PRESERVATION AND PRODUCTIVITY OF APPLES IN HIMACHAL PRADESH

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INTRODUCTION

According to the world renowned US based manufacturing company Emerson, India is the world’s second largest producer of fruits and vegetables but is not as good in preserving the materials that’s why it is throwing away fresh produce worth INR 133 billion every year and it has to import the basic fruits like apple, papaya from other states like Australia.

Apple production in India had shown us the various trends in past 10 years, “in 2009/2010 production declined from 1.98 to 1.77 million metric tons, due to high temperatures and drought. Whereas India had a record apple crop of 2.89 million metric tons in 2010/11.”

Himachal Pradesh plays an important part in the apple production of India. Agriculture is the main economic of Himachal Pradesh and is also known as the “Fruit Bowl of Nation” (APEDA)."

It is estimated that 70-80 percent of the Indian apple growers market their produce via organized marketing channels and approximately 85-90 percent of this fruit is consumed fresh - while the rest is exported, processed, or wasted. (source GAIN report of USDA)

Our projects aims at the steps that can be taken to store and preserve apples till they reach to the consumers at retail level and methods for cost reduction. If the wastage is reduced it will help to bring down the cost. We will look at the techniques that can be implemented at every step of apple production to get a better yield.

In India only about 1-2 percent of retail is organized (GAIN report USDA Foreign Agriculture Services, dated: 19/6/2013). Most retailing is carried out by the unorganized sector, including push carts, street vendors, corner shops, and weekly markets. Large regional divergences exist throughout India. This is because high margins are often extracted at various stages of the supply chain, as well as due to the time and transportation costs associated with supplying apples from northern states to other domestic markets in southern and western regions.

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We also observe a very fluctuating price at the retail level in the same seasonal year, which to irregularities in the distribution system. We will look at the steps that can be taken to check the prices of apples. In ideal situation we can have a very stable price, which could be only possible through government help.

This project would benefit every single individual, small retail shopkeepers, and especially farmers. We will begin by determining techniques that are already being used on the apple orchard to preserve apples and evaluating them. Then we would carry our study on post-harvest management techniques followed by analysis of the retail business of apple industry. Finally we will propose techniques to improve the quality of apples, to store the apples and steps that can be taken to curb the fluctuations of the apple prices at the retail level.

![Figure 1. India: Apple Production by State](image-url)

Source: National Horticulture Board of India

*Estimates
1.2 LITERATURE REVIEW

In this chapter we discuss about the research plan of our project. First we give a brief description about the site we are going to visit. we will look who are the stakeholders. we will discuss why there is a need to study in this topic. Next we will describe the techniques which are already being used in other countries but are not being used in Himachal Pradesh.

1.2.1 SITE DISCRIPTION

Kullu, one of the districts of Himachal Pradesh, is approx. 70kms away from Mandi and is situated on the bank of Beas River, known for its beautiful hills and apple orchards, produces a large quantity of apples. A large part of economy of the Kullu district depends on the apple production. The cultivated apple area of Kullu is about 18524 hectares and the annual apple production usually lies between 80000 to 90000 metric tons\(^2\).

We are planning to visit apple orchards nearby Kullu town (capital of Kullu district) and Manali, 30 kms away from Kullu town, situated on the bank of Beas River.

1.2.2 STAKE HOLDERS

As our project goal is to preserve and cost reduction of apple (fruit) in Himachal Pradesh. We need to understand who is considered a stakeholder in this process. The stakeholders in our project are the farmers, common people, small local shopkeepers, and relevant governmental organization (Horticulture department). Although all of the stakeholders are important, not all are necessary to discuss in depth for the focus of this project. We have determined that the key participants to evaluate are the communities of farmers and local shopkeepers of fruits, local agencies that have an interest in local economies.

1.2.3 BACKGROUND

CARES TAKEN AT PRE-HARVESTING STAGE

A number of research have been done in the field of apple cultivation, storage and preservation. Many of the researches we found deals with the subject of increasing the growth of apple in different terrains of the world and the maintaining of the quality of apples. Some of the techniques we found are as follows:

\(^2\)http://kullu.net/agriculture/a1006.html

Agriculture - Horticulture
kullu.net
AFTERCARE

One of the technique used in the aftercare of apple is clean basin management. In this technique the basin is kept clean by hand or by black alkathene mulching which controls weed, conserve moisture and improves the quality of fruits as well. Mulching is more effective in colder areas in comparison to warmer places because it increases the soil temperature.

The quality and production of apple are also affected by heavy bearing in apples which also results in the alternate bearing cycle of production. Hand thinning (reducing the bearing density by hands) is also a feasible process here but it is not economical.

FRUIT DROP

Fruit drop occurs in three phases’ i.e. early drop, June drop and pre harvest drop. Some apple trees which are naturally thin and cannot sustain the natural conditions drops their fruits which is called early drop or natural drop. June drop occurs due to less soil moisture. The drop of fruits before ripening is known as the pre-harvest drop, which is caused by certain environmental conditions like wind buffeting, mowing spraying etc.

IRRIGATION

Apple crop need a certain degree of moisture content in soil. Most of the apple orchards are in hilly terrain where irrigation facility is not adequate. Uniform distribution of rainfall and irrigation during critical periods is needed for the better growth of apples. Apple requires about 114 cm of water during the whole year. During summers. We have to irrigate the field within intervals of 8-11 days. At least 8 irrigation are required to be provided during critical period of (April-august).

HARVESTING AND POST-HARVEST MANAGEMENT

The harvest period of apple depends on variety to variety. For example red apple has the harvest period from late September to early October. Maturity and ripening of fruits are the two different phenomenon. The quality of apple can be maximize if harvested in maturity period while harvesting, fruit may or may not attain the fully ripe edible quality. Weather conditions also plays an important role in deciding the harvesting period of different varieties of apple.
We need to understand the following process that are mentioned below for better preservation and the way they will influence the cost of production. It will also help in finding the alternative methods which are better and cheaper method of preservation.

Post-harvest is the handling of the crop or fruit immediately after harvest. The techniques used in the post harvesting are as follows:-

**PRECOOLING**

Pre-cooling is the process of removing heat before packing and further processing of the apples. This can be achieved by placing the apples in cool and ventilated place .we may also keep the apples in cold water to remove heat. Fruit surface must be free of moisture before grading, wrapping or packing in cartons.

**GRADING**

Grading of the apples can be done in 3 ways namely, fruit size, fruit appearance and quality. According to the size apples are graded manually in 6 grades. On the basis of fruit colour, shape and quality, apple are graded in 3 or more quality grades. These grades are normally known as AAA, AA and A; A, B, C. For size grading, mechanical graders with washing and waxing facilities are used now a days.

**PACKAGING**

There are various techniques for packaging apples .in India itself Apples are packed in wooden boxes. In cardboard boxes in some places .there are standardized Size of wooden boxes that can carry about 10 kg or 20 kg fruits in a box. Dimension of wooden boxes are 45.7 cm long, 30.5 cm wide, and 25.4, 27.5 and 30.5 cm in height.

CFB cartons are also used for packing apples. These CFB cartons save the wood and prevent fruit bruising which fetch good market price. The dimensions of CFB cartons with trays are 50.4 cm x 30.3 cm x 28.2 cm and 50.0 cm x 30.0cm x 28.2 cm (inner case).

**STORAGE**

The main step of the post-harvest period is the preservation and storage of fruits and in our project we will be going to draw the attentions of the farmers on the better storage techniques for preserving their produce. Apples have a longer storage life compared to other fruits but storability of different variety vary. Apples start deteriorating after climacteric stage. However, shelf-life of apples can be prolonged by prolonged by providing optimal storage conditions. The storage temperature for apple is -1.1 -0 C. Apple varieties can be stored for 4-8 month after harvesting.
PHYSICOLOGICAL DISORDERS

Scald, Bitter pit, Internal Browning are some common disorders which occurs apple. Scald is the major concern for apple growers. It is favored by hot dry weather before harvest and high and poor ventilation in storage rooms or in packaging. Irregular brown patches are initial symptoms of scald.

Bitter pit occurs during storage and is characterized by small sunken spots on the fruit surface. Initially small water-soaked areas appear which shrink and turn brown with the loss of water and ultimately become brown localized areas of the dead tissue. The most affected ones are irregular picked or the large sized fruits.

Internal browning is characterized by brown discoloration in the flesh usually originated in or near the core. Controlled atmospheric storage with higher temperature can be used as an antidote for this disorder. If we can find some better solutions to these problems, we will be able to increase the overall productivity.

1.2.4 CASE STUDY

Similar studies have been done in china also. In this part we are going to discuss some of the techniques they are using for production and preservation of apples and try to correlate it with the Indian conditions and climatic behavior (source³)

HARVEST

The harvesting period of apples in china is from September to October. Usually apples which are going to the cold storage for the storage for a span of time should be harvested 7-10 days before the harvesting period.

POSTHARVEST TREATMENT

PRECOOLING AND PRE-STORAGE

Due to lack of large refrigeration equipment in China, apples are usually precooled by the natural cold weather at night in most areas. They used Chemical treatment to reduce the incidence of physiological disease and improve the storage performance of apples. For cleaning they used to immerse the apples in a chemical solutions for example calcium chloride solution (3%-6%), ethoxyquin solution (0.25%-0.35%) and thiabendazole solution (1000-2500mg/kg).

³http://iufost.org/publications/books/documents/Chap9LiandLi.pdf
Storage and transport processes for apples in China

PACKAGING
For packaging they used Wrapping papers containing diphenylamine or ethoxyquin. As for the outer packaging, generally cartons are used. Which are made up of yellow paperboard

TRANSPORTATION
In china also they used the trucks and tractors for transporting the apples to the cold storage, same as we are using in India. They also don’t have much efficient technique to avoid mechanical damage.

STORAGE
They are using both the old traditional techniques and the cold storage method for preserving and storing the apples.

TRADITIONAL STORAGE
There are two traditional storage techniques namely trench storage and kiln storage. Trench storage is suitable for preserving late-maturing varieties. It uses the trench whose
Then apples are placed in the trenches at a thickness of 33-67 cm and the trenches covered with a reed mat in order to maintain and control the temperature. It is very effective. Maximum period of storage is 5 months.

In kiln storage, kilns used for preserving apples are about 3-3.3 meters in width, 3.3-3.5 meters in height and 30-50 meters in length. In this method both the doors and air venture opened to the atmosphere to take full advantage of natural low temperatures at night. During day both doors and venture are kept closed.

COLD STORAGE

Cold storage are used where there is natural high air temperatures. Usually, apples are stored in refrigerated (-1 to -3°C) warehouses within 1-2 days after harvest and the temperature of the apples is lowered to -1 to 5°C after 3-5 days. It is capable to keep the apple fresh up to 6 months.

CONTROLLED ATMOSPHERE STORAGE

This is another technique used in China to preserve apples. It is a common and effective method and includes plastic film bag storage and plastic tent storage. In this method the concentration of nitrogen, carbon dioxide and oxygen as well as humidity and temperature are regulated.
CONCLUSIONS FROM CASE STUDY

Many storage methods have been used to preserve apples in China, of which traditional storage, cold storage and CA storage are the most widely used. Traditional storage can prevent most of the quality changes of apples for 2-5 months. It takes full advantage of natural low temperatures to keep apples fresh during winter. Cold storage, the most widely used method for preserving apples all over China can maintain apple quality, safety and nutritional value for nearly 6 months. Although it costs more than traditional storage, it can be used at any time and in any place. CA storage, one of the most expensive storage methods used in China, can achieve even better results in apple preservation but because of its high cost, it is only used for the preservation of high-grade export apples. So we see that now they are more inclined towards advanced technology like controlled atmosphere and we will check whether these advanced techniques are being used in India or not. If not, what are the possibilities of them being used.
1.3 METHODOLOGY

Our goal is to preserve apple and productivity in Himachal Pradesh. To accomplish the goal we will meet the following objectives:

1. Determine techniques that are already being used on the apple orchard to preserve apples.
2. Evaluate the techniques that are already used in harvesting.

3. Study on post-harvest management.
   - Transportation.
   - Cold storage.
   - Marketing.
4. Analyze the retail business of apple industry.
5. Propose techniques to improve the quality of apples.
6. Propose the techniques that can be implemented to store the apples.
7. Steps that can be taken to curb the fluctuations of the apple prices at the retail level.

Chapter three will outline how we intend to achieve these objectives, and is organized into two dimensions. The first will establish a baseline through observations, and surveying in the community. The second will integrate the community with the development of solutions through meetings with farmers.

1.3.1 ASSESSMENT OF THE SITE

VISITING THE FARMERS

Our first step will be to visit to Apple Valley which are located to near Mandi district like Kullu .Although we would like to visit Rohru, Jubbal and Kothkhai which are the highest Apple
production valleys and its covers more than the half of apple production in Remaining Himachal. This Rohru-Hatkoti-Jubbal-Kothkhai belt is popularly known as "APPLE VALLEY" or "GOLDEN BELT" in Himachal and India.

We will learn about their ways of preventing apple trees from bad weather conditions like heavy rain -fall, drought, frost and other undesirable climatic conditions. How do they prevent apples from physical spoilage, spoilage due to insects or rodents, chemical and enzymes spoilage? What are the varieties that are more favorable for them to grow up on their farms? We will also learn the kind of rootstocks they used, the planting methods that they have adopted, manuring and fertilization methods, their harvesting and post harvesting management techniques. We will determine the way the farmer market themselves how do they are affected by any undesirable by fluctuations in the demand and supply chain. What are the minimum profit margin do they expect from the market. What kind of support or how they are affected by the prices regulated by the government. Who would they prefer to sell their product that is to government firms or in private firms? Are they satisfied by the storage facility that are available near them or there is any need to have more cold storage chains in their area.

VISITING THE EXPERTS

Our next step will be to visit horticulture department of Himachal Pradesh and we will learn from the experts that what are the steps government has taken to preserve apple, what are the role government has taken to control the market of apples. The new government schemes that are initiated to help the apple farmers and how government is trying to attract private sectors to invest in the cold storage industries so that we have increased production that will help to balance the increasing demand of apples.

VISIT TO SOME LOCAL MARKET

We would like to know from them the maximum deviation that occurs in the apple prices from its average annual price. Which variety of apples has the maximum demand in the market? What are the verities that sustain more over a large range of temperature and that are less prone to physical spoilage? How does the life of apples get affected by the kind of packing? The ways of packing or cartons in which the wastage is minimal.
1.4 DATA COLLECTION, ANALYSIS AND PROPOSING SOLUTIONS

To collect data for their further assessment we will have recorded interviews at the field visit, photographs of the sites and if possible we will ask farmers, traders, experts, retailers to provide us some written records.

After collecting all the data from various farms we will have a short assessment on that with our faculty mentor. We would like to discuss the results of this assessments with the experts of the horticulture department and we will also discusses about the current research ,new techniques ,innovations that are being developed for the apple industries .To conclude our project we will compile all findings collected for horticulture department , farmers, and the market surveys . Then we will propose the solution to the problems that we mentioned at the beginning of this chapter.

1.5 PROJECT PLAN

After doing a brief research on our project and we have proposed a tentative schedule to go about it which is shown in the figure below. In Kullu district we will have our first field visit where we will spend three days studying the tools and techniques of apple farming .In the first week after the first visit we would analyze our study of first visit. After that we will go for the second phase of field visit that will be in Manali. And a week following filed visit we will be giving on analyzing the data of Manali visit. For the next four week we will be visit horticulture department near Sonal valley and the some whole sale market. After the completion of our field expedition we will complete the final analyses, make recommendations, propose solutions and conclude the project.
1.2.6 CONCLUSION

It is evident that to learn about of apple productivity we need to look at factors such as weather condition, quality of apple seeds, quality of soil and management of apple plant, quality of pesticides, insecticides, irrigation facility, pollution, technology, that are playing a sustainable role in adversely affecting the apple productivity.

As the state government is actively participating in favor of apple industry and initiating new schemes for the benefit of apple producers, traders and cold storage owners. So in future there is still large scope of apple production in Himachal Pradesh if better quality, modern technology, availability of high quality of Sapling/seeds, proper management of labor, graders, packing & transport, marketing, better quality of pesticides, insecticides, fertilizers and proper irrigation facilities etc. are provided.
UNIT 2: FIELD STUDY

2.1 Mandi

We did a survey of retail fruit market of Mandi (H.P). we began our survey by visiting small vendors around ‘Indra market’ and Mandi bridge. We interviewed them about how do they preserve fruits but we came to know that they are not using any preservation method as their sale is low. They suggested us to visit the bigger shops near the chowk. There are around 2 big shops which sales fruit both in retail and bulk level. We had a long discussion with them on preservation, sale, and cost. Our discussion was highly focused on apples and Japani fruit (persimmon). we came to know that they are not doing anything about preservation. They were just concerned more about the fact that the fruits that are in stock must be kept in cooler places which is not the problem in these areas like Himachal Pradesh where the average temperature is low compared to the rest of the India. They preferred to buy fruits that are packed in cardboard boxes. They try to keep the fruits in the netted spongy covering.
2.1.1 INTERVIEW

The following questions were asked in the interview conducted by us:

Q: What is your monthly sale of Apple?
A: We sale around 15 quintals of apples in the peak season and around 8 to 10 quintals in off season.

Q: For how long can you keep the apples such that they are in the condition of sell?
A: The stock is maintained keeping the fact that the apples get perished within 15 to 20 days in winter season, the Japni fruit lasts for up to 10 days in the winter season and in summer season apple last for 10 days before it gets perished.

Q: What do you do with the damaged fruits?
A: The fruits which are less damage are sold at lower prices and the fruits which are more spoiled are just thrown away or served to animals.

Q: How are you able to preserve apple for this much duration?
A: We do not use any special technique for preservation we just placed them in
cooler environment and keep them away from sunlight.

Q: Does the type of packaging affect the life of fruit?
A: Yes it does, we prefer to buy apples that are packed in cardboard boxes rather than wooden boxes we have noticed that the amount of wastage due to physical spoilage is more in wooden boxes. Now a day's every single piece is separately covered with a netted spongy material. This also helps in preventing the physical spoilage. Spoiled apples are not able to infect other apples due to the separation made by this netted covering between the apples. It also help us in easy transportation.

FIGURE 4: NETTED SPONGY COVERS ON APPLES .PHOTO CREDIT: RAJIV RANJAN

Q: From where do you purchase the Apples?
A: We buy apples in the winter season directly from farms of Kullu, Kinnaur and in summer season we purchase it from the cold storage around Chandigarh.
Q: How frequently do you purchase apples from Kullu?
A: We purchase twice in a week.

Q: Why do you purchase apple in off session from Chandigarh?
A: We don’t have any cold storage here that’s why we have to purchase it from Chandigarh.

Q: Through whom do you purchase apple from Chandigarh, are there any agents involved?
A: No, apples are auctioned there and any one can purchase it by putting the right bid.

Q: If cold storages are available here weather it would be beneficial or not?
A: Off course it will be beneficial as it will bring down the coast of transportation. We will be able to purchase fresh fruits and it will also reduce the damages that are caused during transportation.

Q: From where do you purchase Japani fruit (persimmon)?
A: Japani fruit is very sessional and it gets spoiled very easily in summer season that’s why we purchase it from Kullu and Shimla only in winter season.
Q: Are you able to deal directly with the farmers of Kullu and Kinnaur?  
A: No, we deal through agents who charges commission from both sides.

Q: How the apples of Kinnaur is different from apples of Kullu?  
A: The variety of apple we get from Kinnaur is known as ‘royal’ this is superior in quality then apples of Kullu. ’Royal’ Varity is more delicious, larger in size and reddish in color. We sale more apples of Kinnaur, but we keep apples of Kullu also as they are cheaper and we have costumer for this Varity of apple.

A VARIETY OF APPLES FROM KULLU .PHOTO CREDIT: RISHABH SAHU

Q: How does the rate of apples fluctuate during a year?  
A: Low quality of apples go to a lowest of 20 Rs/kg, in peak season and they can reach up to 100 Rs/kg in off season when we purchase it from Chandigarh. And the better qualities of apple like ‘royal’ go to a lowest of 60 Rs/kg, and can go above 120 Rs/kg in off season

2.1.2 CONCLUSION FROM RETAIL MARKET

We learnt that better packaging helps to preserve the fruits for the longer time. Some improvements have already been done in packaging like use of cardboard
cartons and a separate covering for every single piece. We weren't able to find preservation methods in Mandi because sale of these retailers is very low, if they use preservation technique then that won't be economically beneficial for them. If cold storage are made available near Mandi then that will definitely bring down the cost.

2.2 APPLE ORCHARDS

As it was required for our project to have a survey on the apple and persimmon farms. So this part of our report i.e. report 2 consists the findings of our survey which took place in Kullu district. Basically we surveyed a village named Sainj and the villages surrounding it. It is at approx. 5000 ft. altitude. Basically most of the area around this village is devoted to the great Himalayan national park.

We did an intense 2 day survey interviewing the villagers who were involved in the plantation of apples, persimmon. We found that this village also had a decent amount of production of almonds, pears etc. but it seems our project was related to apples so we were concerned about it, so we only collected the data and visited the farms of apples and persimmon. As we have mentioned in our previous reports that we need to learn the preservation techniques used in the villages. So that if there is a scope of improvement somewhere we can come up with the solution. In our survey we were also concerned about the different techniques being used in every step of apple production, starting from pollination till it being transported to the market/cold storage. The survey was also focused on the ways of plantation, varieties of apple cultivated, newer irrigation techniques and government schemes.

The information and the data collected are mentioned in the “FINDINGS” section.
2.2.1 FINDINGS AND DISCUSSION

Pre-Harvesting Stage

We came to know that the time period of apples from pollination to get ready is about 4 months, April to September. When we visited the village i.e. around 26th of April we saw that trees were bearing flowers. After pollination takes place in the flowers, the flowers drop within few days and it starts bearing fruits. And then the fruits come out of these buds afterwards these fruits took around 4 months to come in proper size. Once the fruit came in their proper sizes they start to ripen and it takes around 1 month before all the fruits get ripened. As all the fruits do not get ripened at the same time so the fruits are plucked down in 2-3 times.

The varieties that were being produced in Sainj are red royal, royal delicious, golden and kali Dar. Golden and Kali Dar are used as a female plant for pollination of red royal. The female to male plant ratio is 1:4. Only three-fourthof the pollination becomes successful.
Interviewing Jawahar Negi

**Post-Harvesting Stage**

**Pre-cooling**
Pre-cooling is the process in which apples are cooled before packing or storing them. They used to keep the apples in open for one night on dried straws.

**Packing/storage**
For packaging they uses cardboard boxes and padding being done with the straws. For storage they had small rooms inside their houses which has large no of open wooden cupboards. Only single layer of apples were placed on each shelf. Proper gape was maintained around each apple to protect it from getting affected by the
surrounding apples. This arrangement also helped the air to circulate and keep the temperature of apples in control.

For their self-consumption in off season they used to preserve the apples in the form of Sequri. The apples are cut down in small pieces and dried in sun. When the apples get fully dehydrated they packed them in jars for the summers, these dehydrated apples are called Sequri.

They said us that there was no cold storage available for them in Kullu. They have to send their apples to Chandigarh.

**Diseases**

The apples are most affected by the disease cancour. Disease like ring also affect the apple production in those areas. Cancour is a disease which affects the trees at less altitude and ring is caused by the insects. In cancour the fruits get dehydrated and the skin of the apples start to come out. In ring the insects make the tree hollow from inside.

We came to know that the disease like cancour were very specific to farms located at lower altitude. The farmers of Sainj told us that their apples can be highly affected by the cancour if proper irrigation should not be there. But the farmers of nearby villages who had their farms at much higher altitude confirmed us that they are not facing these problems. Insecticides and pesticides are easily available for protecting the apple trees from the ring.

**Transportation Facilities**

Though the village Sainj has decent transportation facilities but the villages nearby Sainj had almost no transportation facilities. As these villages are at higher altitude it is very difficult to bring down the fruit from villages to the Sainj.
HPMC/Government Support

They were not satisfied with the government schemes. As there was no support from the government in fixing the minimum selling price of the apples, they have HPMC center about 15km away so they do not face much problems in purchasing insecticides and fertilizers.
Irrigation

They are having poor irrigation facility. They were highly dependent on rainfall. As the terrain is not flat so watering the plant becomes very difficult. They suggested us that if government could help them in improving their irrigation facilities like building small tanks at different altitudes from which they can water the plant at that level.

Data collected from some of the people whom we interviewed

<table>
<thead>
<tr>
<th>NAME</th>
<th>LAND OWNED (in bighas)</th>
<th>Number of trees (available/fully grown)</th>
<th>NET PRODUCTION (quintals)</th>
<th>VARITIES PRODUCE</th>
<th>WASTAGE (IN QUINTALS) after ripening</th>
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<tbody>
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<td>200</td>
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<td>120</td>
<td>40</td>
<td>40</td>
<td>Red royal, kali dar</td>
</tr>
<tr>
<td>Dhyan Singh</td>
<td>8-9</td>
<td>150</td>
<td>50</td>
<td>50</td>
<td>Red royal, golden, kali dar</td>
</tr>
<tr>
<td>Lal Singh</td>
<td>10</td>
<td>200</td>
<td>100</td>
<td>90</td>
<td>Red royal, golden, kali dar</td>
</tr>
<tr>
<td>Manohar negi</td>
<td>10-11</td>
<td>200</td>
<td>80</td>
<td>70</td>
<td>Royal, golden, kali dar</td>
</tr>
<tr>
<td>Daulatram</td>
<td>12</td>
<td>250</td>
<td>60</td>
<td>60</td>
<td>Delicious, maharaj</td>
</tr>
</tbody>
</table>
2.2.2 New Challenges
The new Challenges being faced by the farmers in this region of Kullu districts is due to climatic and environmental changes. We observed that a very large number of tunnels were being mined for the power projects. Very huge amount of hot gasses are exhausted from these tunnels which has led to increase the surrounding temperature. Crusher plants are built around these tunnels to crush the rock that are mined, and during the process of crushing dust particles are ejected in to the atmosphere which latter get settled on the surface of the apples. These dust particles damage the fruits. The farmers are not able to tackle this new problem.

2.3 HPMC

Himachal Pradesh Horticultural Produce Marketing and Processing Corporation Ltd. popularly known as HPMC, was established in the year 1974 as State Public Undertaking with the objective of marketing of fresh fruits and processing of all types of surplus fruits. It has developed the most modern system of marketing in the country. The unique characteristics of this organization are that it provides all the services to the fruit growers, which are required for marketing of fruits.

2.3.1 PURPOSE OF OUR VISIT
We visited HPMC (horticulture produce Marketing Corporation), Sundernagar to learn from the experts that what are the steps government has taken to preserve apple, what role government has played to control the market of apples. The new government schemes that are initiated to help the apple farmers and how government is trying to attract private sectors to invest in the cold storage industries so that we have increased production that will help to balance the increasing demand of apples. The storage facilities they are providing for farmers.
2.4.2 RESULTS

We came to know that the rate at which apples are to be bought are decided at HPMC Shimla. The rate at which the apples were bought in the previous three years was around rupees 8. As the rates are very less compared to the rate being provided by the traders, farmers sell their A grade in private hands and B, C grade apples are sold to HPMC. Government even buys poor grade of apples just for the benefit of the fruit growers even though large quantity of these apples are rotten and thus are just thrown away. These apples are processed into juice, jam, wine etc.

There is no cold storage facilities for raw apples in Sundernagar though HPMC has this facilities at Patlikhul (Kullu) and Shimla where farmers can store their apples on rent. We observe that the grading, packaging, and other similar process are done manually and there is urgent need to have automated plants in these sections.
UNIT 3: ANALYSIS

3.1 OBSERVATIONS

We learnt that most of the problems are localized for example the diseases like cancor being depend upon the geographical conditions. We came to know that these diseases are severe

The problems in the area were pertinent to the geography of the location. Agricultural diseases like Cancor and Ring were prevalent in lower altitudes due to dehydration of apples. Our survey revealed that villages like Sainj weren’t afflicted by these problems. Such trend was corroborated by villages in the vicinity. However there were different problems present in these close cluster of villages e.g.: transportation etc.

There has been a detrimental effect of mining activities and crusher plants whose airborne dust settles on the apples. They also cause other environmental problems like affecting the pollination cycle and spoiling fruits during their setting phase. We also suspect that temperature rise results because of these activities further making the ambience less conductive for apple farming.

HPMC has opened up a cold storage unit for instance in Patlikhul where farmers can store their harvested apple. These apples can be sold during off season in order to obtain higher revenue and profit. Irrigation facility is in shambles. The farmers are heavily reliant on reliable rainfall for proper harvest. The piping system set up for these farms are laid above the ground as it proves to be cheaper. As a result these pipes remain susceptible to ruptures. The underground installation of these pipes should be facilitated and financed by the government.

The farmers have to make do with their own small inefficient storage units which remains reliable during winters. They preserve their apples in form of Sequiri although this mode of storage is done only for apples meant for self-consumption. Also this form might not be commercially viable for sale as people wouldn’t want to eat their apples that way.
3.1.1 Charts

Percentage loss during the process of apple production

- Before fruit set: 70%
- During fruit set: 9%
- After harvest: 3%
3.2 CONCLUSION

During the course of our project which has been an exemplary and gratifying experience, we have managed to glean loads of information about apple preservation and production. The most marked observation has been the underutilization of the arable land resource. The production ought to be higher than what is being put out right now. A higher land use productivity would result in improved sustenance for small scale cultivators. On a higher priority for the state authorities should be the welfare of these small scale cultivators which can be achieved as aforementioned.

Other agricultural and logistical infrastructure hold a lot of scope for improvement. Such efforts would complement productivity gains and would even help us to reap out the maximum from our status quo.

Also noted was the prevalent ignorance and lack of awareness of modern agricultural schemes. The government should ratchet up the awareness schemes to disseminate the knowledge in rural areas.

Prima facie there appeared to be reluctance among the farmers to adopt new agricultural technologies. But this again can be attributed to the lag that the farming populace has with the new technologies and techniques that have been successfully adopted worldwide.

We hope our research work would be followed up in future in order to obtain a more comprehensive insight into the prevalent situation and to come up with technically rigorous and efficient solutions designed in accordance with the social architecture out there.
3.3 RECOMMENDATIONS

3.3.1 SOCIAL:

- Government should help farmers in improving their irrigation facilities by building small tanks at different altitudes.
- Weather forecasting methods these days have been successful with a high amount of predictability. Protective nets can be put around the trees in case of imminent hail storm to avoid heavy duty damage.
- Drought patterns can be better estimated to implement a better irrigation scheme. Farmers in these cases can save up some of their irrigation water for later use.
  Harvest and precooling can be delayed if heavy rainfalls are forecasted.
- Lucrative financial schemes and avenues should be open up by the government for private players to invest in cold storage units. Loans at lower interest would work a long way to attract them.
- Late maturing species like the Red Royal need to be planted in a special manner. A certain amount of spacing is required between different units. The space in between can be used to plant early maturing species like Bulgaria which would reap fruits much quickly. When the late maturing trees grow further in latter stages the trees planted in between can be uprooted to provide room for them.
- HPCM should be more proactive in advertising their different schemes and other agricultural knowledge so that they have a much wider reach E.g.: New high yielding varieties been developed.
3.3.2 TECHNICAL:

- Use of mobile processing plants to process fruits that can't be brought to the factories on time.
- Introduction of refrigerated vehicle for transportation of apples.
- Control atmosphere techniques for preservation.
- Farmers can setup their own low cost cold room using CoolBot for refrigeration.

3.3.2.1 CONTROLLED ATMOSPHERE (C.A.) STORAGE

Control atmosphere can be used along with temperature control system for proper management of temperature and relative humidity. In controlled atmosphere techniques the concentration of gases, present in the store room is also maintained, which increases the life of fruits rather than when kept in only temperature controlled atmosphere.

Some simple methods for modifying the composition of air in the storage environment are listed below (from Kader, 1992). Air coming into the storeroom or being re-circulated within the room must pass through a monitoring and control system.

**Oxygen gas control:**

**to DECREASE:**
- purging with nitrogen
- from liquid nitrogen through an evaporator
- from a membrane system nitrogen generator
- from a molecular sieve system nitrogen generator

**Carbon dioxide control:**

**to INCREASE:**
- dry ice
- pressurized gas cylinder
to DECREASE:

Molecular sieve scrubber
activated charcoal scrubber
sodium hydroxide scrubber
hydrated lime (use 0.6 kg of hydrated lime to treat the air used to ventilate 100 kg of fruit Air can be directed to pass through a box, located inside or outside the C.A. storeroom).

Ethylene control:

to DECREASE:
potassium permanganate
activated charcoal
catalytic oxidation

<table>
<thead>
<tr>
<th>Temperature</th>
<th>0-5°C or 32-41°F</th>
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<tbody>
<tr>
<td>O₂ % range</td>
<td>2-3</td>
</tr>
<tr>
<td>CO₂ % range</td>
<td>15-20</td>
</tr>
</tbody>
</table>

3.3.3.2 COOLBOT TECHNOLOGY
Air-Conditioner

Advantage

- easy to install
- low cost

Disadvantage

- Cannot decrease the temperature below certain limit.
- If used for refrigeration, its coil will freeze below 60°F.

Coolbot Technique

- Coolbot is an electric device developed in United States as an inexpensive way for small scale producer to cool products on their farms.
- Used in conjunction with an air-conditioner, becomes the heart and brain of a walk-in cooler.
- Prevents freeze up by cycling the compressor on and off based on sensor readings of room temperature.
- Frost on the cooling coils and by “fooling” the air conditioners temperature sensor with a tiny micro-heater.
- Can cool down to 33° F with sufficient capacity of air.
- Simple digital controls.

The coolbot fools the air conditioner into thinking that the temperature in a room is 75.73°F, even when it is much colder.
Benefits

- Farmers can use it for pre-cooling of apples.
- Can be used to make refrigerated vehicles.
Appendix 1 - Questions

FARMERS -
1. how much farm land do you own ?
2. what fraction of this land is given to apple production in (bighas) ?
3. What fraction of land is given to other fruits production?
4. what is the net production ?
   (i)Apples  (ii)others
5. varieties they produce ? and production of each variety ?  (i)
6. what is the production of each variety of apple per bigha ?
7. time period for the apples from pollination to get ready ?
8. how ripe are the apples when you pick them down man ? (a) yes (b)no
9. what percentage of pollination become successful -
   a) <1/4  b) 1/4-1/2  c) >1/2
10. how the apple crop is affected by insects and pests ?
   (i)
11. type of disease ?(i)
12. are the proper insecticides and pesticides easily available ?
13. Is government providing and subsidies for the purchase of pesticides? (a)yes (b)no
14. what kind of irrigation facilities are available to you ? how the government is helping in this?
15. are you informed by horticulture department about the new varieties and new techniques of production ?  (a)yes  (b) no
16. whom do you prefer to sell -government agencies or private agencies and why?
17. How you are selling the apples (i)formal (ii)non formal
18. do government help you in setting up the minimum marketing prices?

19. what kind of transportation facilities you are using?

20. How much is the wastage during transportation? fraction

21. do you use any traditional method to store apples? other products? if yes then what are those techniques?

22. how far is the cold storage? are sufficient number of cold storage available?

23. What are the minimum profit margin do you expect from the market?

24. how do you think government can help you in increasing the production?

Question related to wastage of the fruits:-

Before ripening of the fruits how much fruits is going waste during
1\textsuperscript{st} month
2\textsuperscript{nd} month
3\textsuperscript{rd} month
4\textsuperscript{th} month

Are you preserving the fruits, or any traditional way to kept apple fresh or edible for more time? (i)

(ii)

During picking of the fruits:
How much fruit is going to be wasted due to

(i) natural ways

(ii) human

(iii) animals

Are you preserving the fruits, or any traditional way to kept apple fresh or edible for more time

During grading of the fruits is there any wastage in the process?

During packing and transportation of the fruits is there any wastage?
# Preservation and Productivity of Apples in Himachal Pradesh

<table>
<thead>
<tr>
<th>Introduction</th>
<th>Results</th>
<th>Observation</th>
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</table>
| Apple is currently the most heavily consumed fruit in India. To fulfill the increasing demand of apple there is urgent need for the expansion of necessary infrastructure and cold storage chain. | - It has 25% success rate.  
- Few farmers are not using pollinator bees for pollination. | - Most of the problems are very tractable  
- The diseases like cancer, ring depend upon geographical conditions.  
- Environmental changes due to huge construction in some areas like Sainj (Kullu) has created a challenge to preserve fruits from the adverse effects of the dust particles ejected from these sites.  
- The only traditional method found of preserving the apples is only in the form of Soquir  
- Lack of awareness of schemes/steps taken by HPMC for apple industry, like cold storage facility in Patlikuhal. |

**Objective**
- Our project aims at measures that can be taken at every step of apple production to get a better yield.  
- It aims at the improvement of storage and preservation techniques to reduce the wastage of apples.

**Methodology**
- Survey of the apple orchards, cold storage houses, HPMC factory.
- Interviewing farmers, apple traders, HPMC officers.
- Comparing techniques used by the local farmers to the new advancements made in this sector.

**Fruit Set**
- Condition like hill storm, wind, heavy rain etc.
- Apple generally affected by diseases like cancer, ring.
- Loss in production due to irrigation facility.
- Quality of fruits are being affected by environmental changes.

**Precrushing/Packaging**
- This is done after manual grading.

**Transportation**
- Unavailability of proper vehicles to transport

**Cold Storage**
- Lack of Cold Storage in these areas
- Unawareness of cold storage facility of HPMC

**Marketing**
- They sell their fruits to the traders through auctions

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<th>Photos</th>
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