Indian Journal of Agricultural Economics 76: 2 (2021):278-291
DOI:10.63040/25827510.2021.02.005

# Potential of Apple Cultivation in Doubling Farmer's Income through Technological and Market Interventions: An Empirical Study in Jammu & Kashmir

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**ABSTRACT**

The study is based on the data collected from 200 selected farmers spread over four major apple growing districts of Kashmir Valley and 11 CA stores of Kundli Industrial Growth Center (IGC) - Haryana, 6 from IGC Lassipora, Kashmir and a mega apple juice plant located in Industrial Estate on the outskirts of Srinagar. The data was collected through personal interview method using pre-tested schedule during 2017-18 and analysed using appropriate statistical tools. The study shows that the expected net returns from high density orcharding are 2.5 times higher than traditional; adoption of recommended scientific spray schedule substantially minimises cost (Rs. 38,355/ha) amounting to saving Rs. 555 crore for the entire Kashmir valley; pollinizers and pollination management are expected to add value equivalent to Rs. 2,48,312/ha; however, there is a lack of convergence between production and apple based industrial and entrepreneurial value chain and that strategic alignment of farms and market functionaries, processors and cold chain needs to be promoted for ensuring adequate returns to each of the stakeholders.

**Keywords: Jammu and Kashmir, Apple value chain, Demand, Interventions**

**JEL:Q13, Q16, Q17**

I

## INTRODUCTION

About 76 million tonnes of apples were grown worldwide in 2018, with China producing more than half of this total (58 per cent) followed by United States (6 per cent), Turkey (3.61 per cent), India (3.02 per cent), and Iran (2.06 per cent).The largest exporters of apples were China, the U.S, Turkey, Poland, Italy, Iran, and India while the biggest importers in the same year were Russia, Germany, the UK and the Netherlands. Average productivity of apple in India is nearly 6-8 tonnes per hectare, which is much lower than that of countries like Belgium (46.22t/ha), Denmark (41.87 t/ha), and Netherlands (40.40 t/ha) (FAO, 2018). Jammu and Kashmir (J&K), Himachal Pradesh, Uttarakhand and Arunachal Pradesh are the major apple producing states of India. The two important states namely J&K and Himachal Pradesh accounts for 92 per cent of the total production and about 85 per cent of the total area under apple cultivation in India. In terms of productivity, J&K has achieved

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the highest productivity (13 t/ha) followed by Himachal Pradesh (5-6 t/ha) and Uttarakhand (2.16 t/ha) (NHB, 2017).

Apple is the principle fruit crop of Jammu and Kashmir and accounts for 51 per cent of total area of 2.72 lakh hectare under all temperate fruits grown in the state. Presently the state contributes 75 per cent of total Indian apple production with an average yield of commercially important apple cultivars per unit area is the highest in the country ranging between 10-13 t/ha, but compares poorly with yields of 20-40 t/ha in horticulturally advanced countries. The climatic and other agro-ecological factors of Kashmir valley are ideally suited to the cultivation of many apple varieties besides other temperate fruits. Around 5-6 lakh families comprising about 30 lakh people are directly or indirectly associated with apple cultivation and generating an income of Rs. 8000 crores annually for the state (Government of Jammu & Kashmir, 2018).

Apple industry in the state has emerged as an important sector for diversification towards horticulture and has established its credibility in doubling farm income through increased productivity, generating employment and in enhancing exports, besides providing household livelihood security. Apart from the government schemes, the more profound factor for diversification of valley's agriculture towards apple sector is driven by comparative advantage principle. Furthermore, a growing consumer awareness about healthy eating, and established perceptions about apples as a healthy and flavourful fruit coupled with increasing income, the Indian market for apples has huge growth potential .To meet the growing demand presently country imports more than 3.50 lakh metric tonnes of apple. It also provides ample opportunities for sustaining large number of agro industries which generate substantial employment opportunities.

Apple is known in India as a most significant commercial fruit crop. However, on the production front, the low quality of apple is linked with traditional and age-old practices of cultivation; mono-culture of a few old cultivars; faulty pruning and training practices; use of seedling rootstock of unknown performance; deficiency of suitable pollinizers; ineffective control of pests and diseases; lack of institutional credit, processing and cold chain and inefficient factor inputs are some constraints coupled with, weak production and supply chain, poor marketing strategies, low transparency in the marketing system have turned the terms of trade against the producers(Hakeem *et al.*, 2006). There is a need to revisit apple policy in the state in evolving strategies, identifying options and exploring innovative institutional mechanisms. It requires new interventions, policies and implementation plans at the ground level to further multiply farmer's income manifold. Some of the interventions include: (1) Technological interventions, (2) Pollinizers and pollination management (3) Re-engineering cold/supply chain, and (4) Apple processing.

## II

## MATERIALS AND METHODS

The present paper is based on the combination of secondary and primary data collected from various sources for ICAR -Network project on "Policy Imperatives for Promoting Agricultural Commodities in India: Focus Crop Apple" followed by quantitative and qualitative assessment for comprehensive analysis to come up with a policy paper on doubling farmers' income through various interventions in apple value chain in J&K state. The study is an attempt to describe and quantify the various facets of apple value chain. A sample of 200 farmers from districts Baramulla, Shopian, Pulwama and Kulgam of the Kashmir Valley were selected purposively because of having the tremendous inclination of the farming community towards diversification of agriculture through apple cultivation. Multistage Random Sampling was used to select the 200 farmers from 10 villages with 20 randomly selected farmers from each village. Primary data collection was followed by the personal interview method using pre-structured schedules.

Controlled Atmospheric (CA) storage was found to be an important link in the apple value chain which has come up in recent past and the economics of CA storage was worked out by selecting eleven CA stores of Kundli Industrial Growth Center (IGC) - Haryana and six from IGC Lassipora. Costs and returns from the CA store units were determined to assess whether it pays a farmer to store his farm produce. As a sequel to the present study, processing being an important link in the apple value chain was also evaluated. For the present study, mega apple juice plant located at Industrial Estate at outskirts of Srinagar capital city was purposively selected to evaluate the economics of apple juice processing in the value chain and its impact on farmers' income. Three years cross sectional data was collected from the processing plant, Budgam for the reference years 2014-15 to 2017-18, to avoid any abnormal production period.

Multiple regression analysis was carried out to examine the factors influencing the apple production. Production function was estimated on per hectare basis to measure the returns to various factors of production. Some of the non-strategic collinear variables were dropped from the analysis to improve the precision of regression parameter. Based on the goodness of fit ($R^2$), the linear regression model of the following form was used:

$$Y = \beta_0 + \sum_{i=1}^{n} \beta_i X_i + U_i$$

where,

$Y$ = Gross revenue from apple cultivation (Rs ha$^{-1}$)

$\beta_0$ = Intercept

$\beta_i$ = Regression coefficient of i-th independent variable (i = 1…..n)

$X_1$ = Expenditure incurred on fertilisers (Rs ha$^{-1}$.)

$X_2$ = Expenditure incurred on plant protection (Rs $ha^{-1}$)
$X_3$ = Expenditure incurred on manures (Rs $ha^{-1}$)
$X_4$ = Expenditure on irrigation (Rs $ha^{-1}$)
$X_5$ = Expenditure incurred on total labour (Rs $ha^{-1}$)
$U_i$ = Random term (i = 1…..n)

The significance of regression coefficient was tested by employing student't' test.

*Estimation of Costs and Returns from Storage*

The costs and returns from the storage were determined to know whether it pays a farmer to store his farm produce and it was worked out with the help of the following formula:

NR = GR- C

where,
NR = Net returns to storage; GR = $P_1 - P_0$ (Gross Returns)
$P_0$ = Purchase price or market price at the time of storage; $P_1$ = Selling or market price at the time of de-storing; C = Cost involved in storage
NR = > 0, implies positive returns on storage; NR = <0, implies negative returns on storage.

*Garret Ranking Technique*

Garret ranking technique was used to assess which constraint affected the apple yield/quality significantly. A total number of 200 respondents were surveyed across all districts of the valley and each respondent ranked the constraint. According to Garret ranking technique, each rank given by the respondent was converted to percent position using the following formulae.

$$Percent\ Position = {100(R_{ij} - 0.5)}/{N}$$

where $R_{ij}$ is the rank given by i-th respondent to j-th factor, N is the number of factor the respondent has ranked.

The percent position was converted into score using the Garret's Table and the factor with maximum average score depicts that particular factor is affecting the respondent significantly.

*Pollination Welfare Implication*

Pollination welfare implication model was used to quantify role of pollination in apple value chain and its incremental benefit in multiplying farmer's income.

W = S. $\Delta$q
W= Welfare implication (INR);

S = Area under apple production (ha);
$\Delta q$ = Increase in net returns (INR/ha) as a consequence of pollination service
($\therefore \Delta q$ = Added returns from pollination – Added costs of pollination).

## III

## RESULTS AND DISCUSSION

### (i) *Situation Analysis of Apple*

#### (a) *Trends in Area, Production and Productivity of Apple*

Globally area, production and yield of apple has recorded compound growth rate of 1.2, 2.4, and 1.2 per cent per annum from 1973-74 to 2014-15 respectively. During the same period the area, production and yield of apple in Asia recorded the growth rate of 3.9, 6.3 and 2.4 per cent per annum respectively, while India recorded the growth rate of 2.4, 3.5 and 1.1 per cent, respectively (Table 1).

TABLE 1. REGION WISE COMPOUND GROWTH RATES IN APPLE (1973-74 TO 2014-15)

| Regions (1) | Area (2) | Production (3) | Yield (4) |
|---|---|---|---|
| India | 2.4** (0.044) | 3.5* (0.090) | 1.1 (0.088) |
| Asia | 3.9* (0.181) | 6.3* (0.093) | 2.4* (0.133) |
| World | 1.2 (0.088) | 2.4* (0.044) | 1.2 (0.088) |

*Data Source:* FAO, 2018;
*Note*: * and **Significant at 1 and 5 per cent level.

Dynamics of apple industry in Jammu & Kashmir state revealed that area increased by 1.4 per cent from 2011-12 to 2016-17, while as production decreased by 0.2 per cent during the same period due to large area being in transition phase. Inspite of manifold increase in area and production, yield has remained almost stagnant at around 9 metric tonnes during the past two decades. However, with concerted efforts of the farmers, yield has picked up and during the year 2010-11 it has recorded more than 13 metric tonnes per hectare. Area under apple has witnessed a continuous increase since 1980s from 60,286 hectare, which increased to 1, 63,000 hectare in 2017-18. Production also exhibited the same pattern and increased by more than eight times and touched nearly 19 lakh metric tonnes during 2018-19. Overall, the bygone decade apple industry of state showed an overriding performance by achieving higher trajectory in area expansion besides production and productivity (Malik and Choure, 2014).

#### (b) *Returns from Apple Farming and Factors*

Returns from bearing orchards were calculated on per hectare basis, so as to present the actual picture of the economics of apple growing orchards. The results revealed that bearing orchards exhibited gross returns of Rs.920531 and net returns of Rs.619695 (Table 2). Average production per hectare was more than 2000 thousand boxes of apple (39570 kg), where one box contains 18 kg of fruit. Net returns from apple can be increased if the extension services are strengthened by educating the farmers about proper input use which has been found below merit during the course of investigation. Average production cost per kg was found to be Rs.7.60with the cost benefit ratio of 1: 3.06.

TABLE 2. RETURNS FROM APPLE ORCHARDS AND REGRESSION COEFFICIENT ESTIMATES

| Returns from apple orchards during bearing stage | | Regression coefficients explaining determinants on revenue | | |
|---|---|---|---|---|
| Particulars | Cost (Rs.ha$^{1}$) | Independent variables | Estimated coefficients | P-value |
| (1) | (2) | (3) | (4) | (5) |
| Total production cost (Rs.) | 300836 | Fertilisers | 0.36 | 0.015* |
| Average production (kg) | 39570 | Pesticides | 9.03 | 0.045* |
| Gross returns (Rs.) | 920531 | Manures | 1.30 | 0.000* |
| Net returns (Rs.) | 619695 | Irrigation | 0.05 | 0.983 |
| Production cost per kg(Rs.) | 7.60 | Labour | 0.24 | 0.008* |
| Output/input ratio | 3.06 | Adjusted $R^2$(per cent) | 92.10 | |

*Significant at 5 per cent level of significance.

Estimates of regression function depicted in Table 2 revealed that plant protection chemicals and manures were the most significant and positive determinants of revenue from apple cultivation. Irrigation at the farm level also had a positive contribution to the improvement of revenue from apple, however its coefficient turned statistically insignificant. Pesticide level was found to be an important determinant of apple revenue due to the fact that more application of pesticides reduces the chance of losses in apple along the scientific lines. The analysis further revealed that the irrigation and the labour component were also used efficiently on the farms. Positive and significant coefficients indicated that revenue from the apple cultivation can be generated more by using efficiently these factors. Value of coefficient of adjusted $R^2$ shows that the exogenous variables specified in the model explained major variation (92.10 per cent) in total revenue (Naqash, 2015).

(ii) *Doubling Farmers Income through Technological Interventions*

(a) *Replanting / Rejuvenation Programme through High Density Orcharding*

About 20 to 30 per cent of the area under apple in J&K state needs replanting as they are more than 50 years old. Replanting will increase the production and productivity level of old orchards. Replanting involves introduction of new plants in between two rows of existing old trees and gradual removal of old trees once the new plants start giving yield. Rejuvenation may be done relatively on mid-age trees, whose root portion is good but the scion portion are damaged or left unattended for many years and on such trees which result in lower quality and yield.

High productivity can be achieved through shifting from conventional method of planting to High/ Ultra High density in replanting / rejuvenation programme. Most of the developed countries have already shifted to High /Ultra High density planting and achieved yields of about 40-50 MT/ha and in USA about 100 MT/ha. Studies conducted in SKUAST-K university have shown that two types of high density planting:(i) 1000 plants/ha with a potential yield of 50 MT/ha and (ii) 2000 plants per ha with a potential yield of 75 MT/ha can be introduced in J&K state. Thus with a gradual shift towards high density apple orcharding in the state, quantum jump (200 per cent) in farmers' income can be achieved (Table 3).

TABLE 3. REQUIREMENT OF PLANTS FOR CONVERSION OF 33 PER CENT APPLE ORCHARDS WITH HIGH DENSITY AND EXPECTED RETURNS WITH HDP

| Particulars | Figures |
|---|---|
| (1) | (2) |
| Area (ha) 2017-18 under Kashmir | 1,46,016 |
| Area (ha) to be converted to HDP (33 per cent of current area) | 48185 |
| Change in density with use of HDP (trees/ha) | 1,000 |
| Plant requirements for five years (in lakhs) | 48,18,500 |
| Net income from traditional apple orchards (Rs. $ha^{-1}$) | 6,00,000 |
| Expected net returns with high density orcharding (Rs. $ha^{-1}$) | 15,00,000 |

*Source:* Field survey, 2018.

The most common cultivated variety in the valley is that of Delicious group of apples (75 per cent is that of Red Delicious and Royal Delicious). Delicious varieties are alternate bearers, susceptible to scab disease, sensitive to weather change and late bearing cultivars that cannot attract the off-season premium of early cultivars. There is a need to diversify into other exotic varieties of apple like Honey Crisp, Gale Mast, Scarlet Gala, Red Cameo, Royal Empire, Red Fuji, Coe Fuji, Oregon Spur II, Early Red Cameo, Granny Smith, etc. and overcome some of the problems associated with Delicious group of varieties. The new varieties need to be imported and introduced in the State in large scale instead of increasing area under Delicious group of apple.

Table 3 depicts the requirement of plants for conversion of 33 per cent apple orchards with high density. It was found that with 33 per cent conversion of present apple area, 48185 hectares of area can be transformed into high density plantations, creating the plant requirement of more than 48 lakhs with change in density of 1000 trees per hectare. Net income from traditional apple orchards was estimated to be approximately Rs.6 lakh per hectare, with the high density orcharding the expected net returns were found 2.5 times higher to be Rs.15 lakhs/ha, but requires simultaneously huge infrastructure.

(b) *Farm Inputs*

Majority of the farmers (above 80 per cent) faced problem of proper irrigation facilities especially during spray season and fruit maturity period (July/August).

Although, Kashmir is having abundant water resources, still the growers are facing water scarcity. It is the weak water resource management and improper channelisation which is responsible for this important problem, otherwise the state could harvest a very good quality fruit which could increase farmer's income substantially. Moreover, lack of resources generally faced by the marginal farmers' result in lower investment for better production technologies. There is a need for creation of better resources through contract/co-operative /corporate farming to cater to such needs of the growers.

There exists huge gap with respect to appropriate use of plant pesticides, technical know-how of pesticide formulations, appropriate time of spray, frequency and quantum of pesticide sprays, compatibility of various chemicals; besides lack of knowledge regarding different brands/trade names, viz., quality, knowledge and adaptation rate of SKUAST-K spray schedule and externalities of pesticides. Other common glitches are poor adoption of spray schedule, advent of unregistered agencies/ spurious fungicides**,** loan market linked with pesticide trade and resistance and resurgence, defective pruning and training, imbalanced nutritional doses etc. However, application of pesticides as per scientific recommendations and procedures could reduce the cost of this input significantly. Pesticide cost can be reduced largely through application of proper dosage, proper quantum of spray per plant and low cost chemicals available in the market. Table 4 depicts the over-all welfare implications on part of cost minimisation if farmers adhere to scientific and need based along with least cost combination spray schedule. Adopting spray schedule at its maximum in controlling various biotic stresses using least cost combination and availability of the pesticides in the market, a huge sum of money of Rs.555 crores and 253 crores could be saved in Scenarios 1 and II.

TABLE 4. ECONOMICS OF PESTICIDE SPRAYS IN KASHMIR

| Particulars (excluding labour, machinery and fuel cost)<br>(1) | Amount<br>(2) |
|---|---|
| Scenario 1 | |
| Pesticide cost at farmer's field (Rs./ha) | 69,164 |
| Pesticide cost as per spray schedule (only essential sprays) (Rs./ha) | 30,809 |
| Savings (Rs./ha) | 38,355 |
| Total Saving for Kashmir valley(crore Rs.) | 555* |
| Scenario II | |
| Particulars (excluding labour, machinery and fuel cost) | Amount |
| Pesticide cost at farmer's field (Rs./ha) | 69,164 |
| Pesticide cost as per spray schedule (Essential + Need Based sprays) (Rs./ha) | 51,677 |
| Savings (Rs./ha) | 17,487 |
| Total Saving for Kashmir valley(Crore Rs.) | 253* |

*Source*: Field survey, 2018;*Calculated for 144825 ha area under apple cultivation Kashmir.

(c) *Pollinizers and Pollination Management*

Pollination is a prerequisite for fruit and seed set. As fruits and/or seeds are the economic products of most of our crop species, pollination plays a vital role in realising optimal yield. Insect pollination underpins apple production but the extent, to which different pollinator guilds supply this service, particularly across different apple varieties, is unknown. The optimal number of hives/ha for apples has been researched since the mid-1970s, with the recommendations of 1-12 hives/ha (Delaney and Tarpy, 2008). SKUAST-K has taken the initiative to identify native pollinators and utilise them in pollination management. Before planting new trees in an orchard a farmer should make effective combination and location of apple pollinizer varieties and pollinators for optimal yield and quality. Many of the commercial varieties of apples planted in Kashmir valley are self-incompatible and require cross-pollination with pollen from a compatible pollinizer variety. Some important pollinizers include: Manchurian (crab tree), Snowdrift, Golden delicious, Red gold, Scarlet-Siberian and Spartan, etc. Honey bees are the most economically valuable pollinator worldwide, and many high-value crops such as almonds and broccoli are entirely reliant upon pollination services by commercial beekeepers. As per the SKUAST-K studies on 'Pollinizers and Pollination Management', there is potential to increase apple yield by 28 per cent due to combination of pollinizer and pollinators in orchards. It has been also found and also researched elsewhere in advanced countries that it not only help in increasing the productivity levels but also gives better quality and shelf life to the fruit. Better quality and shelf life are very important attributes for getting premium price in market. The intervention of pollinizers and pollination management portrayed in Table 5 revealed that it increased farmer's income manifold by yield and quality gains. On an average it added Rs.278,000/ha to farmers' income with an added cost of Rs. 29688/ha. Further results of Pollination Welfare Implication Model revealed that if the entire area is catered by scientifically managed pollination services it will add 300 crores (INR) to the apple economy of Kashmir (Mahendar, 2018).

TABLE 5. IMPACT OF HONEYBEE POLLINATION ON APPLE QUALITY

| | Managed orchards (n=100) | | Non-managed orchards (n=30) | |
|---|---|---|---|---|
| Particulars<br>(1) | Quality<br>(2) | FGVO (INR)<br>(3) | Quality<br>(4) | FGVO (INR)<br>(5) |
| Total output | 2743 MT<br>(100 per cent) | 777 Lakhs<br>(100 per cent) | 487 MT<br>(100 per cent) | 113 Lakhs<br>(100 per cent) |
| Grade-A | 1609 MT<br>(58.6 per cent) | 558 Lakhs<br>(71.8 per cent) | 148 MT<br>(30.3 per cent) | 48 Lakhs<br>(42.4 per cent) |
| Grade-B | 831 MT<br>(30.2 per cent) | 186 Lakhs<br>(23.9 per cent) | 212 MT<br>(43.5 per cent) | 50 Lakhs<br>(44.2 per cent) |
| Grade-C | 303 MT<br>(11.2 per cent) | 33 Lakhs<br>(4.3 per cent) | 127 MT<br>(26.2 per cent) | 15 Lakhs<br>(13.4 per cent) |

*Source:* Field survey, 2018; Added costs Rs.29,688/ha and Added returns Rs.2,78,000.

(d) *Re-Engineering Cold/Supply Chain*

Advances in controlled atmosphere (CA) technology have had a dramatic effect on apple storage logistics and opened up markets hither to unavailable for fresh and processed apple products. This is an advantage not fully shared by apple fruit in the state whose shelf life extension by CA is much high. The peak harvest season witnesses a glut in the market and depresses the price realisation for the farmers. This is caused by the absence of viable infrastructure to pack, transport and store apple in a manner designed to preserve quality and release the same in the market when the prices are attractive. Creation of adequate CA storage facility in the state could easily manage mismatch in demand and supply, price stabilisation, reduction in post-harvest losses in apple besides huge foreign exchange savings by reducing imports (NABCONS, 2013).

Requirements of storage in 2016-17 for even 35 per cent of incremental market arrivals is likely to be about 6 lakh tonnes. Examination of production and market clusters need creation of cold storage capacity of 1.6 lakh tonnes and CA store capacity of 6 lakh tonnes. This will form less than 35 per cent of the grade A and B apples produced in future. Refrigerated transport using reefer vans will be a necessity when the fruits are stored in CA stores. Given such a situation we have to introduce 50 such reefer vans with a capacity of 10 tonnes each. When linked to CA stores or cold stores this would offer a complete packing cum storage solution to farmers (Table 6).It was observed that both absolute and relative price variability decreased for apple after the promotion of CA storage in Industrial Growth Center, Pulwama market for the entire period.

TABLE 6. POTENTIAL OF CONTROLLED ATMOSPHERIC STORES IN THE VALLEY

| S. No<br>(1) | Particulars<br>(2) | Quantity<br>(3) |
|---|---|---|
| 1. | Production of apple (2016-17) | 1,726,834 |
| 2. | Present installed capacity of CA Storage | 1, 17,200 (19.39 per cent) |
| 3. | Potential of apple Storage @ 35 per cent (2016-17) | 6,04,392 |
| 4. | Deficits | 4, 87,192 (80.61 per cent) |

However, increased arrivals were witnessed particularly during the storage period. After setting up of cold storage, the tendencies of price fluctuations were minimal. This indicated that with the promotion of CA cold storage, fluctuations in prices were reduced and this has helped in achieving the price stabilisation in the long run-an important intervention to double apple grower's income (Table 7).

TABLE 7. COSTS AND RETURNS FROM CA STORAGE

(*Rs. per kg*)

| Market price at the time of storage<br>(1) | Selling price at the time of destoring<br>(2) | Storage cost<br>(3) | Returns on storage<br>(4) | Net returns on storage<br>(5) |
|---|---|---|---|---|
| 42.18 | 67.18 | 11.25 | 25.00 | 13.75 |

*Source:* Field survey, 2018.

(e) *Role of Apple Processing on Farmers Income*

Nearly 30 per cent of total produce of apple crop gowaste due to pre-harvest drop, making the total annual quantum of such fruit about 0.25 million MT (Shah, 1999). The apples which are wasted due to pre-harvest drop, under development of colour, inferior grade and other reasons are utilised for the purpose of processing. These apples cannot be marketed as they give negative returns to growers. Due to non-availability of adequate processing facilities in the state, such fruits do not find an appropriate outlet in the market. Though there have been multi-dimensional efforts to increase the production of apple in the state but processing sector has not received proper attention (Shaheen and Gupta, 2004).

APEDA has identified Kashmir as an Agri- Export Zone for apple. Two major processing plants are presently operating in Kashmir with a total annual installed capacity of 70,000 MT to process raw apple culls. The processing plant, owned by Jammu & Kashmir Horticulture Processing and Marketing Corporation (JKHPMC) is located at the hub of apple producing area, viz., Sopore of Baramulla district. The plant with installed capacity of 10,000 M.T. was established by CADBURY India Pvt. Ltd. in the early eighties and was purchased by JKHPMC in the nineties. The other processing plant with an annual installed capacity of 60,000 MT was established in the year 1999, by a private entrepreneur, viz., FIL Industries at Rangreth, Budgam. On an average, FIL plant realised a net return of Rs.190.76 lacs per annum.The potential is for the establishment of processing plants with a total capacity of 5.10 lakh tonnes in different districts (Table 8).

TABLE 8. POTENTIAL OF APPLE PROCESSING IN JAMMU & KASHMIR

| S.No. (1) | District (2) | Processing potential (MT) (3) | Present installed capacity (MT) (4) | Deficit (MT) (5) | Deficit (per cent) (6) |
|---|---|---|---|---|---|
| 1. | Srinagar | 5290 | - | 5290 | 1.13 |
| 2. | Ganderbal | 19126 | - | 19126 | 4.08 |
| 3.. | Budgam | 43669 | 40,000 | 3669 | 0.78 |
| 4. | Baramulla | 110201 | 10,000 | 100201 | 21.35 |
| 5. | Bandipora | 19450 | - | 19450 | 4.14 |
| 6. | Kupwara | 79692 | - | 79692 | 16.98 |
| 7. | Anantnag | 58326 | - | 58326 | 12.43 |
| 8. | Kulgam | 62178 | - | 62178 | 13.25 |
| 9. | Shopian | 78210 | - | 78210 | 16.66 |
| 10. | Pulwama | 43179 | - | 43179 | 9.20 |
| | Total | 519321 | 50,000 | 469321 | 100.00 |

*Source:* Field survey, 2018.

Revenue-centric opportunities could be grabbed by establishing processing units on large scale at district level reducing the overall wastage to its minimum. The semi-processing units could be established by government agencies/entrepreneurs nearer to apple producing areas. Small scale food parks can be developed at various center points of districts areas facilitating packaging, semi processing, grading, and value addition of apple (Sharma *et al*., 2010).

### *(a) Constraints in Apple Value Chain*

Apple is prone to number of problems and constraints perceived by farmers which result in production, quality and marketing distortions. To restore these problems, huge durable resources in terms of irrigation, post-harvest and market infrastructure, quality inputs besides management of diseases on regular basis needs to be engaged to mitigate reduction in yield, and price losses. Two hundred apple farmers were surveyed across the valley during the years 2017 and 2018 using Garret Ranking technique to measure which problems and constraints contributed towards yield /quality/price loss significantly (Table 9).

TABLE 9. RANKING OF PROBLEMS/CONSTRAINTS FACED BY THE FARMERS

| Constraints/Problems (1) | Rank (2) | Average garret score (3) | Contribution (per cent) (4) |
|---|---|---|---|
| *Production and Financial constraints* | | | |
| Lack of timely availability of good quality inputs | 4 | 59.83 | 6.71 |
| Climate change | 18 | 28.45 | 3.19 |
| Lack of durable capital resources | 13 | 43.70 | 4.90 |
| High incidence of diseases | 2 | 65.50 | 7.34 |
| High incidence of insects pests | 6 | 57.15 | 6.41 |
| Lack of agricultural labour in peak seasons | 10 | 51.05 | 5.72 |
| Inadequate irrigation facilities | 5 | 58.10 | 6.51 |
| Lack of credit availability from institutional sources | 12 | 46.70 | 5.24 |
| High cost of informal credit | 14 | 39.40 | 4.42 |
| Knowledge deficit about package of practices | 11 | 47.75 | 5.35 |
| Low quality extension services | 16 | 32.35 | 3.63 |
| Poor communication facilities | 17 | 32.20 | 3.61 |
| *Marketing Constraints* | | | |
| Demand/supply mismatch and low price of farm produce | 3 | 65.48 | 7.35 |
| Lack of marketing facilities at village level | 7 | 56.43 | 6.33 |
| Lack of post-harvest storage facilities | 1 | 66.03 | 7.40 |
| Lack of reasonably priced and efficient transport | 9 | 51.25 | 5.75 |
| Delayed payment by marketing agencies | 15 | 38.78 | 4.35 |
| High prices of plant protection chemicals | 8 | 51.88 | 5.82 |

*Source:* Field survey, 2018.

It can be concluded from the results that high incidence of diseases, lack of timely availability of good quality inputs, inadequate irrigation facilities and high incidence of insects/pests affect production and quality losses significantly. Under the marketing constraints lack of wellorganised post-harvest storage facilities besides demand/supply mismatch and low price of farm produce and lack of marketing facilities at the village level are the acute and major concerns. Garret Ranking revealed that other production and marketing constraints turned out to be of medium and low intensity. By and large, resolution of each of these constraints faced by apple growers would definitely act as multipliers in increasing farmer's income manifold.

## IV

## CONCLUSION

Apple production including its value chain is an important economic pursuit and source of livelihood to about 30 lakh people of Jammu & Kashmir. The state in recent years has paid a lot of attention to the development process of apple industry. However, there exists wide and marked gap in the productivity of apple as compared to major apple producing countries of the world. The study of apple value chain of the state assumes importance for planning as it guides the planners about the area where it is economical to diversify and the areas which would be most suitable for the development of industries based on the raw material. The present study shows that there exists a huge potential to increase the farmers' income through specific interventions along the value chain. Average production cost per kg was found to be Rs 7.60 with the cost benefit ratio of 1: 3.06. Plant protection chemicals and manure are the most significant and positive determinants of revenue from apple cultivation, besides irrigation. New market players need to be invited who can mobilise the resources for investment coupled with change in policy and support systems from the government. Building capacities in individuals and institutions for effective and remunerative participation in the value chain will go in a long way in the augmentation of capacity of the industry. The study shows that scientific recommended and judicious use of pesticides can save up to Rs. 555 crores; introduction of pollinizers and pollination management for yield and quality gains has a potential of adding value equivalent Rs. 300 crores per annum to the industry. However, some of the interventions that are critical for ensuring equitable returns to the farmers have to be taken at a sectoral level in close coordination with the government. Cold storage should be constructed at export marketing centres so as to ensure the facility of keeping fruit in cold chain at the terminal market when there is glut at export marketing centres. Likewise, State financial agencies should extend loan facility to marginal growers at low interest rate against their produce which will minimise the practice of supplying interest free finance to the growers by the commission agents and then cheating them by charging high commission. Revamped apple sector has to be planned with a right mix of investments, capacity building, technological innovations and committed institutional leadership. These interventions will definitely go a long way in doubling farmers' income besides saving valuable foreign exchange.

*Received February 2021.* *Revision accepted May 2021.*

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