of rapid plantation of other fast growing varieties. Presently its production is mostly confined to Shopian and Kulgam areas of Kashmir only though fresh plantation in other district is also taking place. Batote area of Jammu also houses a production farm of this rare. This variety has been utilized in breeding programme extensively, as a result of which a few hybrids, namely Lal Ambri (Red Delicious + Ambri) Sunehari (Ambri+ Golden Delicious) and ASP-49 (Red Delicious with Ambri) were released. (Anonymous, 2009). ASP-49 is a scab resistant, has more juice content, is sweet and attractive in shape.

**Delicious:**

This is a world renowned variety largely grown in Sopore belt but now grown all over in Kashmir .The fruit has a typical geometrical shape and five lobes at the apex. The skin of this variety is striped; blush red and smooth .It is juicy and aromatic. Its crispiness and aromatic features made it more attractive. It has different sizes and matures for consumption in Mid-September. It has abundant market in various fruit Mandies of the country and is available for five months in the market easily from mid-September. This is a sweet variety of the fruit. It comes in two colors-Red Delicious and Golden Delicious.

**American:**

This kind of Apple is small and round shaped and quite juicy. American apple is very crispy and sweet in taste. The skin of the fruit is white greenish and sweet. This apple ripens in September and is out in market by mid-September. It offers good taste in desserts and comparatively much cheaper in price. This variety is popular with customer for its absolute shape, red color and cheaper price.

**Maharaji:**

Maharaji Apple is a large sized apple with bright red color on a green base and has some conspicuous dots. Skin of the fruit is crisp, juicy, and aromatic yet taste is bit acidic. This variety ripens in late October and it remains fresh for a longer period of time and gets sweeter with time and storage. It is also consumed in cooking and preparation of desserts.

**Razakwari:**

It is the earliest variety of apple in the Kashmir valley. It is sweet and juicy in taste. It is mostly packaged in cardboard boxes. It is not stored in warehouses because of shorter shelf life.

**Chemora:**

The fruits of chemora cultivator are medium to large in size. They ripe in September to October month and thus remain available in market in October and November

**Hazratbali:**

Hazratbali Apple is a medium sized apple and its shapes may vary from round to slightly conical. Color of the fruit may differ from red color to stripe with a tender skin. Skin of this apple is sweet and juicy. This variety cannot be stored for a longer period and has small shelf life. Hazartbali ripens in mid- July and is the oldest variety of apple available in Kashmir valley, and is consumed in large quantities in the country.

Variety name	Size	Shape	Color	Flesh	Ripening time	Harvesting time
AMBRI	Medium	Oblong/conical	Blushed red	Fine grained	September	October
DELICIOUS	Medium	Oblong/conical	Red/golden	Juicy	September	October
AMERICAN	Medium	Round	Blushed red	Fine grained	September	Sep-oct
MAHARAJI	Large	Round	Red with dots	Crispy	Late October	Oct-nov
RAZAKWARI	Medium	Round	Light red	Juicy/ crispy	July	August
CHEMORA	Medium	Flat /pedicel	Yellow	Juicy/ acidic	September	November
HAZRATBALI	Medium	Round/conical	Light red	Sweet	July	August

**Source:** Directorate of Horticulture, Planning and Marketing, J&K, (2014)

**LITERATURE REVIEW:**

This section presents the review of literature to the study of supply chain management with respect to apple industry in Kashmir.

Supply Chain Management (SCM) is basically an extension model of systems model where in input, process and output stages are discussed. However a detailed view about the value chain analysis was given by Michael Porter in his influential book 'Competitive Advantage' (1985). In value chain analysis there are primary and secondary activities which are based on the systems model of input, process and output stages. Supply Chain Management (SCM) is the network of service providers and manufacturers that work together in order to move goods from the stage of raw material to completely finished goods to the end user. It is the ability to form network and provide services to the customers within the boundaries of that network by overcoming the supply chain issues (Peter Singe, 2010). In general, supply chain management links through the information, physical and monetary flows. (Chopra, Sunil, & Meindl, 2007) stated that, supply chain management holds significant position in maintaining the flow of materials from processing units to supplying the finished products or goods to the end consumer.

(Dunne, 2001) stated that supply chain management (SCM) is processing the chain as efficient as possible by better resource use and flow scheduling, reducing the risk that associated with the food contamination and safety, improving the quality over the chain, and decreasing the response of agricultural industries to the changes in consumer demand for the food attributes. Supply chain collaboration concept is of significant importance for the agri-food industry however, some constraints arise due to the nature of industry's products, and the specific structure of the sector. Subsequently, collaboration in the supply chain is often limited to operational issues and to logistics-related activities. (Matopoulos et al, 2007). Collaboration, information sharing and transparency are the three basic components of sustainable supply chain management (Steve, 2010).

(Caigher, 2004) established two basic structures of supply chain. First, the author characterized supply chain as segmented. Here within the overall structure, the sub structure are closely coordinated chain and also with well-defined vertical stages from production to consumer. This chain is based on the certified organic farming. The general form of first structure is:

Farmer -> organic local company -> abroad company -> high value market

Second sub- structure is generally made up of several actors and their relationships are loosely coordinated through long term or short term business transactions. Apart from these, their relationships are not formalized through vertical integration or contracts and so they manage rapidly over time.

Farmers -> traders -> urban markets -> regional markets/local consumer

The practice of monoculture in the fruit orchards leads to spreading of various diseases to the plants. Since all plants in a monoculture are genetically similar, if a disease strikes to which they have no resistance, it can destroy entire populations of plants. Polyculture, which is the mixing of different varieties of plants, reduces the likelihood that one or more of the plants will be resistant to any particular pathogen. Studies have shown planting a mixture of different varieties of trees in the same field to be effective at combating disease (Zhu & Youyong, 2000). A variety of different cultivars are often planted in orchards, mainly in order to cater for different sectors of the market, or as an insurance against cropping failure of any single cultivar. In addition, while some apples produce abundant fertile pollen of their own, others do not (Dennis, 2003); (Jackson, 2003) and in the latter case, pollinator cultivars are planted alongside, or between, the commercial crop cultivars (Jackson, 2003). This means that many apple orchards contain multiple cultivars of the same age growing together (Roach, 1956) under identical environmental conditions.

Pollination is a key event for fruit set. Flowers and developing fruit that are not pollinated, or are poorly fertilized, usually drop soon after they have bloomed (Free, 1993). Insect pollination services are essential to attain profitable yields in apples (Ramírez & Davenport, 2013). Apple, like many of the most important food crops, requires pollination by bees to produce fruit (Free, 1993). Globally, the honey bee (*Apis mellifera*) is considered to be the most important pollinator of apple, and is managed as a commercial pollinator in all apple-growing regions of the world (Brittain, 1933). Many fruit crops, including apple, require cross-pollination meaning that in order to set fruit they need to receive pollen from a genetically different compatible individual. Therefore, 'pollenizers' (i.e. compatible pollen donors) or a mix of compatible cultivars are required to produce apples (Brittain, 1933); (Kendall, 1973). Major apple cultivars can be grouped according to their respective flowering times, for example early flowering, mid-season, mid/late season or late flowering, though these need to be considered depending on geography and climate. Orchard design should contain co-flowering, genetically compatible apple cultivars to maximize potential fruit production. The mixture and arrangement of apple cultivars grown within an orchard should be chosen to provide sufficient and compatible pollen for successful fruit production and, therefore, each flowering period should overlap sufficiently to ensure that pollen availability and stigma receptivity occur at the same time. Only in this way will pollen from one cultivar be received by another. (Brittain, 1933); (Sheffield, 2014) With respect to timing, managed honey bee colonies should be introduced into the orchard when approximately five percent of the apple blossoms have opened (i.e. the king blossoms - the primary or central bud within a cluster that opens first) (Delaplane & Mayer, 2000).

To maximize fruit production, light interception by an orchard and distribution within a canopy must be optimized. Cover orchard floor with reflective materials produces important effects on improving of fruit color, fruit size, and return bloom in apple orchard (Widmer et al., 2001) as well on better fruit firmness, sugar content and advanced in maturity of the fruit (Layne, 2001). The main effect of reflective film is the increases of PAR reflection by reflecting light incoming to floor back into the tree canopy, improving widely the light availability to shading parts of the tree canopy (Widmer et al., 2001)

Conway et al. (1999) suggested that calcium is the most important mineral element determining fruit quality. It seemed to be especially important in apples where it reduced metabolic disorders. Calcium in adequate amounts helped to maintain apple fruit firmness and decreases the incidence of physiological disorders (water core, bitter

pit and internal breakdown). Postharvest decay may also be reduced by increasing the calcium content of apple fruit. (Ali, Raza, Khan, & Hussain, 2004) stored five apple varieties in ordinary storage at room temperature of 25°C. They recommended Golden Delicious and Amri cultivars of apple for storage to fetch good market price. The postharvest quality of Red Delicious apple under different temperatures for one month was studied by Khorshidi et al (2010) and they found that the fruit diameter, weight, volume, firmness, elements of sodium and potassium, marketable quality and color surface were significantly affected rather value loss at different storage temperatures. (Conway, 1982) found in his research that fruits and vegetables require additional cost in value addition, when they are moved from the field to the consumer. Thus it is an economic necessity to decrease costs and wastes by extending the storage life of fruit. The perishability nature of fruits and vegetables tends to affect the total cost of storage and transportation. During the time between harvest and consumption, temperature control is the most important practice in maintaining apple quality; keeping apples cool will slow down the changes associated with ripening and give growers more time to market their apples. The lowest safe temperature recommended when apples are going to be stored for a long term period is from 2 °C to 3 °C (Kader, 2002). According to (LeBlanc et al., 1996), the fruit production chain, including harvest, storage and distribution are generally not perfect with 90 percent of fresh apples stored under improper conditions, especially during the summer period. Fruits undergo several changes during harvesting, transportation and postharvest storage, which affect the nutritional compounds and enzymes involved in the metabolism of those compounds. The changes during prolonged storage periods are related to the taste, nutritional quality and shelf life of the product. It is difficult to preserve nutritional quality of all fruits by a single technology. Thus, it is extremely important to develop sustainable technologies to maintain the quality and shelf life of fruits (Sharma et al., 2009). Robertson et al, (1990) & Murray et al, (1998) while identifying problems in the supply chain of apple fruit found that fruits that are picked before physiological maturity will not ripen satisfactorily and those harvested at more mature stage have shorter life cycle. To ensure maximum storability, apples should be picked when mature, but not fully ripe. If apples are picked when they are too ripe, physiological processes are underway which complicate storage, even under optimal conditions (Ingle, D'Souza, & Townsend, 2000). Juan et al. (1999) investigated the effect of harvest date on storage ability of 'Golden Delicious' apple and cold stored for seven months. Quality indices (soluble solids content, flesh firmness, acidity and starch index) were determined weekly for one month before the first harvest date and upon removal from storage. Fruit susceptibility with increasing maturity was inoculated with *Penicillium expansum*, keeping in cold storages for five weeks. After removal from cold storage, superficial scald and moisture loss incidence were higher on fruit picked earlier. Bitter pit occurrence was also observed. The percentage of marketable size fruit and disease severity increased with harvest date. Apples picked at right stage have the organoleptic qualities which enable them to survive more than six months of storage. Apples which were harvested the earliest were firmest both before and after storage, but lost a greater percentage of their firmness during storage (Robertson et al., 1990). Postharvest evaluation gives possibilities for delivering a high quality product and a basic understanding of apple texture is necessary for the development of technology for postharvest evaluations (Loannides et al., 2007). (Ali, 2005) observed that Postharvest losses in agricultural products are almost unavoidable. Due to comparatively more sensitive and perishable nature, horticultural products are usually more exposed to post harvest losses than other agricultural products. (Hewett et al. 2008) observed that Faulty handling practices coupled with underdeveloped and exploitive marketing systems results in 25-30 percent postharvest losses and value deterioration, leaving little quality surpluses for export and processing. Srinivas et al. (1997) surveyed to assess post-harvest losses and observed that these losses occur because of poor transportation facilities, lack of know-how, poor management and improper market facilities or due to careless handling of the produce by farmers, market intermediaries and consumers. The apple fruits are prone to significant postharvest losses during postharvest handling and storage. The storage life of apple can be increased and post-harvest losses decreased by selecting the best adopted cultivars, provision of optimum nutrition and harvesting at optimum stage (Strief, 1996). Khorshidi et al. (2010) studied the postharvest quality of Red Delicious apple under different temperatures (0, 5 and 12°C) for one month. They found that the fruit diameter, fruit weight, volume, firmness, total titratable acids (TTA), total soluble solids (TSS), elements of sodium and potassium, marketable quality and color surface were significantly affected by different storage temperatures. However, the Red Delicious apple fruit stored at temperature 0°C maintained the better quality attributes. Physical characteristics of agricultural products are the most important parameters to determine the proper standards of design of grading, conveying, processing and packaging systems (Tabatabaefar & Rajabipour, 2005). Among these physical characteristics, mass, volume and projected area are the most important ones in determining sizing systems (Khodabandehloo, 1999). The physical characteristics of apple fruits are important for their storage as well as processing properties.

Significant variations have been reported in physical characteristics among apple cultivars (Weibel, Widmer, & Husistein, 2004). (Cerdas, del, & Saenz, 1993) concluded that almost two thirds of the growers did not grade the fruits and 56.5 percent employed bulk transport, usually consisting of 3 or 4 layers of fruit in the truck. It was found that in Kashmir mixed grading and topping are common phenomenon with farmers (Bharadwaj, et al, 2012).

Kader (2002) claims that "transport vehicles should be well insulated to maintain cool environment for precooled commodities". Moreover, he also recommends that loads should be placed properly inside the trailer, away from the side walls and back door of the trailers. He also recommends transporting during night hours to avoid warm weather, since deterioration will increase as temperature increase. Ilyas et al. (2007) estimated the losses of apples during transportation in different months. When apples were kept in cold storages then losses decreased to 28 percent because certain types of fungus related infections were controlled. The marketing system prevailing in the Jammu and Kashmir state with regards to the apple industry is a disorganized system. Despite its healthy contribution to the state economy this sector has not been blessed with the appropriate attention as it deserved, as reported by (Sahaf, 1984). He has also found that because of the inappropriate infrastructure the state as well as the orchardists is losing a hefty part of their efforts. It has been found that there are three kinds of market functionaries namely commission agents, Mashakhors and Ladanies present in India's largest fruit and vegetable market-Azadpur market (Bharadwaj, et al, 2012). They found that normally commission agents in case of apple deal with more than one varieties of apple, having their own contracts with the farmers and have agents who supply them. Commission agents many times advance money to suppliers in four or five installments depending upon the estimation of crop yield. The study further reveals that there are at least nine marketing channels available for marketing of apple in the sub-continent.

### **OBJECTIVES OF THE STUDY:**

Considering the above facts, the present study has been undertaken with the following objectives:

1. To study the existing supply chain management of apple production in the Kashmir valley.
2. To study the missing values (critical issues) in the existing supply chain management and the causes behind them.
3. To provide the possible solutions to the problems faced by the sector.

### **RESEARCH METHODOLOGY:**

Keeping in view the objectives of the study, the data collected was carried out both at primary level and secondary level. At primary level, data was collected by face to face interview through a pre-tested questionnaire. Random sampling was done as per the study requirements, and north Kashmir was chosen as it is the most dominant apple producing region in the valley. Farmers/fruit growers, forwarding agents, pre-harvest contractors, pesticide dealers and commission agents were taken into consideration.

Secondary data was collected from department of horticulture (P&M) J&K, various websites, Sheri- Kashmir University of Agriculture Science and Technology (SKUAST), and other relevant materials in the form of books and journals were also consulted for the study.

### **CRITICAL ISSUES OR MISSING VALUES IN THE SUPPLY CHAIN OF APPLE INDUSTRY IN KASHMIR:**

#### **At input stage:**

It has been observed in the orchards of Kashmir valley that there is a monoculture of growing red delicious apples. The area covered under delicious variety in Kashmir valley is 45 percent (Ghosh, 2001). The highly disease resistant variety i.e. Maharaji apple cannot be seen now in the most of the orchards. Less diversified apple trees are prone to many diseases and attacks by rodents. The farmers are not aware about this problem and they do not have any idea about diversity and the importance of pollination in the orchards. Pollination management is an important element of apple culture. Before planting it is important to arrange for pollinizers varieties of apple which provide viable, compatible and plentiful pollen. During the bloom season, commercial apple growers usually provide pollinators to carry the pollen. Honeybee hives are commonly used in the United States, and most common pollinator for apple trees is of the genus 'Apis' of honeybees (McGregor & Samuel, 1976). Inadequate pollination not only reduces apple yield, but also increases premature fruit drop which leads to poor quality. The main solution to this problem is to place single trees of a selected pollinizer cultivar, or crab apple trees, as they serve as universal pollinizers within the rows (Figure 10). A recommended pollinizer arrangement within a single row has a

ratio of about 1:7, which is one pollinizer tree for every eighth tree. (Sheffield, 2014). Well pollinated apples have best quality and will have seven to ten seeds (Hartman & Howlett, 1954).

Fruit growers ignore the value of authorized and approved pesticides. Moreover, overdose and inefficient spray of pesticides affect the quality and quantity of apple. Application timing of chemicals can influence its efficacy (Jones, Bound, & Miller, 1998). Kashmir valley is dominated by marginal holders, about 70 percent having orchard holding upto 2 hectors, with an average size of land holdings of 0.53 hector (Anonymous, 2006). Apple scab diseases, outbreak of premature leaf fall and infestation of red spider mite, have declined the quantity as well as quality of the fruit. It is now recognized that virus and virus like disorders mainly contribute in reducing the yield in apple to 4 to 6 tons/hector in India and 40 to 60 tons /hector in developed countries (Bhardwaj et al, 1992).

Climate, soil and water requirements, and plant density are the most important factors which need to be considered before cultivating apple trees in a given place. Apple trees can grow in a wide range of soils from medium textured to gravely sands. Wet soil leads to poor aeration and increased incidence of crown rot in apples (Abu Goukh et al, 1983). Apple cultivators in kashmir miss the chance of high productivity and returns because of improper, unplanned and poor irrigation problems. Pruning is done usually in winter season while trees are dormant. The practice of pruning in summer is negligible in the valley. Pruning in summer improves light penetration, enables fruit color and promotes flower bud formation (Utermark, 1977). The fruit number and yield are reduced linearly with increase severity of pruning following removal of scaffold limbs during the dormant period (Robinson, 1994).

Establishment of an orchard is a long term investment and deserves a very critical planning. There should be optimum spacing to accommodate maximum number of trees per unit area. Spacing of trees should be such when trees fully grow, the fringes of trees should touch each other but the branches should not interlock (Kumar, 1997). Growers in Kashmir valley lack the expertise of proper planting of trees. Poor inputs (water, seeds, fertilizers, agricultural tools) have significantly lowered the production of apple fruits. The size of fruit, its attractiveness, flavor, and pleasing texture all depends upon good quality of raw materials and inputs (Looney, 1993). Inputs available to the growers here are primitive compared to those found in developed countries. Major constraints in the production of fresh fruits and vegetables are non-availability of good quality seeds, inadequate irrigation, lack of soil testing facilities and extension staff (Kumar, Sant, Joshi, & Suresh, 2004).

#### **At processing stage:**

At the peak season of harvesting, the scarcity of apple boxes put producers at a huge risk because of perishable nature of ripe fruits. The delay in the fruit harvesting leads to over maturing of the fruits. Apples harvested at more mature stage have shorter shelf life (Meredith et al., 1989) and did not ship well because of reduced shelf life (Murray et al., 1998).

In Kashmir valley there is still traditional, informal and non- registered sorting and grading system prevailing. Adequate light distribution is an important factor influencing apple yield and aspects of fruit quality such as size and color (Wagenmakers & Callesen, 1995). In China sunlight reflectors are used. In Australia it has become common practice to cover apple orchards with hail netting to protect fruit from damage with hail storms (Proctor & Loughheed, 1976). Enclosing apple fruit in protective bags during development has been practiced in Japan for many years (Ibid). In Kashmir there are no such technologies available for the farmers. Moreover; many marginal apple growers are having the problem of improper labeling and non-registered trademarks.

#### **At output stage:**

There is an acute shortage of affordable cold storages at the farm level and refrigerated storages at the markets and ports. In Kashmir we have single, private cold storage facility at Lasipora, Pulwama and that is costly for a marginal farmer. In addition to it, poor temperature conditions, including sanitation of the available storage rooms and facilities are not up to the standard. Fruit diameter, weight, volume, firmness, elements of sodium and potassium, quality and color surface is significantly affected by different cold storage temperatures (Khorshidi et al, 2010). Extended storage of apple fruit may cause enzymatic browning accompanied by unpleasant colors and flavors and a loss of nutrients (Goupy et al, 1995).

There is no proper quality control mechanism in the valley which would have maintained the quality of apples being exported outside. Retailers and wholesalers consider that there are four main quality problems with apples\_ immaturity, over ripeness, poor grading, marks and blemishes (Anon, 1985). In the Kashmir valley



there is lack of appropriate transport system for apple growers. Poor infrastructure (roads, bridges), lack of refrigerated vehicles are adversely affecting the quality of the fruit. Fruits and vegetables require additional cost in value addition, when they are moved from field to consumer (Conwey et al, 1999). In view of shipment of fruit to the wholesale market by unrefrigerated trucks, growers have the option either to sell at prevailing price or paying for storage in the hope of getting higher price in future. Moreover, truck transport is costly as there is no train connectivity from Kashmir to Jammu.

In the valley, marketing is mainly done by commission agents on the principle of "watak" and "hatha" systems at different fruit mandies of the country, which is universally objectionable (Javid, 2004). The dominance of middlemen ship, especially commission agents in the current supply chain of apple fruit has negatively affected the income of growers. Farmers cannot control it; neither has government taken any step to regulate the whole marketing system of apple fruit. Fruit growers fail to understand the negotiation process by commission agents and traders at various mandies. Price risk is faced by growers and contractors, since there is no guarantee of minimum supporting prices and increasing trend in the market price of the fruit. In the valley it has been seen that there is collusion among middlemen and apple merchants to control prices, hence exploitation of marginal producers is a common practice. Besides, growers' inability to market the product efficiently and effectively in domestic and international markets has shown that there is no promotional strategy adopted by them. Integrated marketing communication can produce stronger message consistency and help to build brand equity and create greater sales impact (Madhavaram & McDonald, 2005). Moreover, due to non-regulated market producers face various malpractices such as deduction of undue charges, quoting of lower price than actual, high commissions by the intermediaries. Consequently, the growers are not able to frame a feasible marketing strategy.

#### **CONCLUSION & SUGGESTIONS:**

Modern orchard management has the goals of attaining sustainable, high yields coincident with achieving marketable fruit quality within desired fruit grading and packaging (Warrington et al, 1996). Many of the existing problems with fruit quality are caused by growers themselves (Link, 1993). Most of the management functions that affect fruit yield and quality such as tree spacing within and between rows, row direction, rootstock and training systems are determined at the time of orchard establishment. However, cultural factors like irrigation, nutrition, pesticide choice and application method, orchard floor management, crop load management, use of hail netting and pruning can be modified at any time after the orchard establishment to change productivity, quality and quantity.

Some of the measures required to re-design the supply chain for improving the competitiveness of the fresh produce are as follows:

Supply chain management may be a powerful tool in linking small farmers to the markets for sustainable income generation. Integrate supply chain for fresh market, processing and export. Agriculture department, especially SKUAST should open its small research centers at district level, so that proper care can be taken of pre-mature leaf fall and other diseases. Proper cold storage facilities should be provided at the easy reach of growers in order to reduce the carriage costs. The state government should provide financial assistance to the growers so that they can take full advantage of the improved technology. There is no technical awareness among fruit growers regarding the use of sunlight reflectors and overhead netting used in the orchards. Horticulture department of the valley should provide the knowledge and technical training to the farmers and highlight the benefits of such advanced technologies. It should be used first on a trial basis and if results are favorable then it can be used in a wider scale. There is need to brand Kashmiri apple in such a manner that the originality of fruit is traced from Kashmir region. As the market rate of apple fruit fluctuates, there should be a Minimum Supporting Price (MSP) fixed per kg or per box on year to year basis by the government so that producers are sure of the minimal value in case of market downfall. As apple industry is one of the major foreign exchange earners of the state, it should be uplifted on the lines of SEZs. Pruning methods, degree and timing should be done with the help of experts and proper training needs to be provided by the horticulture department of the state at the Tehsil and Block level. As fruit growers in the valley are not aware about pollination and its benefits for the overall orchard health and management, they need to consider strongly beehive pollination. It acts as a resistant against harsh weather conditions and deadly diseases by cross pollinating highly disease resistant variety (e.g.; Maharaji) and highly disease susceptible variety (e.g.; Delicious).

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