FCBM

The Apex Body Of India's Corrugated Packaging Industry

SINCE 1971

FEDERATION OF CORRUGATED BOX MANUFACTURERS OF INDIA

REPORT

Promotion of Corrugated Boxes for packing Agricultural produce can be a game changer for NATIONAL ECONOMY

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SYNOPSIS OF REPORT

- Introduction of corrugated boxes in packing agricultural produce can be a game changer for national economy

- It can prevent almost half of the current 30% wastage the country accrues every year

- It is lighter and more compact packaging to reduce cost of transportation by 75% in comparison to other available packaging options. This would be a great saving on petroleum consumption vis a vis national wealth conservation.

- It would be an opportunity for generating grass root employment specially in rural areas which India badly requires with its half young population.

- It would generate a new source for GST revenue for the states.

- It would prevent deforestation of millions of cubic feet of wood currently being used for crude wooden crates

- It would empower farmers and states to brand their products including GI Tag if available on similar lines as Darjeeling Tea, Himachal Apples, Maharashtra Alphonso Mangoes etc.

- Only one state has taken the initiative to promote this packaging through incentives, sops and regulations and is reaping benefits for their economy that is Himachal Pradesh for their apples.

- National and State governments must take equal intiatives to make this successful.

In spite of a brilliant growth of the industry and service sector backed by a healthy growth of our GDP in the last decades India is still vastly dependent on its agricultural sector for its sustenance both in contribution to its GDP and majorly to its employment. A look at the chart below will establish two facts that we are within the top ten economic powers **but our contributory factors are totally different than the rest.**

GDP sector composition, 2017 (in percentage and in billions of dollars) of top ten nations					
Rank	Country/Economy	Total GDP (US$MM)	Agriculture	Industry	Service
–	**World**	**75212696**	**5.90%**	**30.50%**	**63.60%**
1	USA	17946996	1.12%	19.10%	79.70%
2	China	12218281	6.90%	40.10%	52.90%
3	Japan	4730300	1.20%	27.50%	71.40%
4	Germany	3494900	0.80%	28.10%	71.10%
5	UK	2649890	0.70%	21.00%	78.30%
6	France	2488280	1.90%	18.30%	79.80%
7	India	2250990	17.40%	25.80%	56.90%
8	Italy	1852500	2.00%	24.20%	73.80%
9	Brazil	1769600	5.40%	27.40%	67.20%
10	Canada	1532340	1.80%	28.60%	69.60%
Comparison of employments generated for the same period					
	India		42.74%	23.79%	33.48%

It is estimated that India losses over Rs 92500 crores annually as post harvest damage. The major reasons for this are inadequate infrastructure for appropriate storage, transportation and **one of the major reasons is non availability/adaption of appropriate packaging.**

For centuries the agricultural and horticultural produce has gone through a transformation in its transportation and packaging worldwide.

The age old practice of packing and transportation

Has evolved into the online trade

With the onset of globalization and improvement of infrastructure and logistical facilities the availability of each vegetable and fruit is not restricted to its particular season of harvest or geological area of growth. With modern infrastructure and technology all produces can be made available to anywhere in the world and any time of the year.

So far in most part of India, we are slightly behind in the race for development in infrastructure, logistics and **TO A GREAT EXTENT IN ADOPTION OF MODERN PACKAGING SOLUTIONS.** Currently, India is losing almost 35% of its produce on damages due to improper and unhygienic packaging and improper logistic infrastructures.

The age old practice of packing vulnerable agricultural and horticultural produces has been by wooden crates and cane baskets. **Surprising, being a global economic power our adaptation to modern packaging has not progressed apart from pocket areas due to local initiatives. So let us look at the options of packaging**

WOODEN CRATES

But worldwide this is practice has been discontinued and/or on the verge of discontinuation. The reasons are as follows:

- **Manufacturing of wooden crates puts an extra claim on the natural forest resources.**
- **Untreated wood is exposed to contamination with fungi and bacteria.**

- **Treatment of wooden crates with paint or other chemicals may cause produce deterioration and add chemical contamination.**
- **The material may be too hard or rough for produce like soft fruits, and therefore liners of a soft material may be needed with additional cost.**
- **Disposal of the crates after use which has no recycling value.**
- **With the restriction of deforestation its availability has also become a costly option of packaging whereas illegal felling of trees are causing harm to ecology.**
- **Storage of wooden crates take a lot of space as it cannot be collapsed.**
- **The weight of a wooden crate adds to the transportation cost which is substantial.**
- **Illiterate farmers over stuff crates to save cost but actually lands with lot of damage.**

CONSIDERING THE ABOVE REASONS EVEN OUR NEIGHBOURING STATE PAKISTAN HAS BANNED WOODEN CRATES AS GIVEN IN THE NEWS ARTICLE IN THE ANNEXURE……..SEE ANNEXURE A

So what was the trend in the advanced world? The advanced world over the last four decades transformed their wooden crates to plastic crates.

PLASTIC CRATES

Advantages of plastic crates

- **The advantage of plastic crates are its light weight and its sturdiness**
- **Plastic crates can be reused for multiple times by sending back to the source**
- **It is more aesthetic in looks than a wooden crates**
- **It can be washed and cleaned**

Disadvantages of plastic crates

- **Huge transport cost for ferrying back empty crates therefore not viable for long distance destinations.**
- **Requirement of washing, cleaning and sanitization which our country doesn't have the infrastructure.**

- Recycling of these materials also have its limitations
- But over the last decade major research programs in the advanced countries have identified the plastic crates as a major source of Microbiological contamination in spite of their advanced industrial cleaning procedure and we don't have the infrastructure at all.
- The advance world is now moving out of plastic crates

VARIOUS RESEARCH REPORT ON PLASTIC CRATES FROM EUROPE, CANADA AND USA IS ANNEXED……ANNEXURE B

CORRUGATED BOXES

The major advantages on the use of corrugated boxes are:

- Its light weight and can be customised to size and weight requirement.
- It is cheaper than other options.
- It is almost eco-friendly and entire recyclable.
- It provides an additional cushioning with its softer surface and therefore avoids peeling and damaging soft fruits and vegetables.
- It can be made water proof if desired
- Aesthetically it's the best option as desired printing for branding and marketing can be taken up. **(the biggest example is the Himachal Apple in India)**
- It has a multirole contribution to the economy. India's need of the hour is employment and corrugated box manufacturing is a labour intensive MSME industry and its implementation to agri sector would create job opportunity at rural level.

But surprising the advantage of using corrugated box was first established in India by **IIM, Ahmedabad** by conducting field trials over two years from 1998 to 2001. Plastic crates were not available then so their comparative study was between wooden crates and corrugated boxes and the concluding test result was as follows:

COMPARATIVE PERFORMANCE OF PETI AND CARTONS			
Particulars	**Wooden Crate**	**VC-15 (15 kg cap)**	**VC-20 (20 kg cap)**
Compression Test			
(a) Stacking strength	>>350 kg	250 kg	325 kg
(b) Compressive strength	43 kg/mm	35 kg/mm	42 kg/mm
Vibration Test	**Damage to tomato after**		
(a) 20 minutes	7.00%	3.60%	3.20%

(b) 40 minutes	10.50%	5.30%	5.40%
(c) 60 minutes	13.50%	6.20%	-
Drop Test	**Damage to tomato after**		
(i) Straight fall (20 cm)			
(a) 6 drops	4.00%	2.10%	2.60%
(b) 12 drops	6.00%	2.80%	3.30%
(c) 15 drops	-	3.20%	4.00%
(ii) Angular fall (25^0 tilt)			
(a) 10 drops	4.00%	-	-
(b) 15 drops	-	2.90%	2.30%

DETAILED STUDY REPORT OF IIM, AHMEDABAD.....ANNEXURE C

Based on the IIM study report the Govt of Himachal Pradesh and Gujarat has influenced and helped the apple and tomato growers to adapt to packaging in corrugated boxes. Over the last decade they have achieved zero tolerance to wooded crate packaging.

There was another study for the development of Horticultural Products by the IIT, Mandi as recent as 2017. Amongst its various recommendations they have clearly advocated the use of corrugated boxes in page no 17.

IIT, MANDI STUDY REPORT.....ANNEXURE D

The Himachal Pradesh government is the only one till date who took the initiative to study through various professional agencies the benefits of proper packaging planning for betterment of the products safety and branding and moreover has given a thought towards long term ecological effects towards their policy. They are the only state government to have researched and implemented packaging policies for the benefit of their farmers, products and ecology. To break the age old habits and myth they had gone on to declare initially subsidies to promote and encourage the use of corrugated boxes in the beginning of last decade. Today after a decade the results are showing and subsidies are withdrawn. It has become now a policy and habbit. Countless MSME manufacturing units have cropped up in the state creating a new revenue/employment opportunity for the locals.

SAMPLE NOTIFICATION FOR INITIAL SUBSIDY.....ANNEXURE E

Thereafter, they have maintained a packaging policy for packaging of their apples. The result over last decade and a half the Himachal apple brand was built up. They have not let go the control and the government keeps a strict policy on the quality of the boxes to control the brand image. They issue a pre-season notification on the quality of cartons to be used.

SAMPLE NOTIFICATION AND PRESS RELEASE.....ANNEXURE F

CONCLUSION

With all the technical data given let us now take a hypothetical economic situation to assess its commercial viability. For calculation purpose we take the governments data for 2016-17 for horticultural production of 295.2 million tons let us see the effects if corrugated cartons were used to pack at least half the said quantity. **What does it mean to national economy and employment?**

Horticultural Produce for the year 2016-17 as per government record	**295.2**	**Million tons**
Generating National Revenue and Employment		
If half was packed in corrugated boxes	147.6	Million tons
Annual Consumption of paper 1kg per box of 20kgs material	7.38	million tones
Paper consumption per month	615000	Tons
Paper Mill employment per month @ one man day for every 40 tons	15375	Mandays
Box manufacturers employment @ 5 man days per ton	3075000	Mandays
Total Direct employment per month	3090375	Mandays
Indirect Employment (x4)	12361500	Mandays
Total Employment	**15451875**	Mandays
Monthly Value of Box @ Rs 40/- per kg	24,600,000.00	Rupees
Monthly GST generated @ 12%	2,952,000.00	Rupees
Generating National Resource Saving		
Annual Deforestation Saved for 7.38 million wooden crates @ 0.33 cft	2.44	Million cft
Annual Transportation Cost saved on 500 km @ Rs 3/- per kg. (Wooden crate 5kgs - CB Boxes 1 kg)	29.52	Million Rupees

IT'S TIME FOR OUR GOVERNMENTS, IIP AND BOX MANUFACTURERS TO WORK HAND IN HAND TO UPGRADE OUR AGRICULTURE SECTOR TO SAVE NATIONAL WASTAGE AND INCREASE NATIONAL REVENUE WITH EMPLOYMENT. SPECIALLY THE COUNTRY HAVING A HUGE POPULATION OF YOUTH THIS COULD BE A WONDERFUL OPPORTUNITY FOR JOB GENERATION IN THE HEART OF RURAL INDIA.

THINGS NEED TO BE ADDRESSED

<u>UNION GOVERNMENT</u>

1. **There should be an immediate ban on usage of wooden crates for agricultural and horticultural products packaging to save post harvest waste and prevent deforestation.**

2. **Coordinate with states to identify fruits and soft vegetables growing areas and declare incentives to put up MSME plants for manufacturing corrugated boxes to meet the seasonal demands.**
3. **If required use central agencies involved with agricultural activities to distribute cartons to farmers at controlled rates.**
4. **Standardize and implement the mention of place of cultivation for all produce with clear weights mentioned per package.**

STATE GOVERNMENTS

1. **Use Himachal Pradesh module to encourage usage of corrugated boxes.**
2. **Monitor intensely to prevent usage of wooden crates specially with illegal felling.**
3. **Create initial subsidy regime to lure and attract farmers to get into the practice of using corrugated boxes.**
4. **Create a advisory committee with participants from Indian Institute of Packaging and packaging trade body to plan the specifications and production capacities to meet the demands.**

Comparison showing space required by 50 wooden crates, 30 plastic crates and 500 cartons

THIS WILL ALSO GIVE A BIRTH OF NEW INDUSTRY TO THE STATES AND THE RESULTS WILL BE:

- **Establishment of multiple SME industries to cater to need of boxes district wise requirement by the farmers.**

- **Being SME sector huge land procurement not required.**
- **Huge investments will flow in multiple MSME units**
- **Setting up of backward integration industries will take place like paper and adhesive.**
- **Generation of employment direct and indirect as it is a labour intensive unit**
- **Revenue generation to the government in terms GST.**
- **This will be a total rural based economy boost for the states.**
- **This will also help in monitoring the quality and trade.**

The improvement of packaging by corrugated cartons of agricultural and horticultural produce will increase its shelf life, give the farmers an opportunity for branding its product like the tea gardens and reduce its damage. But this sector needs to be educated, regimented and influenced into this habit to break away from its traditional myth. But this will only be possible when the respective governments both central and states takes a call to lead the movement. The research units and industry can and will give the necessary support and hand holding

ANNEXURE A

A news article from Pakistan on why they had to ban use of wooden crates and introduce the use of corrugated boxes for the welfare of their trade and business.

DAWN

http://www.dawn.com/news/1176632

Use of wood packaging banned for exports

AAMIR SHAFAAT KHAN — UPDATED APR 18, 2015 10:15AM

DPP had received serious warnings from the European Union and other countries due to increasing interceptions of consignments infested with pests and deterioration in quality due to use of wooden packaging. -Reuters/File

KARACHI: The Department of Plant Protection (DPP), Ministry of National Food Security and Research (MNFSR), has banned the use of wood packaging including crates, boxes and cases, for storing fruits and vegetables intended for exports from May 20, 2015.

The decision has been taken considering phytosanitary measures since wood is a pathway to the introduction of pests. DPP had received serious warnings from the European Union and other countries due to increasing interceptions of consignments infested with pests and deterioration in quality due to use of wooden packaging. According to the circular, no official phytosanitary certificate shall be issued to any perishables (fruits and vegetables) intended for export in wood packing material as a phytosanitary measure under the guidelines of ISPM-15 to which Pakistan is a signatory in compliance to the procedures of International Plant Protection Convention 1951.

Co-Chairman All Pakistan Fruit and Vegetable Exporters Importers and Merchants Association (PFVA) Waheed Ahmed in a letter to the MNFSR on April 16, 2015 said the association is against the use of wood packaging currently in use. “It is untreated wood and poor in presentation. Some countries still use wood but their packaging complies with international standards. The wood is treated, evenly coloured, well presented and sustainably sourced. If exporters use similar standard of wooden packing, the cost would far outweigh the cost of corrugated packaging,” the letter said.

By complying with international best practices, the quality and price of Pakistani mangoes and other produce would improve and additional markets can be tapped, the letter added.

It is worth noting that Dubai is a transit hub and once there, the exports are re-exported in better packaging to other Gulf countries including Bahrain, Iraq, Lebanon, etc as they do not accept wooden crates. Due to this restriction, exporters are unable to enhance exports of perishable goods to these countries. Even for domestic markets, fruits including grapes, apples, strawberry and cherries **are packed in corrugated cartons so that during cold storage, development of fungus can be avoided.**

Pakistan is the only major exporter of fruits in wooden packaging in unrefrigerated containers to the UAE and Muscat. Such practices are not allowed by International Standards and present a poor image of Pakistan. The PFVA office bearer said that out of the total exports, around 50-60 per cent is exported to UAE and Muscat and of this only 25pc is shipped in wooden crates. Around 93pc of mango is consumed locally and only 7pc is exported. Of the share exported, only 25pc goes to the UAE and Muscat.

Waheed said using corrugated cartons would play a pivotal role in the enhancement of exports. The role of the middleman would be limited and exporters would directly procure products from the growers. The profit margin of the middleman would be shared between exporters and growers. Waheed further said that supermarkets in Middle East are reluctant to showcase Pakistani mangoes due to unhygienic and unattractive packing. They are demanding attractive packaging and also want compliance with international standards such as GLOBAL CARE, GOBAL GAP, HACCP, ISO. The wooden crates used in Pakistan do not qualify under any of those standards, he said.

The UAE government has already started initiatives to ban wooden packaging from unsustainable sources to stop deforestation and present a good image of the UAE. Certification of wood treatment and sustainability certification will be a must in the near future, the PVFA letter said.

“Eventually international markets will not accept our current wooden packaging. If the UAE, Muscat and other Gulf countries impose ban on Pakistani agriculture products, this will give opportunity to other global countries to impose ban on our products as well,” it added. The letter said that there are plenty of corrugated production units in Pakistan to cater for the demand and in the long run, a changeover would bring down the price of packaging.

Published in Dawn, April 18th, 2015

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ANNEXURE B

International Study reports from universities of various countries across Europe and North America emphasizing the need to adapt to corrugated boxes for packing agricultural and horticultural produces.

INTERNATIONAL AGRICULTURAL PACKAGING SCENARIO

The industrially advanced world has gone through its trial and error of various packaging medium over the last two decades especially with the onset of online trade it has gone through even more change.

Study report from Europe available to us shows the following

- The rigid container system and the corrugated board tray system have the same total costs per litre for 500 km distance.
- The foldable container system is more expensive for 500 km distance.
- From the environmental point of view, the corrugated board trays score the best, since the eco-costs are lower in all cases.

Further there had been various studies in the developed nations on the usage of plastic crates and they have found to contaminate and encourage bacterial infections. Some of the study reports along with their reference links follow:

CANADA & USA

Studies Find Reusable Produce Containers Often Contaminated

Another study by Keith Warriner, University of Guelph, Ontario

Link :

https://www.foodnavigator-usa.com/Article/2013/10/12/Research-finds-most-reusable-produce-containers-unsanitary?utm_source=copyright&utm_medium=OnSite&utm_campaign=copyright

Reusable produce containers often contaminated

12-Oct-2013 By Jenni Spinner

Up to 64% of reusable plastic containers (RPCs) used to ship fruit and vegetables are unsanitary, according to research.

By **James Andrews** on November 20, 2014

Reusable plastic containers used by farmers to ship fresh produce from farms to grocery stores have gained wide usage in the last decade, effectively replacing corrugated boxes with a more environmentally friendly alternative. **But two studies — one in Canada and one in the U.S. — have found serious problems with the general sanitation and cleanliness of those containers, raising concerns about possible food safety risks.** They say the containers — which some retailers now require growers to use — **could transfer pathogens from contaminated produce onto clean produce when not sanitized thoroughly.** First, in 2013 and again this year, **Canadian researchers found evidence of faecal bacteria left over in containers said to have been sanitized.** University of Guelph food science professor Keith Warriner, Ph.D., found contamination of innocuous strains of coli form E. coli on containers, suggesting that the company's sanitation process was inadequate, he said. **Judging the**

cleanliness of the containers using U.K. food safety standards of food surfaces, Warriner determined that 43 percent of containers failed sanitary standards when inspected this year. Now, in California, a soon-to-be-published companion study found similar results. University of California Davis extension research specialist Trevor Suslow, Ph.D., found that a "significant number" of produce containers exceeded reasonable expectations for cleanliness and failed to meet expected microbiological standards for surface sanitation. Over a six-day period, Suslow's team inspected produce containers after they had been sanitized but before they had been given to growers to pack for shipments.

The system is arranged so that growers rent out the containers from the manufacturer and empty containers are sent back to the manufacturer to undergo a sanitation process before being packed with produce once again. But Suslow and Warriner want to raise awareness in the produce industry that these sanitation processes might not be getting the job done. "Although we're aware there's a cleaning and sanitizing process, it appears to be inconsistent and we found a number of indicators of uncleanliness in our study," Suslow told **Food Safety News**. After swabbing container surfaces for bacterial indicators of uncleanliness, Suslow found 38 percent of samples to carry 100,000 bacterial cells, while eight percent had more than one million. That, he said, wasn't acceptable.

One problem with the containers is that they have hinges and other pinch-points where food can get caught and stay trapped for a long time. The studies found numerous instances of mold and spoilage in containers that had undergone the sanitization process. While no cases of illness have been directly connected to produce containers, Suslow said that it would be very difficult to trace an illness back to something as unsuspecting as a plastic container. "Taking a systems approach to produce safety, while there may be no recognized outbreaks linked to containers, we see a lot of sporadic illnesses where you never learn the cause," he said. Warriner said that his study also found a noticeable increase in broken containers between the first and second years of his study.

Unfortunately, he said, growers are sometimes in a position where they're eager to take any available container, as it's the only way they can ship out product. In the Canadian study, Warriner found that the company providing containers to growers in Canada did not have a washing facility in the country. As a result, the containers were supposed to be shipped back to Chicago to undergo cleaning after delivery. In the case of the unclean containers returning to Canada, Warriner could only speculate as to what was occurring: "There's one of three things going on," he said. "One, they're going to Chicago but not being sanitized; two, they're not going to Chicago; or three, they're going to Chicago, being sanitized, and somehow meeting the cleanliness standards of the company." For now, the companies have no cleanliness standards on public record, Warriner said. Warriner also questioned the silence of retailers on the topic. "What's interesting is that although retailers have very strong scrutiny about food products, they haven't really paid attention to the food safety concern here," he said. Another problem Warriner found: sticker labels from previous produce shipments would often remain stuck inside the containers. In one case, a label for products grown in Mexico made its way to a farm in Canada.

With two independent studies raising such similar concerns about reusable containers, Suslow said that he hopes the container manufacturers will recalculate their cleaning and

With two independent studies raising such similar concerns about reusable containers, Suslow said that he hopes the container manufacturers will recalculate their cleaning and sanitization processes. In the meantime, growers and handlers should implement their own procedures for cleaning the containers, he said, and possibly testing the containers with rapid bacterial swabs themselves. Suslow said that because it's impossible to completely control for contamination when growing produce in an open environment, fresh produce shouldn't come into direct contact with reusable containers. "Contamination of these containers is something you should be able to control, and if you can't, you have to start looking for other options," he said. *Photo of soiled plant material inside a reusable produce container courtesy of Trevor Suslow.*

ITALY

https://www.packagingstrategies.com/articles/89019-fruit-packed-in-corrugated-is-safer-and-fresher

Fruit packed in corrugated box is safer and fresher

August 5, 2016

New scientific research indicates that corrugated packaging keeps fruit fresher and safer than reusable plastic crates (RPCs) and can significantly reduce contamination from transferred microorganisms.

The research, conducted by the University of Bologna and initiated by the European Federation of Corrugated Board Manufacturers (FEFCO), found that corrugated trays ensured higher-quality packed fruits with reduced microbial cross-contamination and longer shelf-life. Lower bacterial contamination decreases the risk of foodborne illnesses and increases the fruit's freshness, scent, appearance and taste.

Microbiological contamination of fresh produce is a major concern for retailers. Pathogenic bacteria can make people sick, and spoilage bacteria reduces shelf-life. In both cases, the role of packaging can be critical.

"We are encouraged by the most recent research conducted by the University of Bologna", says Dennis Colley, president and CEO of the U.S.-based Fibre Box Association (FBA). "We know corrugated is clean when it reaches the grower/shipper. Now, this research shows corrugated, in addition to cushioning and protecting produce, also mitigates the spread of contamination if the container becomes contaminated while packing or if fresh produce begins to decay during transportation. The ability of corrugated packaging to increase shelf-life could translate into significantly reduced shrink and potentially millions of dollars in savings for retailers."

The research was led by Professor Rosalba Lanciotti at the University of Bologna's Department of Agricultural and Food Sciences. It examined the exchange of microbes

between produce and packaging and vice-versa, and focused especially on determining how differences in packaging materials can influence cross-contamination.

The results showed that fruit packed in corrugated fared better (with fewer transferred pathogenic and spoilage bacteria) than the fruit packed in RPCs. The differences in microbiological quality were statistically significant.

Methodology

Scientists deliberately contaminated both corrugated trays and RPCs with the same number of Escherichia coli, Saccharomyces cerevisiae and Pseudomonas spp. microorganisms. Fresh peaches were washed with tap water, sterilized with a sodium solution, rinsed with sterilized water and then air-dried before being placed into the containers for testing. Next, researchers measured the levels of bacteria that transferred to the fruit over time.

Results

Fruit packed in plastic crates reached contamination levels generally associated with spoilage 48 to 72 hours earlier than the fruit packed in corrugated trays.

Contributing factors such as storage temperature, length of time before sale, and superficial damage on the peaches were also considered. Results showed that all these factors influenced the microbial transfer from packaging material to fruit, but the transfer of spoilage microorganisms was always lower in corrugated trays.

The tests also showed that in some conditions (i.e. high storage temperature) up to 95% of peaches packed in the deliberately contaminated RPCs were infected with E. coli after 48 hours. By contrast, the E. coli contamination level never exceeded 25% of the peaches packed in corrugated containers that had been contaminated with the same levels of microorganisms.

Rising Concerns

The research comes as other concerns have been raised recently over the hygiene of RPCs. Last November, the Department of Food Science at the University of Arkansas showed that typical industry cleaning procedures failed to adequately sanitize RPCs. The research team led by Dr. Steven Ricke found Salmonella cells on the crates even after cleaning. He noted that bacteria hide in the cracks and crevices of the crates' surface, making it difficult for industrial sanitizers to reach them.

Conclusion

University of Bologna's new study proved that using corrugated instead of plastic packaging for fruit can significantly reduce potential contamination via microbial transfer. Professor Lanciotti and her team concluded that peaches packed in corrugated therefore reach consumers in a safer and fresher state than those in plastic crates.

Published online 2016 Jun 16.

Contribution of Two Different Packaging Material to Microbial Contamination of Peaches: Implications in Their Microbiological Quality

Francesca Patrignani, Lorenzo Siroli, Fausto Gardini, and Rosalba Lanciotti*

Abstract

ANNEXURE C

A field study report by IIM, Ahmedabad of how to improve the packaging of agricultural and horticultural produces for better transportation and preservation

Development of Corrugated Fiber Board Cartons for Long Distance Transport of Tomato in India

Girja Sharan
S. Srivastav
Kishor P. Rawale
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W.P. No.2008-11-02
November 2008

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Development of Corrugated Fiber Board Cartons for Long Distance Transport of Tomato in India

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Abstract

Tomato growers of Gujarat , north-west India , traditionally send produce to wholesale market in Ahmedabad city for auction. Growing areas lie about 250-300 km from the city. Growers were constrained to sell there even if the prices were not attractive which the case usually as season advanced was. Lack of sturdy packaging deterred them from sending produce to more distant markets such as Bombay (600 km) , Delhi (900 km) or Bangalore (2000) . Peti, the box used presently, made of strips of wood nailed together does not protect the produce adequately. Although, there are many large packaging firms in the region producing boxes for various consumer products, problem of tomato growers was not recognized. Their view was that tomato being a low-value commodity, growers will not buy better packaging. Being mostly small, growers were not organized enough to raise funds to sponsor research at public R&D institutions in the area. That task was therefore taken up. Boxes that protected the produce better on long journey and were affordable were designed and introduced successfully in the region. This paper describes the development.

Index Terms –Cartons for tomato, fruit damages in transit, packaging for shipment.

INTRODUCTION

Gujarat, a province in north-west India, produces about 700,000 ton of tomato each season. Growers are mostly small farmers. Crop is planted in August; picking starts in November and continues till March. Growers pack the produce at farmstead and then send via trucks to the wholesale market in Ahmedabad city for auction. Growing areas lie in 200 km radius around the city. As picking starts only a small quantity of produce arrives for auction. Arrivals peak towards the end of December and then a gradual decline sets in. Growers realize better price in the beginning. But by the middle of the season prices decline considerably. In some seasons, the decline is so steep that growers are unable to recover even the cost of packaging and transport. Small growers numbering thousands are impacted severely. This problem was noticed in the season of 1998, when growers were forced to suspend picking mid season because of slump in prices. Media highlighted the problem. Perceiving an opportunity for service engineering, we visited and interviewed growers to find out what would help in such a situation in future. They indicated that when prices are low in Ahmedabad, higher prices actually prevail in adjoining provinces where during that time there is no local crop. But the deterrent was lack of sturdy packaging which could transport the produce safely to distant markets- Bombay (500 km), Jaipur (700 km), Delhi (900 km), and Bangalore (2000 km). Their conventional packaging -"peti"-box made of strips of wood nailed together, they felt would not protect the produce adequately in transit.

The information gathered from growers led us first to quantify the damages incurred in transit with tomato packed in petis. A random sample of petis arriving at Ahmedabad auction market was studied (Siripurapu, et al, 1998). Sample petis were emptied out, each fruit inspected visually for mechanical damages. Petis that had traveled 120 km had 3 – 4.5 % (600 to 900 gm in 20 kg) fruit with serious damages - bursts, bruises, fresh skin cracks. Those with 270 km travel had greater damage 5.5 to 7 %. Mechanical damages tend to grow non-linearly with transit distance. Thus the view of the growers about likely losses on longer journey was well –founded. It became apparent that a better packaging would be needed to enable growers to send produce safely over longer distances.

The next step was to search for a better box in the market. There are a number of box makers in the region – some large ones. Interaction indicated that some of them were aware of the packaging problems of tomato growers but had no plans to address it. They said they did not have the experience of designing containers for materials that need special care and are perishable. They also apprehended that tomato being a low value produce, growers may not spend more for better packaging. That triggered the start of the initiative reported here. Two boxes made of corrugated fiber board (CFB) were developed keeping in view the physiological and rheological properties of tomato and the economic conditions of the growers. One box was launched in the Gujarat market in the season of 1999-2000, just over a year after the problem was identified. The second box was modified slightly in response to needs of growers of a different region (Himachal) who too were in search of a better packaging. It was named Himachal Carton and launched in 2001 in that region. This paper describes the development which passed through the following stages.

1. Survey of packaging currently used, engineering evaluation of the most important one to identify its merits and demerits.

2. Setting specifications for new packaging in consultation with the stakeholders-growers, transporters, handlers and traders.
3. Design prototype, laboratory tests and field trial
4. Introduction in the market.

Engineering Evaluation of Peti

A survey revealed that growers used an assortment of boxes to pack tomato which included used CFB boxes that previously packed cold drink bottles, medicine, cosmetics, biscuits, household appliances. These were purchased from scrap dealers. Flutes of these single-journey boxes get flattened on first use, compressive strength is lowered and these tend to bulge easily. Usage only signified that growers were in need of a better packaging. More common mode of packaging was the peti-a box of 42x30x28 cm, holding 20 kg produce. Peti was selected for study and evaluation (Figure 1).

MATERIALS AND METHODS

Generally these are stacked in columns of 4 to 6 in the truck. Thus, the bottom peti would have a load of about 125 kg. On occasions there could be some extra such as person sitting atop. Petis are exposed to shocks while being loaded and unloaded. From farm gate to the retail stores there could be up to ten lift-drops. More sever shocks are encountered in transit when vehicle moves on rough roads with potholes and speed breakers. Shocks induced from road surface are transmitted to the produce via wheel-suspension-packaging box link. A good box should preserve its structural integrity and protect the produce through all these. Three type of tests were accordingly carried out-Box Compression Test (BCT), Drop Test and Vibration Test–to evaluate the peti.

In BCT empty petis were placed between platens of the machine (Unique Enterprises, Pune, India). As the upper platen moved down, deformation and load were displayed on the read-out panel. Loading rate was 11.8 mm/minute. Deformation was noted at intervals of 25 kg. Six replications were made. Drop tests involved subjecting petis filled with 20 kg tomato to a sequence of drops. Two types of test were done-straight drop from height of 20 cm, second, one edge of the box bottom remained on platform, opposite edge lifted to angle of 25 degree and dropped. Structural damages to petis and to produce were noted. Vibration tests were done on a machine supplied by the same manufacturer. It had pre-set frequency (3 Hz) and pre-set amplitude (15-mm horizontal and 6 mm vertical). The manufacturer indicated that one hour on the machine represented 1000 km of road travel. Three identical tomato-filled boxes were placed side by side on the platform of a vibrator. Machine was turned on. One box was removed after every 20 minutes. At the end of the test, damages to the boxes and produce were noted.

Tests were conducted in July 1998. A set of newly made petis was procured for tests. The outer dimension of the sample petis was 42x30x28 cm, tare weight between 2.4 to 2.6 kg. Petis were stored for 72 hours in a room with temperature at 23°C and RH 50 percent. Tests were carried out in the laboratory of Core Emballage Limited, Ahmedabad, and a large box maker of India. This was not a growing season in Gujarat; therefore tomatoes were purchased from the wholesale market, each day in the morning. Fruits used for tests were carefully selected-free from cracks and skin discontinuities. Tomatoes were also sorted for size uniformity with a template with various sizes of opening. Fruits of 50–55 mm along major axis were selected for tests.

Test results were published earlier elsewhere (Sharan et al, 1999a, 1999b, Sharan and Srivastav, 2000). Some key results are given here. Deformation of petis increased (Figure 2) almost linearly with load. It did not exceed 6 mm under a load of 250 kg. Fresh produce carrying boxes are required not to deform more than 10 mm when stacked in columns in truck (Technical Association of the Pulp and Paper Industry, 1993). Peti met that requirement. Up to five straight drops did not cause significant damage to peti or to produce. After the fifth drop, (Table I) nails of corner joints loosened causing the box to deform diagonally. Fruits that burst or developed skin discontinuity were 4 % after six straight drops, 7% after twelve. Angular drops are nearly equally severe. Peti was not strong enough to withstand long enough sequence of drops normally expected in handling. A significant proportion of the produce especially near the bottom will suffer damages. Vibration test simulates road travel. The acceleration to which the boxes under test are subject to is given (Technical Association of the Pulp and Paper Industry, 1993) by equation (1). Given the frequency and amplitudes in this particular machine, the acceleration to which the boxes were subjected to worked out to 0. 6 g units.

$$G = \frac{D\ f^{2}}{250} \qquad (1)$$

Where

G = Number of g units

D = Displacement, mm

f = Frequency, Hz

FIGURE 1 PETIS BEING ASSEMBLED

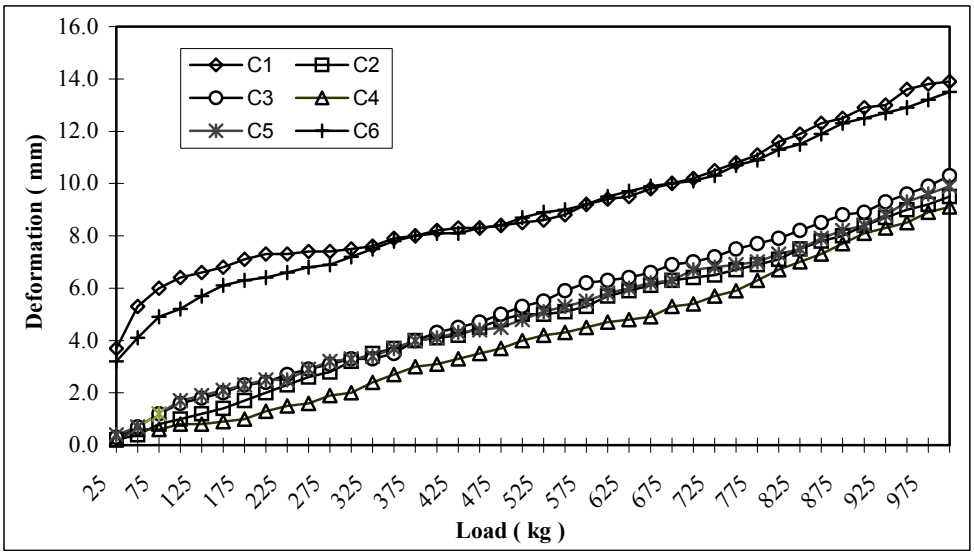

FIGURE 2
FORCE DEFORMATION CURVE OF PETI

TABLE I
DAMAGE TO PETI AND PRODUCE IN DROP TESTS

Weight of peti filled with tomato (kg)	Drops type and number	Damage to peti	Damage to tomato
20	6 (straight)	Nails loosened , cracks on some slats diagonal elongation 0.9 – 1.4 cm	Fruits in the lower part bust , burst fruit in three replications 734 gm (4% of total)
20	12 (straight)	Nails loosened , cracks on some slats diagonal elongation 0.4 – 0.9 cm	Fruits in the lower part bust , burst fruit 1280 gm (7% of total)
20	10 (angular)	One side of the cartoon was totally damaged, nails come out diagonal elongation 1.4 cm	Fruits in the lower part bust , burst fruit 850 gm (4.6 % of total)

TABLE II
DAMAGES TO PRODUCE AND PETI IN VIBRATION

Exposure time (min)	Proportion of produce damaged (%)	Diagonal Elongation of peti (cm)
20	7.0	0.3
40	10.5	0.4 – 0.6
60	13.5	1 – 1.5

Values mean of two replications

Results of vibration are given in Table II. Vibrations loosen the corner joints much the same way as in the course of drops. Amount of damaged produce increases with duration of exposure to vibration. It was concluded that peti was strong in compression but not strong enough to withstand shocks encountered in handling and transit. Its corner joints loosen causing diagonal deformation. Fruits in the lower part are damaged. An alternative that could transport the produce safely over longer distance was considered desirable.

Specifications of New Packaging Box

Desired features of new boxes were developed by consultation with users and transporters.

(a) *Stacking strength* -250 kg- so that these could be stacked to height of up to 2 m common in Indian trucks.
(b) *Withstand handling abuse*-retain structural integrity through a sequence of at least 15 straight and angular drops.

(c) *Withstand road-induced shock* - protect produce and its own structural integrity over a 2000 km road journey.
(d) *Ventilation* -8 holes of 20 mm diameter.
(e) *Capacity* - 20 to 25 kg tomato.
(f) *Material and Environmental Factor* -material used should not create disposal problem.
(g) *Cost* -about Rs.15 per piece comparable to that of the peti.
(h) *Ease of Handling -p*rovision of grip for handling.
(i) *Produce Identification* -graphics printable

Two different boxes VC-20, VC-15 were designed with specifications given in table III.

TABLE III
SPECIFICATIONS

Specifications	*VC-20*	*VC-15*
Capacity (kg)	20	15
Material of construction	CFB, 5 ply	CFB, 5 ply
Internal dimensions (mm)	430 x 205 x 390	363 x 192 x 373
Style of box	RSC 0201	RSC 0201
Direction of flutes	Vertical	Vertical
Type of flutes	B/C	B/C
Grammage of plies (g/m^2)	150	150
Bursting strength ($kg.cm^2$)	11±1	11±1
Cobb value (g/m^2)	140 gsm	140 gsm
Type of adhesive	Starch based	Starch based
Number of pieces per box	1	1
Joints	Glued	Glued
Number of ventilation holes	8	8
Diameter and position of holes	24.5 mm, long wall	24.5 mm, long wall

Laboratory and field trial
Fifty pieces of each were fabricated and tested in manner described above. All cartons used in the test were pre-conditioned for 72 hours, in a room where relative humidity of 50 per cent and temperature of 23°C was maintained (Sharan, et al, 1999b). Tomatoes (trade name Rashmi) were commercial hybrids. BCT tests (Table IV) confirmed that both boxes were capable of withstanding 250 kg load with less than 6 mm deformation. As expected, the damage increases with increase in the number of drops (Table V). There was no damage to the boxes during the drops, both straight and angular. Vibration tests revealed that damage to produce increases with exposure time (Table VI). Box VC -15 retained its structural integrity. But VC-20 failed after 35-55 mt. Table VII gives a summary of attributes of wood and newly developed boxes.

TABLE IV
BCT TEST DATA

Load (kg)	Deformation (mm)	
	VC-15	*VC-20*
25	0	0
50	0	0
75	1.9	1
100	3.1	2.1
125	3.8	2.8
150	4.1	3.4
175	4.6	3.7
200	5.1	4.3
225	5.6	4.9
250	5.7	5.4
275	Failure	5.9
300		6.5
325		6.6
350		Failure

VC-15 : Values up to 225 kg are mean of 6, and 250 kg value of 4 replications
VC-20 : Values up to 300 kg are mean of 5, and 320 kg value of 4 replications

TABLE V
DAMAGE TO PRODUCE IN DROP TEST

Cartons	Straight Drop (20 cm)			Angular Drop (25^0)
	6 nos.	*12 nos.*	*15 nos.*	15
VC-15	2.1 %	2.8 %	3.2 %	2.9 %
VC-20	2.6 %	3.3 %	4.0 %	2.3 %

Damage values mean of 3 replications

TABLE VI
DAMAGE TO PRODUCE IN VIBRATION TEST

Cartons	Exposure time (min)			
	20	*40*	*60*	*120*
VC-15	3.6 %	5.3 %	6.2 %	-
VC-20	3.2 %	5.4 %	-	-

Damage is mean of 2 replications and rounded off.

TABLE VII
COMPARATIVE PERFORMANCE OF PETI AND CARTONS

Particulars	Peti	VC-15 (15 kg cap)	VC-20 (20 kg cap)
Compression Test			
(a) Stacking strength	>>350 kg	250 kg	325 kg
(b) Compressive strength	43 kg/mm	35 kg/mm	42 kg/mm
Vibration Test			
Damage to tomato after			
(a) 20 minutes	7.0 %	3.6 %	3.2 %
(b) 40 minutes	10.5 %	5.3 %	5.4 %
(c) 60 minutes	13.5 %	6.2 %	-
(d) 120 minutes	-	-	-
Drop Test			
Damage to tomato after			
(i) Straight fall (20 cm)			
(a) 6 drops	4.0 %	2.1%	2.6 %
(b) 12 drops	6.0 %	2.8%	3.3 %
(c) 15 drops	-	3.2%	4.0 %
(ii) Angular fall (25^0 tilt)			
(a) 10 drops	4.0 %	-	-
(b) 15 drops	-	2.9%	2.3 %

Jan-Feb, 1999 Core Emballage Ltd, Ahmedabad

After laboratory tests, a transport trial was carried out. One-half of the truck was loaded with tomato packed in petis and the other half with produce packed in VC-15 and VC-20. Overall damage in petis was found to be higher (4.6 per cent) than that on Vastrapur cartons (2.8 per cent) (Sharan et al, 1999b, Sharan and Srivastav, 2000). The boxes appeared to be satisfactory in performance and an improvement over the petis.

The box (VC-20) was introduced in the Gujarat region in the season of 1999- 2000. About a year after the launch of cartons in Gujarat region, we were approached by the International Development Enterprises (IDE, India), an NGO working with small tomato growers in the hills in Himachal. There too the growers used similar peti. But the Himachal government had just then passed a law banning felling trees to make the petis. Pine trees were mostly used. IDE perceived that an alternative would need to be developed urgently. IDE team visited us to see the box, took a sample to show to the growers in Solan area and selected VC-15 for trial. They also invited us to visit their growers to receive feedback and to determine if any special features were needed. We visited the area and had discussions with the growers. The post harvest practices were

documented. Almost all aspects were similar here except one-which the harvest season here got some rains and therefore the cartons will need protection. A positive aspect was that the tomato here was off-season and attracted much better prices making it easier to spend some more for packaging.

Kits consisted of sets of wood strips cut to measure. Suppliers delivered the kits at a convenient pick-up point on the road side near the farms. Growers needed only to use hammer and nails to assemble the peti from the kits. It took about four minutes to assemble one. Peti had provision for aeration, and smooth inner finish, though nails some times protruded. Tare weight of freshly made peti was 2.7 kg. Petis were usually available for Rs.18-20 per piece. Growers indicated that they liked the VC-15 box. But before finalizing the choice they required that a transport trial be organized from their area to Delhi. Two thousand five hundred boxes were manufactured and taken to Solan. They set the aims of trial as follows. Overall damage to the produce was 1.5% in VC, nearly half of that in the (2.1 %) in the petis (Sharan and Rawale, 2001). Growers who witnessed the trial also suggested modifications relating to the capacity of the box, placement of ventilation holes, side grip, moisture resistance and competitiveness in pricing. The modifications were carried out and the new box-Himachal Carton -was made available in the market in Delhi (FIGURE 3, 4) and Shimla area.

FIGURE 3
HIMACHAL CARTONS AT ROADHEAD FOR TRANSPORT

FIGURE 4
HIMACHAL CARTONS AT DELHI AUCTION MARKET

CONCLUSION

The wood box traditionally used by commercial growers to transport tomato to auction market in Gujarat province (India) was a poor packaging. It has sufficient compressive strength for four- tier stacking usual on trucks , but could not withstand long sequences of lift-drops in handling and the dynamic shocks encountered in transit over rough roads. That constrained the growers to sell produce in Ahmedabad and deterred them from sending it to more distant markets to realize better prices. Growers community consists of thousands of small farmers who could not engage R&D institutions to solve their packaging problem. The local box makers too ignored the problem apprehending that the growers will not be willing to pay for better packaging. The task of developing a safer and affordable packaging was recognized as important and was carried out in partnership with a large box- maker. Two boxes were developed, tested in laboratory and in road journey. Manufacturing and marketing arrangements were worked out with private firms and cartons introduced in the regional markets. New boxes have gradually gained acceptance are in increasing use.

ANNEXURE D

A study report by IIT, Mandi recommending the government of Himachal Pradesh on various area of improvement and implementation for betterment of their agricultural and horticultural produce. This includes packaging in page 17

Extending the Apple Season: Cold Storage in Himachal Pradesh, India

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Indian Institute of Technology Mandi

Extending the Apple Season: Cold Storage in Himachal Pradesh, India

An Interactive Qualifying Project
submitted to the Faculty of
WORCESTER POLYTECHNIC INSTITUTE
in partial fulfillment of the requirements for the
degree of Bachelor of Science

by
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Date:
2nd May 2017

Report Submitted to:

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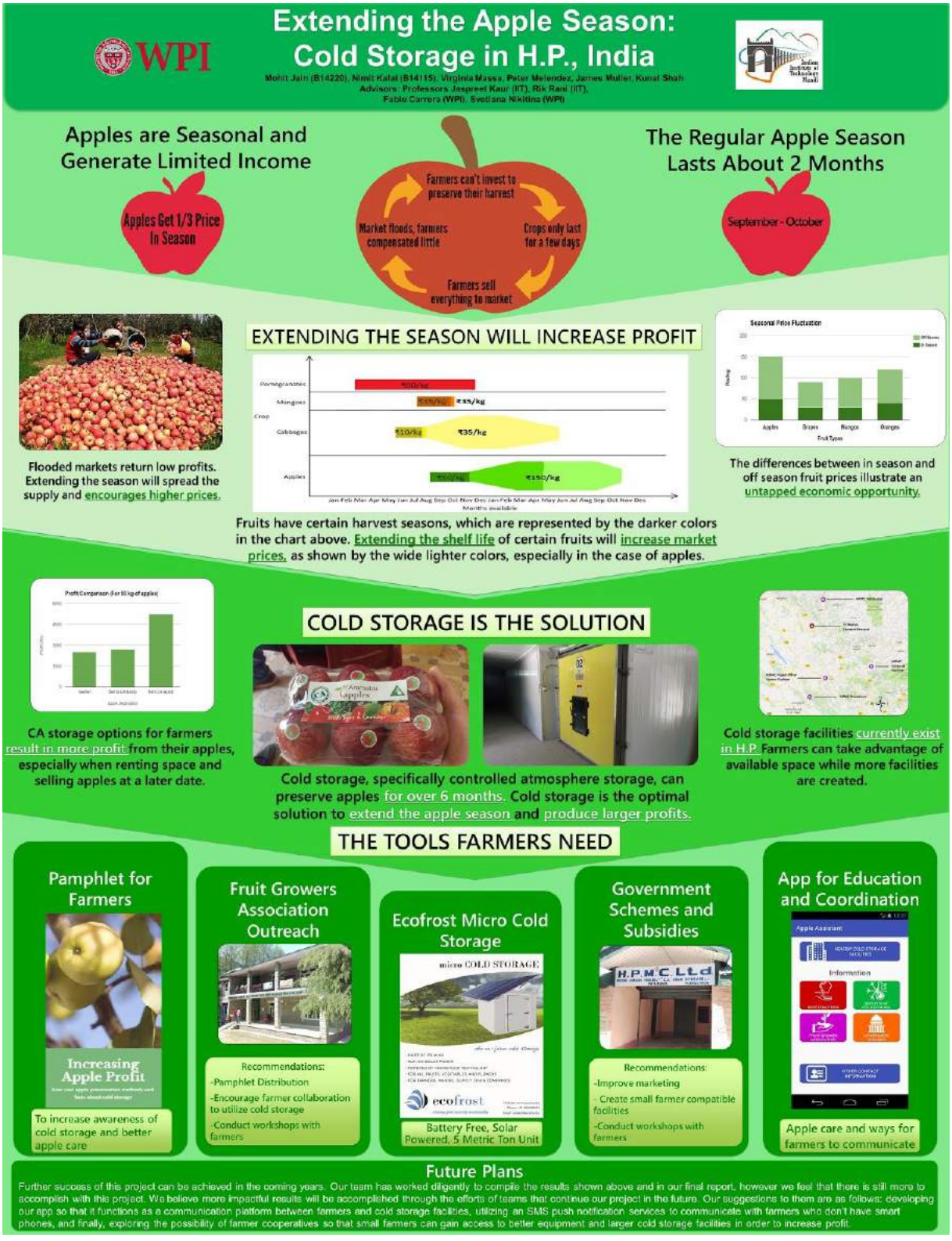
Abstract

This project attempted to understand problems affecting fruit and vegetable farmers in Himachal Pradesh, India, and identify ways to alleviate them. To this end, we interviewed farmers, storage facilities, and a local farmers' association, and conducted research into modern preservation practices. Our work indicated that cold storage in the region could be incredibly useful to apple farmers, but awareness and coordination are lacking. To help remedy this, we developed a mobile application and pamphlet helping connect farmers with cold storage.

Executive Summary / Poster



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1. Helping Farmers Preserve Crops in Himachal Pradesh

Agriculture is a very significant part of the economy in Himachal Pradesh, yet farmers have few means to preserve their crops. According to a 2012-2013 report submitted by the Economics and Statistics Department of Himachal Pradesh, about 69% of workers in the region are employed in agriculture. In addition, 87% of farmers are small-scale (Choudhary, 2016) and own, on average, two acres of land (Singh et al., 1997). With few options in terms of long term storage or preservation of crops, farmers often use relatively ineffective home-constructed storage methods (Overview of grain drying, 2017). As a result, farmers often need to push most of their goods to market immediately, driving prices down and leading to lower profits (Sidhu, 2005, and Bhandari, 2016). Figure 1 demonstrates this vicious cycle.

Our mission was to design and promote a solution empowering farmers in Himachal Pradesh to better preserve their crops, ultimately improving their profit potential. In our research, we analyzed ways we could either help farmers avoid crop damage or increase shelf life, attempting to determine which would benefit farmers more.

Our first objective in achieving this goal was to investigate current food preservation practices in areas near Mandi by interviewing farmers and markets, and determine the problems farmers face. Our second objective was to research and assess alternative preservation plans that would benefit farmers. Our final objective was to select one optimal plan that would maximize farmers' profits, and devise a way for farmers to take advantage of that plan.

Through our research we determined increasing shelf life of crops to be the more potent route for profit increase, while additional ways to avoid crop damage were often difficult or expensive for farmers. Furthermore, we determined that the most accessible, inexpensive, and beneficial way to extend shelf life by several months was through the use of cold storage, an established and growing sector in Himachal Pradesh, potentially yielding huge profit increases for farmers. This solution is merely waiting for farmers to take advantage of it.

Figure 1. The cycle trapping farmers in this region.

2. Challenges Faced by Himachal Pradesh Farmers

Himachal Pradesh is one of the northernmost states of India. In this fairly temperate region, a variety of fruits and nuts are grown (State Department of Horticulture, 2016). The weather in Himachal Pradesh is hot and dry from March to June, rainy during the monsoon season from July until September, and chilly from October to February. According to the Koppen classification system, much of Himachal Pradesh has a "cwa" climate (Grieser, Rubel, Beck, Kottek, & Rudolf, 2006). This is known as a humid subtropical climate, with relatively dry winters and warm summers (Arnfield, 2016).

The region of Himachal Pradesh borders the Himalayas and consists mostly of hills interspersed with river valleys. A case study by Singh et al. in 1997 found that both terraces and paddies dot the region, such as those in Figure 2. Pandey (2009) notes that apple orchards are especially common, with production of apples comprising 88% of fruit production. Farmers tend to rely on a single crop for their income and are unable to keep harvests longer than a few days, so they are at the mercy of the market. The ability to store crops for a longer period of time would allow them instead to take advantage of higher off-season prices and make their produce available throughout more of the year. Since these prices are often **2-3 times** those in-season, low-cost storage could allow farmers to reap immense profits every year. This would also reduce the flooding of markets in-season, raising those prices so farmers without this technology benefit as well.

Figure 2. Terracing style of three farms in Kataula, Himachal Pradesh.

2.1 Benefits of Cold Storage

The climate and geography of this region is conducive to large harvests. The warm weather and rain make the area very suitable for growing fruits and vegetables. The monsoon season brings plentiful rain to needy crops, hastening growth (Arnfield, 2016).

However, these conditions are very poor for storing crops in the open or in makeshift storage. Cold storage, encompassing both standard refrigerated and controlled atmosphere storage, can extend the life of crops a great deal, especially in the case of the ubiquitous apple (Refrigeration, 2015).

While apples left in the open may be lucky to last a week, Fischbacher and Marsden (1966) indicate that refrigerated storage can preserve them up to **six months**, while controlled atmosphere can keep apples for nearly **twelve months**, as demonstrated in Figure 3. Of the many possible methods to store fruit, refrigeration is definitely the most potent, and remains relatively inexpensive. If apple farmers are able to use this technology, they can safeguard their crops from the weather and other dangers, and have more opportunities to sell at market. While there is not a huge selection of cold storage facilities in the region currently, this number is growing due to government subsidies and private investment, and those that exist are attempting to make themselves more accessible to farmers (Bodhi, 2015, Sharma, 2013, and Sally, 2011).

Figure 3. Apples stored in controlled atmosphere storage, still crisp after six months.

Another benefit of controlled atmosphere storage in particular is how well it maintains the quality of fruit. Studies demonstrate that long-term controlled atmosphere storage affects the chemical composition of the apples in a manner very similar to short-term open air storage. In fact, the composition and amount of antioxidants between apples stored in the air and in controlled atmosphere is identical (Van der Sluis et al., 2001). Anthocyanins, a class of flavonoids known help DNA repair and prevent cancer (Lila, 2004), also show no decrease in apples stored in controlled atmosphere (Leja et al., 2003). While the amino acid content of apples may degrade in long term storage, controlled atmosphere storage prevents this due to minimal CO_2 and O_2 levels (Lee & Adel, 2000). Overall, vitamin content is minimally affected by this kind of long-term storage, retaining the nutritional value of the fruit.

3. Methodology

This project was geared toward discovering problems with crop preservation faced by farmers in Himachal Pradesh and ways to alleviate them. Our work attempted to improve their situation and introduce several recommendations for further work. An overview of our project's strategies can be seen in Figure 4.

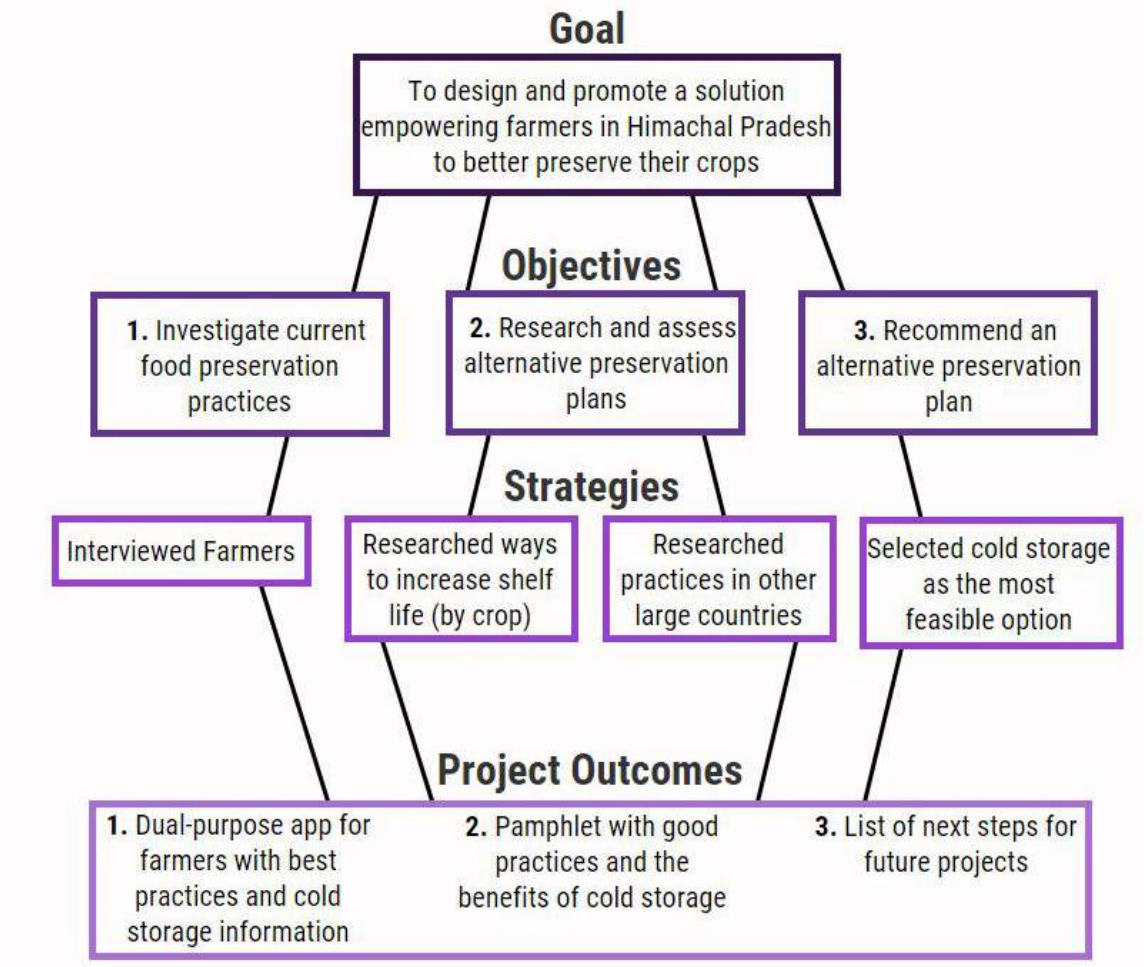

Figure 4. Our project flowchart.

3.1 Objective 1: Investigating current practices

We began by conducting interviews with small-scale fruit and vegetable farmers near the IIT Mandi campus in order to understand what types of problems they face in the **post-harvest handling** or **preservation** of their crops (Appendix A). We interviewed vegetable farmers in Kataula, pomegranate farmers in Bajaura, and mango farmers in Budhar. Finding that there was **not a great opportunity to help** these farmers, we went to apple orchards north of Kullu (see Figure 5). While there, we conducted an interview with the president of the Kullu Fruit Growers' Association in Patlikuhal to gain insight on problems faced by the apple farmers residing in that region.

Our talk with apple farmers and the Kullu Fruit Growers' Association lead us to the potential benefit of extending the season. To assess this possibility, we interviewed owners of market stalls in Mandi to determine **crop prices** both in- and off-season. This venture indicated to us exactly how profitable selling fruit off-season could be.

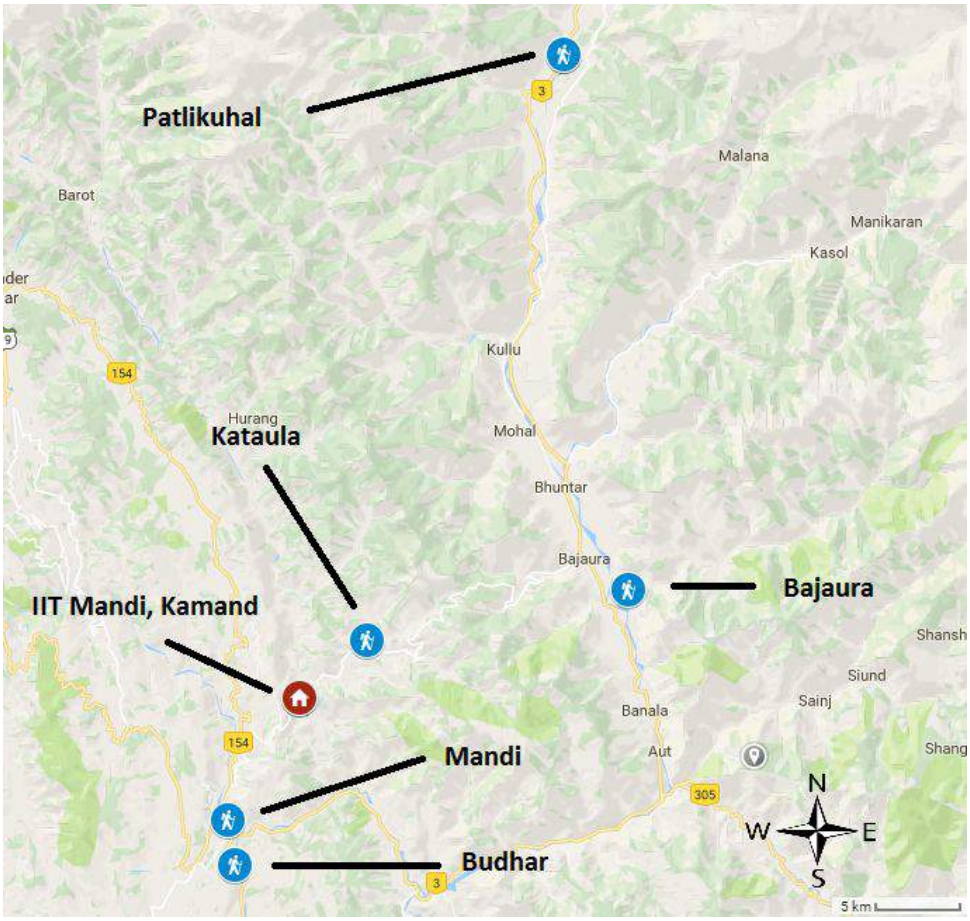

Figure 5. Map of Interview Locations.

3.2 Objective 2: Researching and assessing alternative preservation plans

On campus, we conducted research into many different methods of preserving fruits and vegetables. Chemical treatments, changes in packaging, and water treatment were considered. However, our research into refrigerated storage indicated that it would be by far the best solution. As cold storage is most effective on apples, we performed a cost-benefit analysis on storing the fruit for several months before selling it at market.

Furthermore, we traveled to Patlikuhal, north of Kullu to discover whether or not apple farmers in the area could benefit from **nearby cold storage opportunities**. While there, we talked with owners of Aromatrix Flora Private Limited, a private controlled atmosphere facility, and HPMC Patlikuhal, a government funded controlled atmosphere facility. We ascertained a broad overview of their operation, how fruit or vegetable farmers in the region might benefit from cold storage, and the cost to rent these facilities (see Appendix

A). The talks here indicated strongly that both facilities are willing and able to rent space to farmers, and that they are aware apple farmers would be best served by storing fruit.

3.3 Objective 3: Recommending an alternative preservation plan

In order to craft solid recommendations for farmers, we assessed all the information available to us and identified that cold storage for apples is most effective on the basis of feasibility and cost. We then discussed the merits and flaws of our plan with the Kullu Fruit Growers' Association and cold storage facilities, ascertaining from them how best to combat the lack of awareness and coordination among farmers. Finally, we created a **mobile Android application** and informational **pamphlet** to help **improve communication** between farmers and cold storage facilities, allowing them to use the existing network to their profound advantage. We then brainstormed a number of further steps so others might continue our work.

4. Results and Discussion

The interviews we conducted with fruit farmers helped us identify causes of crop loss and current methods farmers use to extend shelf life. We researched globally used preservation methods, and discussed cold storage at two facilities in Patlikuhal. Information gathered from visiting markets in Mandi allowed us to analyze the costs and benefits of these methods and select cold storage as our optimal plan.

4.1 Preservation Methods Currently Used by Farmers

Both apples and mangoes suffered losses from bruising and rot, while all fruit farmers we interviewed needed to contend with diseases (see Table 1). In order to avoid further loss, every farmer attempted to sell their crops as quickly as possible. In every case, however, these fruits were left outside, under a tarp, or in crates for nearly a day. Most took precautions such as destroying or burying bruised, rotting, or diseased fruit before loading it for transport. Every farmer shipped in cardboard cartons or plastic crates, but relatively few took further packing measures such as using newspaper to line individual fruit or wrap crates. No apple farmer took advantage of any available cold storage.

Table 1. Loss percentages, cited reasons, and time before sale for several types of crops.

Crop	# of Interviews	Loss before Sale	Primary Cited Reasons	Average Wait
Apple	3	15-20%	Bruising, rot, disease	1 day
Mango	3	25%	Bruising, rot, disease, infestation, wild animals	1-2 days
Pomegranate	6	5-10%	Disease	<1 day
Vegetables	2	10%	Rot (unseasonal rain)	12 hours

4.2 Established Methods to Increase Shelf Life

Once we understood the problems faced by farmers, we researched methods scientifically proven to extend shelf life. We considered four main types of techniques: **chemical** treatment methods, **hot water** treatment, improved **packaging**, and **refrigeration**. Of these four, only improved **packaging** and **refrigeration** are economically viable for farmers, and **refrigeration** can extend the life of fruits into the off-season, greatly boosting profits.

Our interviews with produce vendors in Mandi markets indicated major price fluctuations during the year (see Figure 6). If stored for several months, fruit might be sold for anywhere from 2-5 times the original price.

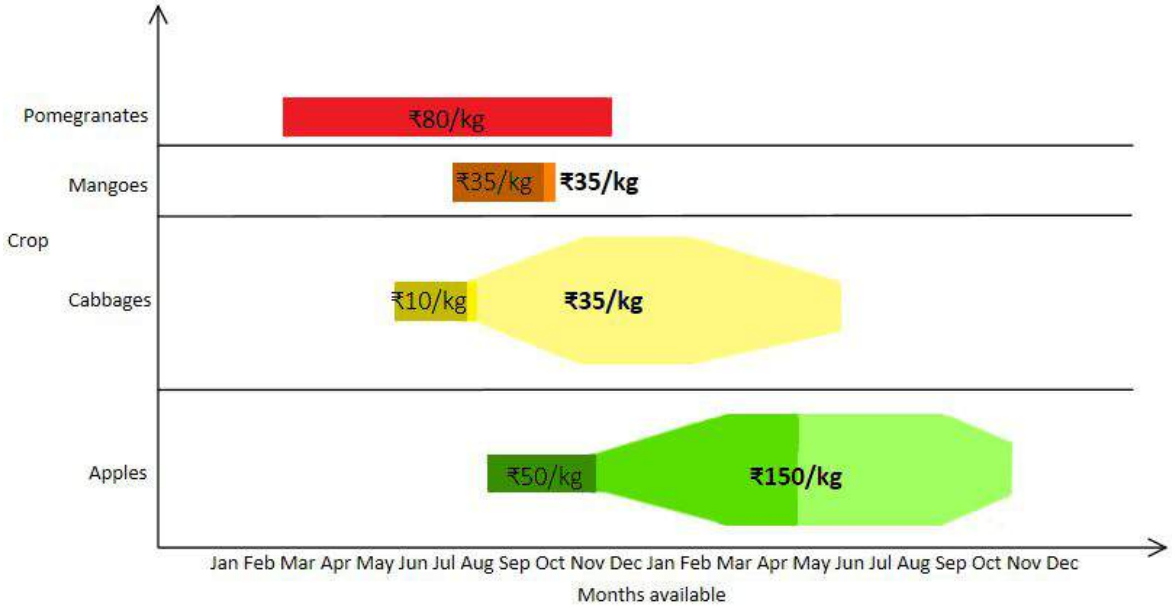

Figure 6. Demonstration of exceptionally long cold storage life of apples (and cabbages) compared to other local fruits. Normal season is shown in darker color, potential from refrigeration in the medium color, and controlled atmosphere life in light color with approximate sale prices. (Only one season shown for clarity)

4.3 Extending Shelf Life with Cold Storage

Our research into refrigeration indicated that of locally grown fruits and vegetables, the storage life of **apples** can be extended up to **six months**, while that of **cabbages** can be extended up to **ten months**. This extends well into the off-season where they can be sold for more (see Table 2). Many other fruits and vegetables do not benefit significantly enough to be sold off-season.

In the case of **cabbages**, however, the vegetable farmers we spoke to all practiced crop rotation to produce income year round, and stated **they would have no time** to keep tabs on stored goods. Furthermore, these farmers grow very small quantities of crops, making storage much less economically viable. Due to these difficulties, we decided that it was not advisable to recommend cold storage for vegetables.

As **88% of fruit and vegetable growers** in this region are apple farmers, there is a massive stakeholder base who can possibly make use of refrigerated storage. Additionally, as seen in Figure 6, apples can be sold for **3 times more** in the off-season, having the potential to significantly increase the income of farmers if stored for just an additional 3-4 months. Furthermore, simple refrigerated storage can provide farmers with more flexibility in selling their crop, allowing them to sell in smaller quantities over a larger span of time rather than selling all at once.

Table 2. Comparison of holding life of several fruits and vegetables. Produce worth refrigerating has the corresponding box highlighted in yellow, and produce worth controlled atmosphere storage has the corresponding box highlighted in green.

Fruit or Vegetable	Apple	Mango	Grape	Pomegranate	Cabbage	Capsicum	Garlic
Shelf Life	<2 weeks	~3 days	3-5 days	6 months	Few days	Few days	3-5 months
Life with refrigeration	3-6 months	1 week	5-10 days		1 week	1-2 weeks	
Life with Controlled Atmosphere	12+ months	6 weeks	5-10 days		10 months	1-2 weeks	
Worth it?	Yes	No	No	No	No	No	No
Notes				No extension with cold	See above	Green keeps the longest	Molds in fridge

4.4 Controlled Atmosphere Options Available

The controlled atmosphere facilities indicated that their space could be rented for just under **2 rupees per kilogram per month**. In lieu of renting space, these facilities purchase apples from individual farmers at **3-4 rupees more per kilogram** than market price, and sell the apples themselves off-season; when purchasing in this fashion, they buy a **minimum of 50 kg** from each farmer so they are able to fill the minimum chamber size of **100 metric tons**. Both these options pose a potential profit for farmers, provided they can bring enough good quality apples that the facility will accept (see Figure 7). Renting space could be as simple as gathering several farmers and making a call to the facility. Transportation could be arranged by the facility or by farmers, but the profit margin is so large that this will hardly make a dent in the farmer's earnings.

Despite extremely low costs for farmers to rent from two controlled atmosphere facilities north of Kullu, none of the apple farmers we interviewed actually stored their crops. When we interviewed staff at these storage facilities, both indicated that they would like to rent out space, but **could not find interested farmers**. Our interview with the Kullu Fruit Growers' Association revealed that farmers have difficulty organizing to rent a large chamber; furthermore, storing the **minimum 150 days (5 months)** that such controlled

atmosphere facilities require poses a financial difficulty for them. We believe the problem lies in a lack of communication between these facilities and farmers, as well as a lack of coordination and awareness among farmers to rent out chambers. Our proposed solutions and recommendations aim to improve these aspects in order to help apple farmers reap the vast benefits cold storage opportunities can provide.

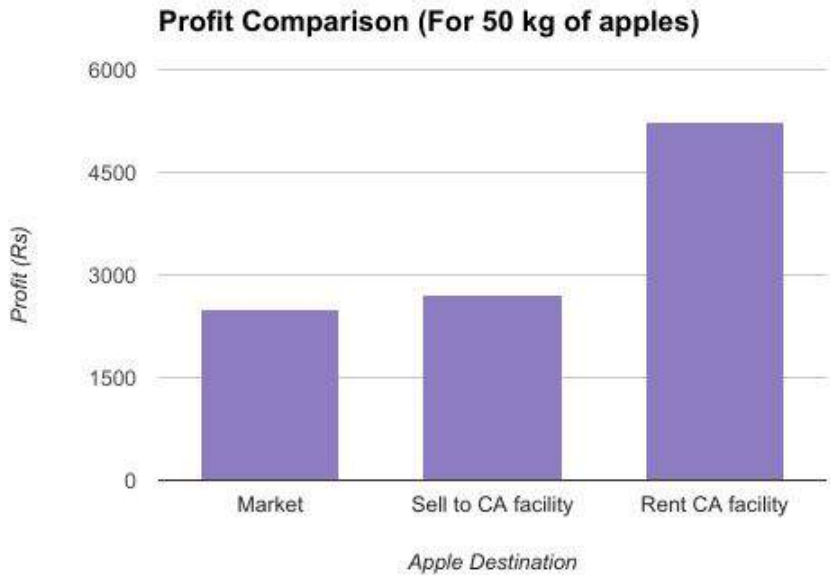

Figure 7. Potential profit for farmers, including rental and transportation costs.

4.5 Discussion: Missed Opportunity Due to Lack of Communication and Awareness

As two controlled atmosphere facilities already exist in the Kullu region, there is an **amazing opportunity available** for farmers. Although the facilities would rather rent, they can also purchase crop from the farmers, paying the farmers up front and using their own transportation. This is a worry free solution for farmers that also gives them an **additional 6-8% profit**. Although the 200 metric ton minimum would be too much for a single farmer, collaborating with others could net them **double the profit**, as seen in Figure 7. Since cold storage facilities have no trouble selling the crop they purchase from farmers currently, there is certainly a market for these off-season apples. Unlike chemical treatments, controlled atmosphere storage does little to change the composition of the apple crop, and retains the nutritional value. Because of all the potential benefits, we believe that enabling farmers to use cold storage is the most effective way to increase their income. The only thing missing is farmers who are both aware of the opportunity and sufficiently organized.

Moreover, the government in Himachal Pradesh is attempting to promote the growth of cold storage across the region. Government subsidies can provide for **75% of the cost** of

cold chain infrastructure, to a maximum of Rs. 10 crore (India Filings, 2014). As a result, private companies are looking to develop further in this region and create facilities more accessible and plentiful for farmers.

Although it is the government's policy to help farmers by spurring the construction of cold storage through subsidies, there appears to be a disconnect between storage and farmers. The government prefers to construct large controlled atmosphere facilities, which can be more difficult for small-scale farmers to make use of. A map of the locations of these facilities can be seen in Appendix B. Small farmers prefer standard refrigerated storage because they are able to access their crops at any time, giving them more opportunities to sell and obtain needed income for survival. Organization among farmers may negate these problems, opening the door to using controlled atmosphere facilities. Since apples survive much longer in CA storage, potential profits also increase a great deal. Increasing accessibility to small farmers and educating them about the options available may lead to an increase in the use of these facilities.

Opportunities for farmers to learn are sparse, however. While the Kullu Fruit Growers' Association indicated they conducted training events and workshops, no one we interviewed knew of any government-run workshops, indicating that they may be insufficiently marketed. If farmers had more opportunity to connect and learn, they could improve their techniques, make use of storage, turn greater profits both in and out of season, and improve their economic situation.

Multiple limitations on our work made it more difficult to draw relevant conclusions. The major limitation has been the language barrier, as farmers and officials alike spoke little English. This barrier has made it difficult to ask the exact questions we wanted, and may have skewed the information we obtained; for instance, we needed to call back the controlled atmosphere facilities multiple times to make clarifications. Moreover, we had many more questions we would have liked to ask both apple farmers and the Kullu Fruit Growers' Association, but were unable to contact them. Without this information, we can only work with the knowledge that many farmers own smartphones, and usually one person in the family can read Hindi, allowing us to use writing to spread information. Once several farmers are aware of the opportunity and the necessity to cooperate, they may begin to spread word of mouth themselves.

Because we gathered data exclusively through interviews, we needed to account for personal bias. Farmers may not have been inclined to be entirely honest with us, fudging numbers to inflate production or downplay losses. In addition, our small sample size, due to time constraints and difficulty in finding farmers willing to interview with us, means our data does not necessarily capture the average fruit or vegetable farmer in Himachal Pradesh. Regardless of these difficulties with our research, we believe all apple farmers across the region could benefit greatly from using cold storage facilities.

5. Conclusions and Outcomes

Cold storage is gradually expanding within Himachal Pradesh, but farmers are still struggling to use the resources at their disposal. Since many farmers are small-scale in nature, our research indicates that they are struggling to profit not only because they have few ways to ensure crops reach market in good condition, but also because they cannot use

methods such as cold storage to their advantage. Several farmers indicated that they were aware that cold storage existed, but that they believed it was of little benefit to them. Moreover, farmers have very few means of communication with each other and potential buyers, including cold storage facilities. In order to rectify the situation, and increase the standard of living for farmers across the Himalayan foothills, better communication channels should be established.

As a first step, we have created a **pamphlet** geared towards informing apple farmers about good practices for handling and packaging the fragile fruit. The pamphlet also contains details of cold storage and its benefits, notably the massively increased profit from each harvest. These pamphlets can be distributed by the Kullu Fruit Growers' Association or the government in addition to their normal workshops, as a guide to farmers (see Appendix C).

Taking the idea a step further, we have built the skeleton of a dual purpose **mobile Android application**, intended for apple farmers. Screenshots of this app can be seen in Appendix D. Part of this app will be **educational**, informing farmers of good agricultural practices and how to handle and care for the fruit. The app also will contain information on cold storage and its benefits, and how farmers can work together to rent large cold storage spaces collectively. The application will also contain a mockup showing how it could be used to allow farmers to **find cold storage facilities nearby**. In this way, multiple farmers who are interested can collaborate and rent a single unit which none of them would have been able to fill individually. If enough interest and support is recognized from these stakeholders in the future, the functionality of this application could be extended to allow farmers to find each other, and allow cold storage facilities to send updates and announcements to farmers, while helping to organize space rental.

Apple farmers and cold storage facilities stand to gain much by using this app to coordinate. Since there is **no shortage** of apple growers in the region, they represent an immense potential market for these facilities, and simply need to work together to rent space. Facilities such as those in Patlikuhal are already available, hoping to rent space to farmers, and the government is providing subsidies to encourage further construction. Storage is cheap, while the **profits are certain to be quite significant**, even if farmers only put a small portion of their crop in storage. Both farmers and facilities are able to arrange transportation, while the facilities can provide crates for farmers to store in. Farmers will also be able to spread the word and inform each other about new opportunities and potential markets to sell to, some of which already exist, purchasing off-season apples from the controlled atmosphere facilities.

Our many interviews indicate that farmers would greatly benefit from **outreach** in addition to current training programs, improving their access to useful knowledge about both caring for and storing crops. Unfortunately, a major obstacle to farmers is their relative lack of funds. The proper way to remedy the situation is to move slowly, step by step, and give farmers the tools they need to improve their livelihoods over time. If farmers were to successfully organize and act as a group (i.e. a **farming cooperative**), they would have greater influence over market prices and better ability to store and sell their crops when it is most beneficial to them. With greater communication and more opportunities to work together, the formation of such farming cooperatives may come to pass. In time, farmers may claim a better place in the economy of Himachal Pradesh.

6. Recommendations

To continue the work we have started here, we recommend **expanding cold storage**, **decreasing crop loss**, and **future projects** in the years to come (see Table 3).

Table 3. Overview of project outcomes and recommendations.

Goals	*Increase farmer* ***Awareness***	*Increase* ***Communication***	*Increase* ***Accessibility*** *for small farmers*
Deliverables	· Android Application · Pamphlet	· Android Application	· Android Application
Recommendations for the future	· Sign at cold storage · Workshops	· Push SMS notifications	· Farming cooperatives · Expanding cold storage · Smaller facilities · Compartmentalization

6.1 Expand and Improve Cold Storage

We would like to encourage both the government of Himachal Pradesh and private companies to attempt to set up relatively small refrigeration facilities. Costs to maintain such smaller facilities will be higher than current larger ones, so work will need to be done in the local community to ensure farmers are aware of them and use them extensively. The primary use of this cold storage will be to allow farmers to reap the benefits of off-season prices. The extra storage space will be another step in bringing fresh fruit to Himachal Pradesh year-round. In addition, when funds become available, refrigerated trucks ought to be gradually phased in to maintain fruit quality. Meanwhile, new and existing storage can look into compartmentalization for greater access to smaller farmers, and ensure they have a sign out front advertising their presence.

6.2 Research Micro Cold Storage

During our research, we discovered a new small-scale refrigeration option co-developed by students at IIT Kharagpur. Ecofrost, a portable, battery-free, solar-powered, 5-metric-ton-capacity cold storage unit offers a multitude of advantages to farmers who invest in it (Pandey, 2011). The unit is delivered and installed by a company called Ecozen Solutions who claim that this Rs. 12.1 lakh system can lead to 40% more profit, breaking even after only 2 years of use. While the price tag may seem like a steep investment to small farmers, government subsidies currently exist allowing farmers to cover 50-70% of the cost using bank loans (India Filings, 2014). Since the device will cover its cost in two years, farmers won't need to risk a large, long-term investment. More research into the logistical aspects of this system is needed in order to make it an easy option for farmers in Himachal Pradesh.

6.3 Improve Packaging for Crops

There are a few cheap methods available to help apple and mango farmers deliver their harvest to market unharmed. Both fruits are easily bruised, even though apples may seem firm; **care should be taken** during harvest and storage not to drop or bounce them around. **Corrugated fiberboard boxes** stuffed with **dry grass or hay** are an effective way to package and transport crops. These materials give a boost to survivability in transport, and have a negligible cost.

6.4 Continue App Development

Further projects might be undertaken at IIT in order to continue our work. Our **app** needs further development and community participation to truly become a useful tool for farmers and storage alike. Both cold storage and farmers should be able to register and find each other. Farmers should also be able to communicate and work together to bring goods to market at better times or store them together to reduce costs. Some obstacles to be overcome include understanding farmers' needs thoroughly and spreading the word to many different villages. As another possibility, a push SMS plan for farmers without smartphones could work to help them coordinate to meet needs. We are aware of at least one established network, *mKisan* (see References), which offers such notifications to farmers.

6.5 Research Farming Cooperatives

A second possible project would be looking into the possibility of forming farming **cooperatives** in this region. Farmers usually work within their families and have wildly varying practices and associates. As a cooperative, farmers have an easier time storing crops, can support each other, and can work together to improve their livelihoods. Overall, the formation of cooperatives would be a major next step for farmers in Himachal Pradesh both financially and socially. Some major problems that need to be overcome are linking enough farmers, generating interest, and distrust and disagreements between farmers. While apple farmers may benefit the most from cooperatives in this way, any group of farmers can work together and improve their conditions.

6.6 Research More Into Controlled Atmosphere

Along with cabbage and apples, there could be more crops that are suitable for controlled atmosphere storage. The crops that we have listed are only ones grown by farmers we interviewed. More research and interviews can be done to see if any other crops can be successfully kept in cold storage.

ANNEXURE E

A copy of notification of the Himachal Pradesh government to introduce subsidies for encouraging farmers to start using corrugated boxes in 2003-04

Arrangements for the packaging of fruits viz. "Cost subsidy" on various types of Cartons and "Transport subsidy" on the imports of cucalyptus/poplar boxes/wood (phatties/geltus) during the year 2004-

Himachal Pradesh Government is encouraging the use of substitute packaging for the packing of apple, other fruits for the last many years. For this purpose "Cost subsidy on various types of cartons" and transport subsidy on the imports of cucalyptus/poplar boxes/wood (platties/geltus)" is being provided so that not only valuable forest wealth of State could be protected but also packing cases may be available at reasonable prices to the fruit growers. The details of utilized cartons and nos. of imported cucalyptus/poplar boxes as well as subsidy amount is given vide Annexure "H".

During the year 2003-04, as per carton subsidy policy, the Statement Government provided cartons subsidy "at source" to the growers on 18-20 kg. capacity Apple/Kinnow & Flower, 10 kg. capacity Kullu/Peach/Pear/Mango/Litchi cargons, 5-6 kg. capacity plum cartons and 4 kg. capacity Almond cartons. The rate and pattern in respect of carton subsidy policy 2003-04, is given as under:-

Sr. No.	Type of carton	Subsidy rate per carton		Maximum nos of carton on subsidy		Maximum limit of subsidy per grower (in Rs.)
		AIPIL	Previously manufactured	AIPIL	Private Manufactured	
01.	18-20 kg. cap. Telescopic apple/kinnow/ Flower cartons	10.00	6.00	1200	2000	
02.	10 kg. cap. Kullu/Pear/peach /Mango/Litchi cartons.	5.00	2.00	2400	6000	12,000
03.	5-6 kg. cap. Plum cartons	1.50	----	8000	----	
04.	4 kg.cap. Almond cartons	1.00	----	12000		

During the year 2003-04, Agro Industrial Packaging India Ltd. (AIPIL), Carton factory, Gumma (Pragati Nagar) near Kotkhai, District Shimla was authorized to manufacture 18-20 kg. cap. Telescopic apple/Kinnow/flower cartons, 10 kg. cap. Kullu/Peach/Pear/Mango/Litchi cargons, 5-6 kg. capacity plum cartons and 4 kg. capacity Almond cartons and these cartons were sold to the growers by the State Government nominated agencies viz. AIPIL itself and HPMC, HIMFED, HP Agro Industries Corporation

Ltd. and Kinfed (only for Kinnaur district). The maximum subsidy limit of carton subsidy was fixed to Rs.12,000/- per grower i.e. every grower was authorized to purchase 12,00, 18-20 kg. cap. Apple/Kinnow & Flower carton, 2400 kg. 10 kg. capacity Kullu/Peach/Pear/Mango/Litchi cargons, 5 kg. capacity plum cartons and 4 kg. capacity Almond cartons from AIPIL or 2000. 18-20 kg. capacity or 6,000. 10 kg. capacity cartons only from Private corrugators.

The details of the sold cartons (AIPIL manufactured and previously manufactured) during the last five years is given as under:-

Year	Sr. No.	Type of carton	Nos. of AIPIL manufactured cartons (in lac.nos.)	Nos. of privately manufactured cartons (in lac nos.)	Total Cartons
1999-2000	1.	Telescopic carton	10.50	---	10.50
	2.	Kullu carton	0.47	---	0.47
	3.	Almoond carton	0.84	---	0.84
		TOTAL	11.81	---	11.81
2000-01	1.	Telescopic carton	58.53	16.13	74.66
	2.	Kullu carton	1.10	3.64	4.74
	3.	Plum carton	----	0.21	0.21
	4.	Almond carton	1.02	---	1.02
		TOTAL	60.65	19.98	80.63
2001-02	1.	Telescopic carton	37.05	14.81	55.19
	2.	Kullu carton	0.75	1.93	2.68
	3.	Almond carton	0.65	---	0.65
		TOTAL	38.45	16.74	55.19
2002-03	1.	Telescopic carton	37.51	43.50	80.01
	2.	Kullu carton	0.16	3.16	3.32
	3.	Plum carton	----	0.46	0.46
	4.	Almond carton	1.17	---	0.17
		TOTAL	37.84	47.12	84.96
2003-04	1.	Telescopic carton	35.10	51.08	86.18
	2.	Kullu carton	0.20	2.77	2.97
	3.	Almond carton	0.26	---	0.26
		TOTAL	35.56	53.85	89.41

As per information gathered from the field officers of this document, about 80 lacs telescopic cartons were purchased by the fruit growers directly from Private corrugators without subsidy for the packing of fruits during the year 2003-04.

Though this year, blooming/setting of flowers in some fruits viz. stone fruits and apple (in law and mid hills) has been normal, yet it is difficult to take accurate estimates for the packing of different fruits at this stage keeping in view whether conditions and production of different fruits during the previous years. The tentative estimates in respect of normal production and expected production having about 20% losses till date due to

drought, hails and gales conditions in respect of especially apples during the year 2004 are given at annexure-I. This year against 2.34 crore standard apple boxes and 2.10 crore boxes (90%) being the marketable surplus, about 1.70 crore C.F.B. carton may be required since in the total export of apple usage of cartons is about 80% and other constitutes being the wooden boxes and gunny bags (Annexure II). Based on this, the estimates for the different types of packaging required to be supplied during the year and the subsidy amount involve, are as under:-

Sr. No.	Types of packaging	Total requirement	Estimated subsidy (in lac. Rs.)
01.	18-20 kg. cap. Apple/Kinnow/Flower cartons	40 AIPIL 100 60 Pvt.	200.00 -----
02.	10 kg. cap kullu/pear/peach/mango/litchi cartons	3 AIPIL	6.00
03.	5-6 kg. cap Plum cartons	1	----
04.	4 kg. cap Almond cartons	1	----
05.	Eucalyptus/poplar wooden box	10	7.00
	Total:	115	213.00

It is mentioned here that normally about 80% of apple produce is packed in CFB carton, out of which 50% CFB cartons directly by the manufactures to the growers without subsidy element and the remaining 50% are given by the Government on subsidized rate.

Out of 100 lac. Apple telescopic cartons, 40 lacs telescopic cartons may be manufactured by AIPIL, 60 lac by private corrugators situated within as well as outside the State without ssubsidy through HPMC, HIMFED, HPAIC and KINFED and remaining 70 lacs may be supplied directly by the private corrugators to the orchardists without involving the nominated agencies and subsidy element. Similarly, 3 lac, 10 kg. capacity Kullu cartons, may be manufactured AIPIL. It is also pointed out here, that the data/figures shown for manufacturing of ruit/flower carton are on estimates and alteration will be keeping in view the actual requirement of different types of cartons in the fruit season.

The Government is providing cost subsidy on various types of cartons since early eighties to the growers to provide substitute packaging for fruit so that the growers could get remunerative prices in the marketing of their produce. Till the year, 1990, only 6% fruit was packed and marketed in C.F.B cartons. The state government imposed a complete ban on green felling of trees for packing of fruits in order to preserve and protect the valuable forest wealth and to maintain the ecological balance.

Initially, the cost subsidy on such types of cartons per grower was maximum to Rs.15000/- which was reduced to Rs.12,000/- in the previous years. Due to the encouragement of C.F.B. cartons by the Government and adoption by the fruit growers with better returns in C.F.B. cartons, the use of packing and marketing in C.F.B. cartons have increased to 80% and that of wooden boxes has reduced from 80% to 5%.

Due to the wide acceptance of C.F.B. cartons subsidy policy on cartons need to be reviewed. It is proposed that subsidy rate and amount of subsidy i.e. from Rs.12,000/- to 6,000/- per grower on AIPIL apple cartons may be stopped in the next three years in a phased manner and on private manufactured cartons should be stopped from this year 2004-05. As regard subsidy on Plum and Almond cartons it may be stopped both for AIPIL and private manufactured cartons from 2004-05. The proposed rate of subsidy and amount of subsidy on different types of AIPIL manufactured cartons during 2004-05 is as under:-

Sr. No.	Type of carton	Subsidy rate per carton		Maximum nos of carton on subsidy		Maximum limit of subsidy per grower (in Rs.)
		AIPIL	Previously manufacture	AIPIL	Private Manufacture	
01.	Telescopic apple/kinnow/ Flower cartons	5.00	---	1200	---	
02.	10 kg. cap. Kullu/carton Pear/peach /Mango/Litchi cartons.	2.00	---	3000	-----	6,000
03.	Plum carton	-----	----	----	----	
04.	Almond carton	-----	----	----		

It is further proposed that the subsidy on AIPIL cartons may be phased out in the next three years as per detail given as under:-

S. No.	Type of carton	Subsidy on AIPIL manufactured cartons (Rs. Per cartons)			
		2004-05	2005-06	2006-07	2007-08
1.	Telescopic apple/ Kinnow cartons	5.00	3.00	2.00	--------
2.	10 kg. capacity Kullu/Pear/Peeach Mango/Litchi cartons	2.00	2.00	1.00	-------

1. Supply of cartons manufactured by Agro Industrial Packaging India Limited (AIPIL) may be done either by itself or through HPMC, Himfed and H.P. Agro Industries Ltd., in the State and through Himfed for district Kinnaur only as per norms and quality parameters laid down by Horticulture Department.

2. The supply of cartons manufactured by private corrugators will be done by HPMC, Himfed and H.P. Agro Industries Corporation and Kinfed on consignment basis strictly as per norms and parameters laid down for quality cartons by Horticulture Department.

3. Subsidy may be made available "at source".

4. Carton subsidy will be available only for the orchardists/growers and not to the contractors.

5. For the receipt of carton subsidy, carton subsidy form and Horticulture card is compulsory. As such, the cartons sold by "AIPIL" and other nominated agencies; Orchardists are required to get it verified on subsidy form from the concerned Horticulture Department Officer/Horticulture Extension Officer, which is further to be produced to the nominated carton agencies, so that no single grower could get subsidy amount more than 6000 i.e. no grower gets more than 1200 telescopic cartons/kinnow cartons or 3000 Kullu cartons/peach/pear/mango/lichi cartons manufactured by AIPIL.

6. Since growers make purchases of cartons in whole year as such it would be proper that fruit/flower growers may be allowed cartons on subsidy throughout the year i.e. from 01.04.2004 to 28.02.2005 through the aforesaid nominated agencies and all other formalities would remain the same which were more applicable during the year 2003-04.

7. Under carton subsidy, as and when private firms supply cartons to the nominated agencies, it would be necessary to send one set of each cash memo/GR/Challan to the Director, Horticulture, Himachal Pradesh specifying despatch destination and nominated agencies will supply such weekly information w.r.t. detail of demand/supply and sale of cartons to Director Horticulture, H.P. so that above information could be made available to the State Government for review from time to time.

As has been made clear in the foregoing paragraphs, total demand of packaging would be around 185 lac boxes. Which would be met by way of importing eucalyptus/poplar wooden boxes and different types of cartons.

Transport Subsidy – As regards wooden boxes for the packing of different fruits, under this policy, State Government is providing transport subsidy on the imports of cucalyptus/poplar boxes (phatties/geltus) since 1989-90 to 2003-04. Under this policy, the detail of rate and pattern of transport subsidy which was applicable during the year 2003-04 is given as under:-

Name of Districts	Type of wood	Rate of transport subsidy	Maximum limit of transport subsidy (Rs. Per truck)
Solan, Sirmour, Bilaspur, Hamirpur, Kaangra and Una	(a) Phatties (b) Geltus	(i) Rs.0.25 per half box. (ii) Rs.0.50 per standard box Rs.5.00 per quintal	500/- 500/- 500/-
Shimla, Kinnaur, Mandi, Kullu, Chamba and Lahaul & Spiti	(c) Phatties (d) Geltus	(i) Rs.0.25 per half box. (ii) Rs.1.00 per standard box (iii) Rs.10.00 per quintal	1000/- 1000/- 1000/-

The department is of the view that rate, pattern and formalities under "Transport subsidy scheme" may be kept the same as were applicable during the year 2003-04 and the above scheme may also be approved from 01.04.2004 to 28.02.2005 so that various beneficiaries viz. private traders, saw mill owners as well as fruit growers could import eucalyptus/poplar wood (phatties/geltus) from outside the State for the packing and marketing of different fruits.

It has been observed that various beneficiaries including fruit growers, demand transport subsidy forms throughout the year and in that situation filed officers face many problems to settle such cases. As such, it is recommended that for issuing of transport subsidy forms, cut off date may be kept as 31.01.2005 and for submission of such cases to the concerned filed officers, the cut off date be kept as 28.02.2005 and no claim will be entertained by the department after 15.03.2005.

To meet out expenditure under "Cost subsidy on cartons" and "Transport subsidy" on the imports of eucalyptus/poplar wood from outside the State, a sum of Rs.213.00 lac. would be required and like previous years, the State Government may take decision to implement the Market Intervention Schemes for some of the fruits. The expenditure under above referred items/schemes would be met under the concerned Marketing and quality control system Viz. 2404 – Crop Husbandry, 110- Horticulture. (22) Marketing Scheme (PLAN) Grant in Aid and subsidy for the year 2003-04 under which a budget provision of Rs.266.33 lacs has been kept for 01.04.2004 to 31.07.2004.

FCBM
The Apex Body Of India's Corrugated Packaging Industry
SINCE 1971

ANNEXURE F

Various press releases and notifications from Himachal Pradesh government to keep a control over the packaging policy of their agricultural and horticultural produces for the welfare of their states economy

HIMACHAL PRADESH GOVERNMENT REGULATES PACKING

by RAVINDER MAKHAIK APRIL 3, 2012

http://hillpost.in/2012/04/himachal-to-standardize-apple-packaging/43420/

Himachal to standardize apple packaging

Shimla: To tackle chaotic apple marketing operations, the state government intends to intervene and introduce standard cartons that would match global packaging norms and bring about market parity for the produce sold.

Making a suo motu statement in the Vidhan Sabha today, Narender Bragta, horticulture minister said that telescopic cartons being currently used had inherent draw backs which not only damaged the fruit during transportation but with the two piece box permitting was expandable that was being used by producers to pack more fruit than the box could safely hold.

HPMC and HIMFED would provide standard universal cartons for apple packaging purposes, he said.

Private manufacturers have also been asked to adopt the standard universal carton, which meets international norms, said the minister.

Directions have been issued to the horticulture department to seek the help of Indian Institute of Packaging for ensuring good quality packaging material to the fruit growers, the minister disclosed in the house.

The standard carton would be a one piece box that would not permit packaging of any extra fruit. Apple growers would be trained about fruit packaging in the new carton boxes, he said.

A standardized box was being introduced after much deliberations with all stakeholders and at the behest of fruit growers themselves who are facing stiff competition from Chinese and American apples in the market, he added.

Being one of the top apple producing states in the country, the fruit is by far the largest cash crop in the state generating an annual economy of Rs 1500 to 2000 crores.

http://www.tribuneindia.com/news/himachal/govt-notifies-apple-packaging-cartons/69958.html

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The State Horticulture Department has notified apple packaging cartons for the coming season. Officials, however, said overweighing was forbidden as manufacturers would mention the maximum weight on each carton that it could carry. “We have notified apple cartons for the coming season. Farmers can use carton of their choice – telescopic and universal,” revealed Tarun Shridhar, Additional Chief Secretary, Horticulture and Forests.

The state government forbids overweighing and overpackaging of the fruit. “Since each carton mentions its carrying capacity, overweighing of cartons is forbidden. Violation can attract punishment,” asserted Shridhar. “We have left a margin of 2 to 3 kg in each carton for farmers before finalising the weight limit,” he added.

HPMC Vice-Chairman Prakash Thakur said farmers preferred to pack apples in all types of cartons — big or small. “The standard cartons developed by the Indian Packaging Institute was dropped as its cost turns out to be Rs 79 (excluding trays), which is very high, considering the average carton cost which was Rs 44 (excluding trays) last year,” he added.
“The society was of the view that packaging of apples in universal cartons was not acceptable as it is an assault on the right of farmers’ freedom to carry out their business as they wish to,” said Vineet Sarjolta, secretary, Himalayan Apple Growers Society.

But farmers hail the decision of the government to check overweighing, asserted Laxman Thakur, chairperson, Ecohorts, Nandpur. Stakeholders, including manufacturers, should be made aware of new packaging cartons rules, Shridhar said. “We will organise awareness camps for all stakeholders before the onset of the season,” he added.