Status Report

on

Cold Store and Ripening Chamber Infrastructure in Punjab

Established Under NHM

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Chapter 1

Over view of cold store and ripening infrastructure in Punjab

1. Introduction: In Punjab, the fruits and vegetables occupy an area of about 76 thousand hectare and 2 lakh hectare respectively with an annual production of approximate 15 lakh MT of fruits and 40 lakh MT of vegetables. The government sees horticulture as a means of agricultural diversification, which not only promotes efficiency in land use, but also creates opportunities for employment particularly for youth and woman in rural areas. However, the horticultural crops are highly perishable in nature and approximately one-third of these valuable produce goes waste annually during postharvest operations due to lack of adequate postharvest infrastructure and awareness about postharvest handling practices.

Causes of Postharvest Losses:

- Lack of awareness about post handling practices for horticultural crops
- Lack of knowledge about packaging techniques and storage (temperature and relative humidity regime) requirement for fruits and vegetables.
- Gaps in cold chain like poor infrastructure,
- Insufficient cold storage capacity (mostly cold storages are meant for potato). The high humidity and temperature controlled storage for fruits and vegetables are lacking.
- Poor transportation and marketing infrastructure etc.

Enough attention has been paid at the pre-harvest stage for boosting up the levels of production by techniques like crop rotation, soil conservation, pest control, fertilizers, irrigation etc. But, post harvest issues have been addressed inadequately. In order to develop suitable handling practices for horticultural produce, it is important to give more focus on creation of postharvest infrastructure, integrated pack houses and cold storages especially for fruits and vegetables.

1.1 Present Status of postharvest infrastructure in Punjab

a) Postharvest Infrastructure created under NHM:

i) Cold storages established under NHM: In Punjab there are about 550 cold stores having about 19 million ton capacity. Out of which 133 cold stores of 4.53 lakh MT capacity and ripening chambers with 2769 MT capacity are established with the financial assistance from NHM.

ii) Farm level pack houses: Under NHM approximate 195 Pack Houses have been set-up in the State for fruits and vegetables. Pack house is the basic need of horticultural sector for collection, grading and sorting of the produce.

iii) Centre of Excellence: Two centres of excellence each for vegetables and citrus fruits has been established at Kartarpur (Jalandhar) and Khanaura (Hoshairpur). One centre of excellence for potato has been proposed at Dhogri (Jalandhar).

b) Postharvest infrastructure created by Punjab Mandi Board: Punjab Mandi Board has also established state of the art postharvest infrastructure in 12 fruits and vegetable markets of Punjab comprising of 16 number multi chambers cold storages each having capacity of 50 MT and 52 ripening chambers with 10 MT capacity each.

c) Postharvest Infrastructure created by Punjab Agro Industry Corporation:

i) Mechanical washing and grading lines: At present, there are five mechanical washing, grading and waxing plants established by Punjab Agro Industries Corporation (PAIC). These washing and waxing plants are established at Chhauni Kalan and Kang Mai in Hoshiarpur district, Abohar, Jattan Tahliwala in Ferozepur district and Badal in Muktsar district. Besides, many progressive growers (more than 100 nos.) have also installed such facilities privately at their own farms.

ii) Processing plants: The Punjab Government has established two pilot scale processing units for processing of Kinnow juice and other fruits and vegetables at Hoshiarpur and Abohar.

iii) High-tech Pack Houses: Five pack houses with cold storage and grading/sorting lines have been established by PAGREXCO at Mushkabad (Ludhiana), Saholi and Lalgarh (Patiala), Kangmai (Hoshiarpur) and Babri (Gurdaspur).

v) Fruit Estates: Further, in order to boost the production and marketing of major fruits, Punjab Government has established five citrus estates in Hoshiarpur and Ferozepur districts, one litchi estate at Pathankot and one pear estate at Amritsar.

1.2 Objective of the survey: To assess the working of cold storage, ripening chambers in Punjab state funded by National Horticulture Mission.

A task to assess the operation and functioning of cold stores in the state of Punjab was assigned by Dr Gurkanwal Singh, Director, Horticulture, Punjab. A State level cold chain committee was constituted to carry out the assigned job. The committee members comprising Dr B V C Mahajan (chairman), Senior Horticulturist, PHPTC, PAU, Ludhiana, Dr Mahesh Kumar (member), Processing Engineer, PHPTC, PAU, Ludhiana, Dr K G Malik (Member), HDO Jalandhar-cum-nodal officer for cold chain and Dr Bikramjit Singh (Member), HDO Ferozepur- cum-nodal officer of cold chain.

The committee visited all places, where cold stores and ripening chambers have been established by various entrepreneurs with financial assistance from NHM. All cold store owners were invited in the office of Deputy Directors (Hort) of concerned district. The committee members apprised them of the latest guidelines of MIDH and educated them about the importance of postharvest handling and storage of fruits and vegetables. They were educated about the role of their business model in supply chain of fruits and vegetables. The committee members discussed in detail that cold store owners/entrepreneurs can support the small and marginal farmers by storing their produce on nominal rent basis, which otherwise farmers have to distress sale in the market at throw away prices. A comprehensive survey was conducted by cold chain committee in different district of Punjab to assess the working of cold stores and problem of cold store owners.


Interaction of Committee Members with stake holders

1.3 Status of cold stores in Punjab: In Punjab there are about 550 cold stores having about 19 million ton capacity. Out of which 133 cold stores of 4.53 lakh MT capacity and ripening

chambers with 2769 MT capacity are established with the financial assistance from NHM (Details provided by Directorate of Horticulture, Punjab is enclosed in Annexure 1).

1.4 Well maintained cold stores:

During visit to various places, the committee experienced that some cold store owners have established excellent stores with good civil structure, proper design and technology. These stores have efficient refrigeration machinery, proper condensing units, control valve, proper insulation, VFD for electricity management etc. These stores also have sorting and grading lines. These are as under:

Sr. No.	Name of the Firm	Capacity (MT)	Address	Year
1.	Sona Chandi Warehousing Solutions	5942	Village BalaChak, Town: Tarantaran, District Tarantaran	2013-14
2.	Grand Father Food Processing Cold Storage	3604	Vill. Mehna, District: Moga	2013-14
3.	Jay Dee Ess Cold Storage	5000	Nakodar Road, VPO. Kala Sanghian, Kapurthala.	2009-10
4.	M/s D. F. Cold Storage	5548	Vill. Ladhewal, Saidowal Road, District Kapurthala	2010-11
5.	M/s Bhatti Agri Tech. Seed Infrastructure	1000	Village Chuhar, Tehsil-Nakodar, District Jalandhar	2013-14
6.	M/s Kartar Cold Storage	2256	Village Lersiwal, Distt. Jalandhar	2011-12
7.	M/s T. N. Cold Storage	4902	Vill. Rahimpur, Distt. Jalandhar	2012-13
8.	K. S. Bal Cold Storage	5824	Village Sehijhangi, P. O. Gakhal, Distt. Jalandhar	2010-11
9.	Dahiya Cold Storage	5776	V.Billi Chahram, Tehsil Shahkot Dist. Jalandhar	2009-10
10.	M/s Jaswant Cold Storage	2200	Village Rohla, Distt. Ludhiana	2012-13
11.	M/s Punjab Cold Store	1650	Village Pandori, Tehsil: Jagraon, District- Ludhiana	2012-13


Visit of Committee Members to Potato Cold Store

1.5 Ripening chambers: All ripening chambers in different distt of Punjab are working satisfactorily and following the ripening technologies as recommended by FSSAI. The banana are being ripened with ethylene gas. Now some of the entrepreneurs are also ripening papayas with same technology. The *entrepreneurs* have understood the importance and usefulness of ethylene based ripening system. This practice will certainly help in checking the use of calcium carbide for ripening of fruits.


Visit of Committee Members to Ripening Chamber Unit

1.6 Methods of ripening of fruits:

(i) Ripening with calcium carbide---a banned technique: The commonly used agent in the ripening process is Calcium carbide (popularly known as Masala), a material more commonly used in gas welding. Calcium carbide is usually kept in small paper packet near the piles of

bananas or inside the heaps of banana or other fruits and the whole package is kept in closed space for a day or two. The chemical, when hydrolyzed, produces heat and acetylene gas along with traces of ethylene which hastens the ripening process. In case of banana the ripening starts within 24-48 hours, depending on ambient temperature and when fruits yield to slight finger pressure, they are kept under ice slabs for lowering temperature and colour develop. However, the fruits ripened with Calcium carbide are overly soft, less tasty with a short shelf life. In addition, it is very dangerous to handle calcium carbide and acetylene because of its explosive properties and health hazardous. The fruits ripened with carbide are reported to cause mouth ulcers, gastric irritation and even food poisoning after consuming these fruits. Moreover the chemical is so reactive that it causes blisters if touched unknowingly with wet hands. The low price of carbide results in their indiscriminate use in artificial ripening of banana, mango and other fruits. **This practice is banned U/S 44-AA of Prevention of Food Adulteration (PFA) Act, 1954 with PFA rules, 1955,due to health reasons.** Inspite of ban, the local dealers are using the same with impunity.

(ii) Ripening with Ethylene gas (Internationally acceptable technique): In this technique, the fruits are exposed to low level of ethylene gas (10-100 ppm) in an air-tight ripening chamber for specific period of 24-72 hours to induce the fruits to ripen. The most important thing in this technique is temperature and relative humidity control inside the ripening chamber, which should range between 15-25^{O}C and 90-95% RH, depending upon the fruit type. Application of ethylene gas facilitates systematic method of ripening which can be utilized for systematic marketing strategies. It is also beneficial to have the ripening system at the fruit processing line for systematic ripening of fruits prior to processing. Ripening under reasonably controlled conditions using ethylene gas can meet the increased consumer demand for properly ripened bananas and also enable the high volume retailers, especially supermarkets to better supply their customers and control the postharvest losses. It guarantees uniform ripening with development of good flavour and colour. Although, initially, the cost of infrastructure is high, but it will compensate with quality of fruits. The technology can be used by fruit whole salers at wholesale markets prior to distribution to retailers. It is important to recognize that though ethylene gas can promote the ripening and colour changes, the quality of such artificially ripened fruits depends mostly on their maturity level at the time of harvest. The use of ethylene

following harvest or storage of fruits is advantageous, since it will shorter the time to ripeness and ensures product uniformity.

1.7 Closure of cold stores and ripening chambers: The Incharge of concerned district informed the committee that some cold store and ripening chambers have been closed by the entrepreneurs due to non-viability of the project.

Name of the Firm	**Capacity**	**Address**	**Year**
M/s Khan Fruit Suppliers	Ripening chamber (36 MT)	Badal Colony, Killianwali, Dist. Muktsar .	2010-11
Punjab Agri-tech Processing Unit	Banana Ripening unit (1800 MT	Vill. Gagra, Samrala, Distt. Ludhiana	2010-11
LECA storage Pvt Ltd	CA store (1000 MT)	Vill Pual, Taragarh Road, P.o Nasarala, Hoshiarpur	2008-09

Recently, one more CA storage (C.A. Vegefruit Stores) has been established at Kharar, District Mohali, Punjab during 2011-12 having capacity of 5320 MT. The working of this CA facility needs to be regularly monitored by concerned HDO/Incharge of that region. In such facility a huge amount of money is contributed by Govt sector and therefore, such infrastructure should work appropriately for the benefit of farmers, traders and consumers. Infact, CA stores performs well for storage of apple. However, the storage of fruits and vegetables other than apple is still a debatable and researchable issue. In the past one similar facility viz. LECA storage Pvt Ltd Hoshiarpur (CA store 1000 MT capacity) has been closed by the owners and the reason for closure of this facility needs to be investigated.

Chapter 2

Technical Details about cold storage infrastructure in Punjab

Types of machinery and technology being used in cold stores:

2.1. Cold Storage Types and Infrastructure: There are following types of cold storages being used in Punjab

1. Bunker type cold storage having brick wall with polystyrene insulation. (Older units, not visited personally but had interaction with the owners at the office of DDH).
2. Fin coil cold storage having brick wall with polystyrene insulation (few also using PUF insulation)
3. Pre-fabricated cold storage (Walk in type, basically for Ripening Chambers)

2.2 Civil work: Two types of building are constructed depending on the external environmental temperature and product type. It is double wall having 4-6 inch gap between two walls or single wall having 9 inch thickness.

2.3 Insulation: The insulating material that is commonly used is Expanded Poly-Styrene (EPS) having a thickness of 4-6 inches. A recent development in insulating material is Poly-Urethane foam (PUF). The material is 4-6 times efficient than the former.

2.4 Refrigeration system: Two types of refrigeration systems are used depending on product type and cold storage area.

2.4.1 Ammonia Based System: This type of system is mainly installed by Frick India Pvt Ltd in Punjab. However there were systems installed by lesser known players or by local companies also. Some cold store owners have pointed out after sale services and spare parts are problems for such systems

2.4.2 Freon/R-22/R 132/R404/R441/ Based System: There were few such systems being used for cold storage purposes. Usually the application of this type of technology is limited to Ripening Chambers only. This type of system requires more initial cost and highly skilled operator for smooth efficient operation.

2.5 Bunker type Vs Fin coil Technology: Potato cold storages working with ammonia refrigerant traditionally has been using ceiling coils popularly known as bunker coils as

evaporators for cooling the produce and claimed to consume less energy without sacrificing the quality of the stored produce, compared to forced draft air coolers (fin coil units) currently being recommended. The cooling process in Bunker System depends on the network of piping through which liquid ammonia circulates, served with a flooded accumulator and a hand expansion valve at the inlet. Every ton of refrigeration requires approximately 300 ft of pipe.

In case, fin coil coolers are used, normally 4 air coolers each of 9-10 TR capacity are used for each cold room storing 1250-1500 ton potatoes.

Table 1: Comparison of energy savings, refrigerant and space requirement of cooling units of a 4000 MT cold storage.

Item	Unit	Type of Vapour Compression System		
		Diffuser	Bunker	Fin coil
Installed Electrical load	hp	180	128	124
Installed Electrical load	kW	134.28	95.49	92.50
Energy saving	%	-	29	31
Refrigerant requirement	kg	1,520	2,200	380
Space requirement for cooling system	cu	452	670	36

(source: Nabard bankable project report)

Table 2: Comparison of Bunker type and Fin coil type cold storage

Item	Bunker Type	Fin Coil Type
Initial Costs	Higher	Lower
Operating Costs	Lower	Higher (Debatable)
Maintenance Cost	Lower	Higher (Debatable)
Uniformity of Temperature	Slow	Yes
Humidity Control	Nil	Yes
Automatic Defrost	Nil	Yes

2.6 Advantage of Fin Coil Evaporators

1. They are compact and occupy less space, thus more quantity of product can be stored within the same volume.
2. They are factory manufactured with the latest technologies, thus their quality is superior to site-fabricated coils.

3. Stainless tube with aluminum fin technology used in modern air coolers prevents rusting due to moisture, which is always present in cold rooms, and makes the coolers much lighter.
4. Defrosting is much easier and faster, but more frequent compared to ceiling coils.
5. Fans can be provided with VFDs to reduce power consumption when the load reduces.
6. The installation becomes simpler and chances of moisture dripping on the product are eliminated.
7. Product cooling is much faster compared to ceiling coils, which is essential for most products barring a few like potatoes.
8. Cost of air cooler vs. ceiling coils is debatable and needs to be analyzed on a case to case basis

Bunker System

Fin Coil System

2.7 Disadvantages of Bunker Coil System

1. These are generally fabricated at site by lay persons and the refrigerant circuiting is, therefore, not properly designed leading to higher pressure drop in the coil, lower suction pressures, compressor operating inefficiently and increasing power consumption.
2. Oil accumulates in the coil and is not drained frequently, again leading to lower compressor suction pressure and higher power consumption.
3. Lower suction pressure leads to frost formation on the coils, reducing its heat transfer capability.

4. As the load reduces, suction pressure drops leading to higher power consumption and frost build up. Both these can be prevented if an evaporator pressure regulator is installed to maintain constant evaporating pressure irrespective of load.

2.8 Potential Energy Efficiency Measures: The following energy efficiency measures are known as major energy savers for common refrigeration systems and refrigerated spaces.

2.8.1 Premium Efficiency Motors: Equipment selection should include high efficiency motors for the compressor, condenser fans, evaporator fans, and pumps. As an added benefit, these motors require less power and therefore give off less heat than equivalent standard motors, thereby reducing the internal cooling load that the motors contribute to the refrigerated space.

2.8.2 Liquid Overfeed Evaporators: In overfeed evaporator systems; excess liquid separated from the vapor in a low-pressure receiver is forced through evaporators. Another benefit of overfeed systems is that the compressors are protected from liquid slugs that might result from fluctuating loads and control malfunction because liquid is separated from the suction gas in the low-pressure receiver.

2.8.3 Evaporator size: Evaporator sizing and selection is based on the maximum cooling load for the system as well as the design temperature difference (TD). Increasing the TD increases the capacity of the evaporator. Therefore the optimal TD minimizes both the evaporator fan and compressor power consumption. The evaporator coils should then be sized accordingly.

2.8.4 Purgers: The presence of non-condensable gases in a refrigeration system not only reduces the capacity and efficiency of the system, but leads to unnecessary wear and tear on the compressor. Purgers minimize the negative effects of non-condensable by periodically expelling them at points of accumulation within the system.

2.8.5 Insulation: External loads on refrigeration systems result from heat transmission through the walls, ceiling, and floor. Heat transmission can be reduced through appropriate insulation in the building envelope. Installing tighter insulation can result in substantially lower cooling energy costs. Refrigerant suction lines should always be insulated, so that return gas does not gain unwanted heat from the ambient surroundings. High return gas temperatures decrease system efficiencies and unnecessarily increase refrigeration energy usage.

Poly styrene insulation

CO_2 / Air exchange system

2.8.6 High Efficiency Lighting Fixtures and Controls: High efficiency lighting in the refrigerated space reduces the facility's energy consumption, as well as minimizing heat gains from the lighting.

2.8.7 Rapid-closing Doors: Installing automatic door closers that limit the amount of time the doors are open can minimize energy losses. High-speed cold storage doors allow for rapid entry and exit of the cold storage area while minimizing energy loss due to air exchange between the refrigerated space and the outside. Air curtains and plastic strip curtains can also be useful for reducing external loads on the cooling system.

2.8.8 Variable Frequency Drives: There are several opportunities for using variable frequency drives (VFDs) in refrigeration systems to achieve significant energy savings. VFDs or two speed motor controls can be used effectively on condensers and evaporator fans. VFDs enable more efficient compressor part-load operation over fixed-speed drive alternatives for many screw compressors and other positive displacement machines

2.8.9 Raising Suction Pressure: When conditions allow, raising the suction pressure of a refrigeration system can result in overall energy savings. As a rule-of-thumb, compressor capacity increases approximately 2.5% per degree Fahrenheit increase in saturated suction temperature. Therefore, in order to meet the required cooling load and maintain the cooling set point temperature, airflow and/or evaporator surface area must be increased. This is accomplished by increasing the evaporator fan speed or increasing the number of evaporators.

2.8.10 Condenser Criteria: Evaporative condensers are the preferred approach for rejecting heat from industrial and large commercial refrigeration systems. Evaporative condensers can operate at lower head pressures than air cooled condensers because ambient wet bulb temperature is utilized for cooling the condensing coils. Compressor operating efficiency is therefore benefitting from a reduction in head pressure

2.8.11 Moderately Oversized Condensers: Moderately oversized condensers are typically an effective energy efficiency option. The larger condensers lower the saturated condensing temperature, reducing the work required from the compressors. The reduction in compressor demand because of the oversized condenser may allow for the selection of smaller compressors. Potentially, additional savings can be realized as a result of this measure by operating a smaller compressor at near full load as opposed to a larger compressor at part load.

2.8.12 Compressor type: Once the appropriate compressor size is determined, compressor type(s) should be selected in light of the variability in loads at the facility. For facilities with significant throughput and new products frequently entering the refrigerated space, the initial pull-down load can be significantly higher than the normal load required maintaining refrigerated conditions, resulting in high variations in load. At full-load capacity, screw compressors generally perform better than reciprocating compressors. However, reciprocating compressors unload more linearly than screw compressors, and therefore can perform better in systems with highly variable loads.

Modern electrical panel for efficient storage operation

Chapter 3

Ammonia Based Refrigeration System – Safety issues

When used as a refrigerant, pure ammonia gas is compressed to form pure liquid ammonia. Unlike ammonia compounds, pure ammonia, in both gas and liquid forms, is a toxic substance that presents a number of hazards. If proper precautions are not taken while working with or around pure ammonia, serious injury or even death can result. In order to prevent injury, basic safety gadgets/gears/masks needs to be used

3.1 Ammonia: Pure ammonia comes in two forms: gas and liquid. Ammonia gas is colourless and has a suffocating, pungent, penetrating odour. **It is also much lighter than air**. If ammonia gas escapes from a refrigeration system or a storage container, it tends to collect in high areas or ceilings. Ammonia gas is very irritating to the eyes, nose, and respiratory system, which makes it easy to detect low concentrations in the air. Depending on the concentration, ammonia can cause coughing, chest pain, breathing difficulty, bronchopneumonia, pulmonary edema, and death from bronchial spasm. Ammonia is a severe eye irritant; it can penetrate the eye quickly, causing permanent blindness. Contact with the skin or eyes can cause severe and potentially fatal burns.

3.2 Toxic effects of ammonia

Ammonia concentration (parts per million)	Effect
2-55 ppm	Normal range of odour threshold*
70 ppm	Stinging or burning in eyes, nose or throat; can cause watering of eyes, sneezing, and coughing*
300 ppm	Severe irritation of eyes, nose or respiratory tract, which becomes intolerable after a few minutes; difficulty breathing; possible burning in lungs (IDLH level)*
2,000 ppm or above	Can be fatal after a few breaths

3.3 Exposure limits of ammonia

Exposure level (parts per million)	**Exposure limit**
25 ppm	Maximum allowable concentration averaged over an eight-hour period
35 ppm	Maximum allowable short-term exposure (15 minutes)
300 ppm or above	Immediately dangerous to life and health (IDLH)

3.4 Employers must have specific procedures to cover concerns such as:

Response to an alarm signal

Leak control

First aid response

Dispersal of leaked ammonia inside the plant

3.5 Control: Engineering and administrative controls are the first line of defence against exposure to Ammonia. Proper building design and ventilation are important engineering considerations. Monitoring/alarm systems are also essential in preventing ammonia exposure. Personal protective equipment is the last line of defense.

- Machine rooms must have two or more exit doors to ensure accessible escape routes.
- Emergency controls to shut down the ammonia compressor must be located outside the machine room.

3.6 Ventilation: Cold storage rooms must have a door that opens easily from the inside. These rooms must also have a means of alerting other workers if a person is unable to exit the room. The machine room must have an independent mechanical ventilation system. Ventilation fans must have a control switch on a separate circuit located outside the machine room.All ventilating fans must provide at least 15 air changes per hour, and must have switches outside the machine room even when an inside switch is installed. Store ammonia cylinders and containers in a cool, dry, and relatively isolated area, protected from weather and extreme temperatures. If cylinders and containers are stored outside, shield them from direct sunlight

3.7 Emergency equipment: Emergency equipment includes eye wash and shower facilities and first aid kits. Workers must have immediate access to each of these items and must know how to use them in case of emergency

3.7.1 Eye wash and shower facilities: Workers must have immediate access to an appropriate first aid kit at each ammonia location. The facilities should have a supply of lukewarm water — not running cold water.

3.7.2 Personal protective equipment: Controlling exposure requires strict attention to ammonia exposure limits. Appropriate respiratory, eye, and skin protection are essential.

3.7.3 Eye protection: Eye contact with liquid ammonia for even a short period can cause permanent disability such as blindness. Flushing must begin within 10 seconds.

Because eye irritation from exposure to ammonia gas normally does not occur until concentrations reach about 70 ppm, eye protection is not mandatory under normal working conditions (in other words, below 25 ppm). All respirators must provide full face protection or be used with effective eye protection.

3.7.4 Skin protection: Skin contact with ammonia can result in severe — even fatal — burns. Workers who are controlling any liquid ammonia leak must have access to full-body protective suits. This equipment must also be available to workers exposed to airborne ammonia concentrations above 300 ppm for more than a few minutes, which causes immediate irritation of moist body areas. (Ammonia reacts instantly with moisture.)

Protective gear that must be available to workers in a Ammonia based refrigeration plant

Ammonia leak detector that trigger alarm and put on ventilation fans

Worker fixing / attending ammonia leakage.

3.7.5 Respiratory protection: Different types of respirators are available to protect workers from exposure to ammonia. Choosing the right respirator must be based on both the needs of each individual worksite and the requirements of the employer's written safe work procedures.

3.7.6 Full face piece respirators with cartridges: When the ammonia concentration is shown to be greater than 35 ppm, workers must wear a full face-piece respirator fitted with a chemical cartridge that protects against ammonia exposure. Full face-piece respirators with cartridges are also appropriate for leak control where tests show the ammonia concentration to be less than 300 ppm (IDLH level).The correct selection of respiratory protection requires an accurate knowledge of the ammonia concentration in the hazard area.

Situation	**Ammonia concentration**	**Respirator choice**
Routine work in ammonia room; leak occurs	Unknown; exit room immediately	Escape respirator
Working on ammonia system; chance of leak	Unknown; exit room immediately if leak occurs	Full face piece respirator
Leak occurs; enter to repair	35-500 ppm	Full facepiece respirator
	300 ppm or more *	SCBA
	Unknown; always assume IDLH level	SCBA

* Concentration above 300 ppm also require full skin protection.

3.7.7. Fire fighting equipments:

Dry	**Water based**
Dry chemical powder type 5.0 kg. cap with ISI Mark fire extinguisher complete with wall mounting bracket	2 sets of water supply pump
Carbon Di-oxide (CO_2) type 4.5 kg, capacity fire extinguisher complete with wall mounting bracket.	2 sets of fire fighting pumps
GI Fire buckets	GI piping, class C with necessary fittings and valves
MS stands for fire buckets	Rubber Hose reel
	Canvas Hose pipe
	MS fabricated hose box with key

Chapter 4

Success Story

M/s : Balaji Ripening Chamber (Brand Name : Bagbani Fresh)
Owner : Sh. Mahender Uneja
Capacity : 12 chambers of 30T each = 360 metric tones

Sh. Mahender Uneja started selling fruits in 1975-76 as street hawker on Rehri. To ease financial situation his wife supported him by stitching clothes. Having himself faced financial hardship, he realized the ground situation of average people and thought of helping them in his own way and within his reach. He toured many banana producing states in South and learnt about ripening the same with traditional method including use of calcium carbide since 1982. However, he faced difficulties with the use of calcium carbide. He also read in newspaper that calcium carbide is health hazard and is banned by Govt of India under Prevention of Food Adulteration Act. Being a person of good moral values he was eager to know about the safer ways of ripening fruits especially banana, but could not find any viable alternative to calcium carbide.

He expanded his banana business in 1991 with direct procurement from South. During 2005, he came to know about the new ripening chamber set up at Ludhiana Mandi by Punjab Mandi Board in technical guidance of PHPTC, PAU, Ludhiana. He visited that facility and learnt the technique of ripening with ethylene gas. He then also visited Jalgaon and saw the banana being ripened in the ripening chambers. He also visited the facility created at Malerkotla by Tata company (Brand : Khet Se)

After getting this exposure, he set up his own banana ripening chambers in 2009 at village Safedda near Cheeka Chowk and started ripening banana. Initially, he faced marketing problem for selling his bananas due to resistance of many traditional traders of that area.

Faced the challenge from traders, he decided to sell his safely ripened bananas directly to public himself and also through his contact with local hawkers. Today he is ripening large quantity of bananas (350 MT / week) supplying to Punjab, Haryana even Delhi. He has a fleet of small capacity vehicles that are purposefully designed for educating the general public about

the safe fruit ripening technique. These vehicles are used for retail selling in local market as well as for supplying to neighboring district / states. He has now made his mission to serve the public with safe fruit at competitive price. His daughter (who is doctor & married to doctor) is looking after this business.

He now employs about 40-50 workers in this activity (majority of which one women from village) thus helping in improving the financial conditions of village folk.

Visit to Balaji Ripening Chamber, Village Saffeda, Patiala (Brand Name : Bagbani Fresh)

Chapter-5

Observations and Suggestions of committee members

The main observation of committee members is that all cold stores and ripening chambers established with financial assistance from NHM are working satisfactorily. However During discussions with the cold store owners the following issues were emerged:

5.1 Observations relating to cold store machinery

1. All cold storages are of Brick and Mortar construction.
2. The thermal insulation mostly used was expanded polystyrene.
3. The refrigeration plants are using ammonia as refrigerant gas.
4. The compressors were open type Reciprocating compressors & owners usually do not know about various types of compressors available.
5. The condensers were universally of Atmospheric type.
6. The evaporators observed were fin coil, but old cold storages are still having bunker technology.
7. The storage of potatoes is on the wooden grated floors and on wooden Mezzanine levels. Mezzanine levels were supported by steel framed structure.
8. It is observed that basic building structure is strong without any noticeable cracks in the walls or in the inside ceiling.
9. The temperatures variance in mezzanine levels was observed, the relative humidity levels are low and low rate of circulation of cold air. The temperature monitoring was done with instruments which were not calibrated.
10. There was no ammonia ventilation system found in the plant room.
11. In majority of cold stores, fresh air ventilation system for replenishing oxygen levels and evacuating expired CO_2 from cold room chambers was not found to be installed.
12. The electrical control panel, wiring, cable support, routing and termination are done without standard electrical panel manufacturing and installation procedures.
13. The electrical consumption is reported to be very high in most of the cold storages.
14. Proper cleaning / service and maintenance of condensers and other refrigeration machinery is carried out regularly except at the time of breakdown.
15. Wooden doors are installed with poor thermal seals.

5.2 Critical Observations

1. Potato is the major commodity being stored in almost all cold stores.
2. The cold store owners do not have the knowledge about storage conditions required for storage of fruits and vegetables except potato (Annexure-ii)
3. Majority of cold store owners engaged in storage of potato, few store dry ration/masala and fruits/vegetables like carrot, cabbage, oranges, apple, pear as per demand of markets but without any knowledge of temperature and relative humidity (RH) requirement of particular commodity.
4. There is lack of qualified human resource that are handling and operating the refrigeration machinery.
5. Human safety issues are almost missing in cold store machinery
6. Operators are not aware of energy saving operational parameters.
7. Control valve, energy saving gadgets, humidification and ventilation systems are missing in majority of cold stores.
8. Cold store owners do not realize the importance of up-gradation of their old cold store units with reference to energy consumption
9. The electricity bills of all cold stores were variable.
10. People raised many queries relating to administrative issues such as
    - Placing cold store in orange category from green by pollution board
    - Peak hour penalties by electricity board. (As cold store keep biological material, so electricity consumption is regular)
    - Mandi fees without getting any services from PSMB. This fee was waived earlier and also not charged by neighoubring states.
    - CLU related issues are also raised by many.

5.3 Suggestion:

1. Extensive and periodic training programme for Cold Store owners regarding various techniques involved in postharvest handling, storage and marketing of fruits and vegetables.

2. The scientists from PHPTC and PAU Ludhiana will act as resource persons for imparting hands-on-training on grading, packaging, storage, marketing techniques to the cold store owners / progressive farmers.
3. The officials from State Department of Horticulture will arrange training programmes at their respected places / district headquarters where a batch of 15-20 cold store owners / farmers / entrepreneurs / traders will attend the training programmes. Such training courses may be arranged under National Horticulture Mission programmes by State Department of Horticulture.
4. The knowledge and practical approach of postharvest management of horticultural produce offers good opportunities for entrepreneurship and employment generation especially for rural youth and women.
5. Exposure visit of cold store owners and farmers to integrated pack houses business establishments in different parts of India.
6. Establishment of laboratory for testing of refrigeration equipments.
7. The stress for formation of co-operatives or producers company of farmers, fruits and vegetable growers, cold store owners should be given for developing market linkage, so that large share of profit goes to farmers instead of middle man.

Chapter 6

Brief summary and conclusion:

A task of assessing the operation and functioning of cold stores and ripening chambers in the state of Punjab was assigned by Dr Gurkanwal Singh, Director, Horticulture, Punjab. A State level cold chain committee comprising Dr B V C Mahajan (Senior Horticulturist at PHPTC, PAU, Ludhiana as Chairman), Dr Mahesh Kumar (Processing Engineer, PHPTC, Ludhiana as member), Dr K G Malik (HDO Jalandhar and nodal officer for cool chain as member) and Dr Bikramjit Singh (HDO Ferozepur and nodal officer for cool chain as member) was constituted to carry out the assigned job. During visit to various places, the committee members had very good interaction with the stake holders, cold store owners and officers of Deptt of Horticulture, Punjab,

In brief the existing postharvest infrastructure in Punjab is as under:

Name of the Agency	Postharvest infrastructure	Remarks
NHM	Cold storage 133 (capacity 4.53 lakh MT)	Different districts of Punjab
NHM	Ripening chamber 2769 MT	Different districts of Punjab
NHM	Pack house, 194 Nos.	Farm level pack house
NHM	Centre of Excellence for vegetables and fruits	Kartarpur (Jalandhar) Khanaura (Hoshiarpur)
Punjab Mandi Board	Cold Storage 16 Nos. (800 MT)	In 13 fruits & vegetables markets of Punjab
Punjab Mandi Board	Ripening chamber 52 Nos. (520 MT)	In 13 fruits & vegetables markets of Punjab
Punjab Agro Industries Corporation	Mechanical washing and grading lines (5 Nos.)	Chhauni Kalan and Kang Mai (Hoshiarpur) Abohar, Jattan Tahliwala (Ferozepur) Badal (Mukstar)
Punjab Agro Industries Corporation	Two pilot scale processing units	Hoshiarpur and Abohar
PAGREXCO	Five pack houses with cold storage and grading / sorting lines	Mushkabad (Ludhiana) Saholi and Lalgarh (Patiala) Kang Mai (Hoshiarpur) Babri (Gurdaspur)
Punjab Govt	Citrus Estattes Litchi Estate Pear Estate	Hoshiarpur and Ferozepur Pathankot Amritsar

Punjab has created good postharvest infrastructure for storage of potato and other fruits and vegetables. The observations of the committee members are that, whatever the postharvest infrastructure available in Punjab (cold store, waxing and grading lines, pack houses, ripening chambers) are working in isolation and their impact on Punjab horticulture seems to be negligible. There is need to develop an integrated model where whole postharvest system works as a chain so that the impact of present infrastructure become visible. It will help in improving the supply chain of fruits and vegetables and minimizing postharvest losses of fruits and vegetables and the inflation of their prices.

During visit to various cold store units, it was observed that none of the cold store owners have adequate knowledge about storage conditions required for different produce, maintenance of quality of stored produce, role of cold store owner in supply chain and knowledge about many more basic concepts of postharvest handling, storage and marketing of fruits and vegetable. Right now none of the cold store owner is ready to go for storage of fresh fruits and vegetables (except potato and apple), which seems to be due to lack of confidence among them in handling these perishable produce.

The committee recommends that there is need to conduct series of hands-on-training programmes for Cold Store owners and farmers collectively on postharvest handling, storage and marketing of fruits and vegetables. There is also need for creation of suitable human resources for providing technical services to the cold store owners at the time of need.

Annexure -I

List of Cold Storage Established under NHM

Sr. No.	Name	Capacity (MT)	Year
	JALANDHAR		
1.	Cold Storage by M/s Kissan Cold Storage at Jalandhar	3010	2009-10
2.	Cold storage by M/s Shri Anand Cold Storage at Jalandhar	5416	2009-10
3.	Cold Storage by M/s Nagra cold Storage at Jalandhar	4124	2009-10
4.	Cold Storage by M/s Surindra Cold Storage at Jalandhar	7722	2009-10
5.	Cold Storage by M/s Khughar Farm Cold Storage at Jalandhar	5040	2009-10
6.	Cold Storage by M/s Surinder Cold Storage at Jalandhar	10972	2009-10
7.	Shakti Cold Storage, Village Nagra, Dist. Jalandhar	1144	2009-10
8.	Jagtar Agri Farm & Cold Storage, Village Nehalluwal, Tehsil Shahkot, Dist. Jalandhar	2637	2009-10
9.	Dahiya Cold Storage V.Billi Chahram, Tehsil Shahkot Dist. Jalandhar	5776	2009-10
10.	M/s Bal Cold Storage Vill. Bal Nau, Distt. Jalandhar.	3732	2009-10
11.	M/s Guru Nanak Cold Storage & General Mills. Moga Road, Village Bajwa Kalan. Shahkot, Distt. Jalandhar.	1572	2009-10
12.	Chatha Kartar Cold Storage V. Dhandowal, Tehsil Shahkot Distt. Jalandhar	3674	2009-10
13.	M/S Ladhar Cold Storage Ladhran, Tehsil Nakodar Distt. Jalandhar.	1161	2009-10
14.	M/S Thind Cold Storage Fazalwal, Tehsil Nakodar Distt. Jalandhar.	1603	2009-10
15.	M/S Khera Farm & Cold Storage, Salah Nagar, P.O. Malsian, Distt. Jalandhar.	1630	2009-10
16.	M/S Kissan Cold Storage, Malsian, Shahkot Road, Distt. Jalandhar.	3010	2009-10
17.	Sandhu Farm & Cold Storage, Vill. Udhopur, Distt. Jalandhar	4514	2010-11
18.	S. B. Cold Storage, Vill. Karari, Distt. Jalandhar	3575	2010-11
19.	M/s Sri Guru Hargobind Cold Storage, Jalandhar District	2950	2010-11
20.	Maharaja Cold Storage, Malsian Road, Nakodar, Distt. Jalandhar	4710	2010-11

21.	Pannu Cold Storage, VPO Bagga, Tehsil Shahkot, District Jalandhar	6448	2010-11
22.	Khehra Cold Storage & Agri Farm, Vill. Talwandi Bharo, Tehsil Nakodar, District Jalandhar	5160	2010-11
23.	Shri Anand Cold Storage, VPO Mand, Kapurthala Road, District Jalandhar	1350	2010-11
24.	Om Cold Storage & Agri. Farm, Village Lohar, Partapura Distt. Jalandhar	3860	2010-11
25.	K. S. Bal Cold Storage, Village Sehijhangi, P. O. Gakhal, Distt. Jalandhar	5824	2010-11
26.	M/s T. F. Cold Storage, VPO Laharan Pratap Pura Distt. Jalandhar	3080	2010-11
27.	M/s H. S. Cold Storage, Vill. Rani Bhatti, Tehsil. Kala Bakra, Distt. Jalandhar	3808	2010-11
28.	Mohan Cold Storage, Village Lambri, Distt. Jalandhar	4712	2011-12
29.	M/s Simran Cold Storage, P.O. Malsain Tehsil Shahkot Distt. Jalandhar Punjab.	5764	2011-12
30.	M/s Varindera Cold Chain systems Pvt. Ltd., Village Lallian Kalan, Distt. Jalandhar Punjab.	4638	2011-12
31.	M/s Shiv Shanker Cold store, Village Ambgarh, Kartarpur, Distt. Jalandhar Punjab.	4500	2011-12
32.	New Thind Cold Storage & Agriculture Farm, Village Partappura P. O. Loharan Jalandhar	3450	2011-12
33.	M/s Dhaliwal Farm & Cold Storage, Village Patti Akalpur, Tehsil Malsian, Jalandhar	2860	2011-12
34.	M/s Kartar Cold Storage, Village Lersiwal, Distt. Jalandhar	2256	2011-12
35.	M/s Shri Guru Har Rai Ji Cold Storage, Village Tahli Sahib, P. O. Kartarpur, Ditt. Jalandhar	4816	2011-12
36.	M/s Shree Bagwati Cold Storage, V.P.O. Singha District Jalandhar	5650	2011-12
37.	M/s Sandhu Cold Storage, Village Uggi, Teh. Nakodar District Jalandhar	4567	2011-12
38.	M/s G.F Cold Store, Village Uggi, Teh. Nakodar District Jalandhar	3117	2011-12
39.	Khurana Agro Foods & Cold Store, Vill. Sangha, PO Kang Sabhu, District Jalandhar	2940	2011-12
40.	Friends Cold Store & Agri Farms, Village Rahimpur Teh. Nakodar, District Jalandhar	3117	2011-12
41.	M/s T. F. Cold Storage, VPO Loharan Partappura, Distt. Jalandhar	1558	2012-13
42.	M/s A. K. Cold Storage, Godaipur, Distt. Jalandhar	2538	2012-13

43.	M/s T. N. Cold Storage, Vill. Rahimpur, Distt. Jalandhar	4902	2012-13
44.	M/s Vrindera Cold Storage, Vill. Singhpur, Distt. Jalandhar	5115	2012-13
45.	M/s Shri Guru Hargobind Cold Storage & Agriculture Farm, Vill. Beas Pind, District Jalandhar	1453	2012-13
46.	M/s Surindera Cold Storage, VPO Sah Jhangi, P. O. Gakhla, Jalandhar	2980	2012-13
47.	Turna Cold Store, Parjian Road, Shahkot, Jalandhar	4510	2009-10
48.	Josan Cold Storage Pvt. Ltd., Village: Budhan wal, P.O. Sandhabnwal Shahkot, Dist. Jalandhar	2300	2011-12
49.	M/s JBF Cold Store, Gonachak, Kala Singhian Road, District- Jalandhar	3190	2012-13
50.	M/s Bhatti Agri Tech. Seed Infrastructure, Village Chuhar, Tehsil- Nakodar, District Jalandhar	1000	2013-14
51.	M/s Thamanwal Cold Storage, Village Thamanwal, Sub Tehsil Nurmahal, Tehsil Phillaur District Jalandhar	3320	2013-14
52.	M/s Jammu Cold Storage, Village Bara Pind, Kartarpur	2404	2011-12
53.	M/s M.S Cold Storage, Village Chota Pind Urf Bara Pind, Kartarpur	2683	2011-12
54.	M/s Baba Bir Singh Cold Storage, Village Todarwal, PO Thatha Nawan, Tehsil Sultanpur, Distt. Kartarpur	5436	2012-13
	KAPURTHALA		
55.	Jay Dee Ess Cold Storage, Nakodar Road, VPO. Kala Sanghian, Kapurthala, Punjab.	5000	2009-10
56.	M/S Gobind Gupta Cold Storage, Dalla, Tehsil Sultanpur, Distt. Kapurthala.	4100	2009-10
57.	B. S. Cold Storage, Kapurthala Road, Nakodar	3520	2010-11
58.	Tashpur Cold Storage, Vill. Tashpur, Distt. Kapurthala	9027	2010-11
59.	M/s Dashmesh Cold Storage, Vill. Bahui, PO Sheikhupur, District Kapurthala	5584	2010-11
60.	M/s D. F. Cold Storage, Vill. Ladhewal, Saidowal Road, Distric Kapurthala	5548	2010-11
61.	M/S Makhija Cold Store Pvt .Ltd , Village Bullarai, Phagwara, Distt. Kapurthala Punjab	4380	2010-11
62.	M/S B. K Cold Store, Village Kot Karar Khan, Tehsil & Distt. Kapurthala	4386	2010-11
63.	Kaura Cold Storage, Village Shahjhanpur, Tehsil Sultanpur. Distt. Kapurthala	5298	2011-12

64.	M/s Dhawan Cold Storage, Village: Sawal, Town, Sultanpur Lodhi, District Kapurthala, State Punjab	2740	2012-13
65.	M/s P.S. Butter Cold Storage, Vill. Kot Karar Khan, Distt. Kapurthala	4762	2012-13
66.	M/s Keshav Cold Storage, Vill. Khusrupur, Distt. Kapurthala	6090	2012-13
67.	M/s Guru Teg Bahadur Cold Storage & Ice Factory, Vill. Madhopur Jallowal, Distt. Kapurthala	2782	2013-14
	AMRITSAR		
68.	M/s Amrik Cold Storage, Gali No. Partap Avenue, Amritsar	3600	2009-10
69.	M/s Sandhu Cold Storage, Asr. Road, Tarn Taran (Asr.)	2500	2009-10
70.	M/S Gujjar Singh Cold Storage, G.T. Road, Manawala, Distt. Amritsar.	2213	2009-10
71.	M/s Marwaha Cold Storage, 354 focal Point, Amritsar	1631	2010-11
72.	M/s Heir Cold Storage, Village: Rakh Devidasspura, Tehsil & District Amritsar	3472	2011-12
73.	M/s Thind Cold Storage Private Ltd. G.T. Road Amritsar	1641	2011-12
74.	M/s Handa Cold Storage, V.P.O Tangra, The. Baba Bakala. District Amritsar	4935	2011-12
75.	M/s Satgur Cold Storage, V.P.O Muchhal, District Amritsar	3044	2011-12
76.	M/s A.K. Cold Store, Village: Ibban Kalan, Chabal Road, Amritsar	2240	2013-14
	LUDHIANA		
77.	M/S Machhiwara Cold Storage, Panjeta, Ludhiana.	5972	2009-10
78.	M/s Sandhu Cold Storage, Vill. Garhi Rarkhana, Ludhiana	3000	2010-11
79.	M/s Gobind Cold Storage, Ludhiana	3406	2010-11
80.	Gurshakti Cold Storage, Samrala, Ludhiana	5100	2010-11
81.	Gill Agro Cold Storage, Samrala, Ludhiana	2500	2010-11
82.	M/s Punjab Cold Store, Vill. Pandori, Jagraon Road, Mullanpur, Ludhiana	1400	2010-11
83.	M/s Mangat Cold Store, Chandigarh Road, Samrala, Distt. Ludhiana	3380	2010-11
84.	M/s Jas Cold Storage, Vill. Sidhwan Bet, Jagroan Road, Distt. Ludhiana	4500	2010-11
85.	M/s Dhillon Bros. Cold Storage, Vill. Malak, Tehsil. Jagroan Road, Distt. Ludhiana	4000	2010-11

86.	M/s Dashmesh Cold Storage, Village Pona Tehsil Jagraon, District- Ludhiana	6156	2012-13
87.	M/s Mehak Cold Storage, Village Issru, Teh. Khanna, District Ludhiana	3600	2012-13
88.	M/s Handa Cold Storage, Village Ramgarh Bhullar, Sidhwan Bet Road, Tehsil Jagraon, District- Ludhiana	3218	2012-13
89.	M/s Punjab Cold Storage, Village Pandori, Tehsil: Jagraon, District- Ludhiana	1650	2012-13
90.	M/s Sarabha Cold Storage, Vill. Toosa, Distt. Ludhiana	2958	2012-13
91.	M/s Jai Shree Gurdev Cold Storage, Vill. Shamaspur, Distt. Ludhiana	5000	2012-13
92.	M/s Jaswant Cold Storage, Village Rohla, Distt. Ludhiana	2200	2012-13
93.	M/s Jas Cold Storage, Sidhwan Bed to Jagraon Raod, Ludhiana	1432	2012-13
	FATEHGARH SAHIB		
94.	M/s J. S. Cold Storage Pvt. Ltd., Amloh, Dist. Fatehgarh Sahib	3200	2009-10
95.	Dashmesh Cold Storage, Vill. Sounti, Almoh, Distt. Fatehgarh Sahib	4000	2010-11
96.	M/s Guru Nanak Cold Storage, Vill. Bir Amloh Distt. Fatehgarh Sahib	5130	2010-11
97.	M/s H S Gill Cold Storage, Vill. Majri Araian, Teh. Amloh Distt. Fatehgarh Sahib	3600	2010-11
98.	M/s Gill Cold Storage, Vill. Bhambri, Teh. Amloh Distt. Fatehgarh Sahib	3420	2010-11
99.	M/s Gill Cold Storage, Bhambri, Amloh, Fatehgarh Sahib, Punjab	2320	2012-13
100.	M/s D. S. Cold Storage, Salana Jiwan Singh Wala, Distt. Fatehgarh Sahib	5000	2012-13
101.	M/s Amrit Cold Storage, Bhadal Thua, Amloh, Distt. Fatehgarh Sahib	5520	2012-13
	MOHALI		
102.	M/s Anubhuti cold Storage, Village Mubarikpur, Tehsil. Derabassi, Dist. Mohali Punjab	926	2009-10
103.	M/s Dashmesh Cold Storage, Vill. Gharaun Distt S.A.S Nagar, Mohali	1047	2010-11
104.	C.A. Vegefruit Stores, Kharar, District Mohali, Punjab	5320	2011-12
	PATIALA		
105.	M/s Gaba Cold Storage Pvt. Ltd., Nabha, Dist. Patiala	2525	2009-10
106.	Shivam Cold Storage, Village Gazipur, Patiala,	5000	2010-11

	Rajpura		
107.	Mahadev Cold Storage, Vill. Ganda, Rajpura Distt. Patiala	3045	2011-12
	HOSHIARPUR		
108.	M/S H.S.B Cold Storage, Shahpur, Hoshiarpur.	3837	2009-10
109.	M/s S. S. Bajwa Cold Storage and Ice Factory, Purhiran, Ring Road, Hoshiarpur	4328	2010-11
110.	M/s Shri Krishan Cold Storage, Village Gigan Wala, Distt. Hoshiarpur	2796	2011-12
111.	M/s Barfani Cold Storage, F-48/49, Focal Point, Phagwara Road, Hoshiarpur	750	2011-12
112.	M/s SBS Cold Storage, Village: Ahirana, P.O.: Ahiran Kalan, District: Hoshiarpur	5201	2012-13
	TARN TARAN		
113.	M/s N. J. Cold Storage Pvt. Ltd., Village Johal Dhaiwala Distt Tarn Taran.	5300	2009-10
114.	M/s Kissan Cold Storage, Village Ekelgada District Tarn Taran Punjab	3360	2011-12
115.	Josan Agro-Foods & Cold Storage, VPO Ekal Gadda, Tehsil Sahib, District Taran Taran	4023	2010-11
116.	M/s Kissan Cold Storage, VPO Ekalgada, Distt. Tarantaran	1720	2012-13
117.	Sona Chandi Warehousing Solutions, Village BalaChak, Town: Tarantaran, District Tarantaran	5942	2013-14
118.	M/s K. K. Agro Foods & Cold Storage, Vill. Balla Chak, Amritsar Road, Distt. Tarantaran	3719	2012-13
	GURDASPUR		
119.	M/s Raj Cold Storage, Rawal Gadriaan PO ranjit bag Gurdaspur Punjab	4045	2011-12
120.	M/s Chahal Cold Store, Village: ChahalKalan, Tehsil Batala, Gurdaspur	1600	2013-14
121.	Zimidara Cold Storage & Ice Factory, Village: Batala Sarki, Town Batala, District Gurdaspur	1000	2013-14
122.	Guru Nanak Cold Storage, Village: Byepass Umarpura, Batala, District Gurdaspur	1582	2013-14
	MOGA		
123.	M/s Miri Piri Cold Storage, Village Dodhar Garbhi, Distt. Moga	2250	2011-12
124.	M/s Dashmesh Cold Storage, Village Indergarh Teh. & District Moga (Pb)	3160	2011-12
125.	M/s Kissan Cold Storage & Agriculture Farm, Vill. Patti Rajpur, Distt. Moga	3117	2012-13
126.	M/s Ram Ditta Cold Store, Village: Darapur, Tehsil & Distt. Moga	2500	2012-13
127.	Grand Father Food Processing Cold Storage,	3604	2013-14

	Vill. Mehna, District: Moga		
	NAWANSHAHAR		
128.	Doaba Cold Storage Private Limited, Village Karyam Distt. Nawansar Punjab	5332	2010-11
129.	M/s Bear Saab Cold Storage, Vill. Barsian, Distt. Nawanshahar	5800	2012-13
130.	M/s Dhillon Cold Storage, Village Chuchak Wind, Tehsil Zira, Ferozepur	3160	2012-13
131.	M/s Singla Cold Storage, Distt. Bhatinda	4318	2012-13
132.	M/s Krishna Cold Storage, Vill. Kokri Kalan, P. O. Janubi, Distt.	1664	2013-14
133.	A. S. Cold Storage, Vill. Bhaura, Distt. S.B.S. Nagar	3220	2010-11
	Total	**452340**	

List of Ripening Chamber Established Under NHM

Sr No.	Agency	Capacity (MT)	No. of Chambers	Cap. per chamber	Location	Year
1	M/s Khan Fruit Suppliers*	36	-	-	Badal Colony, Killianwali, Dist. Muktsar	2010-11
2	M/s Fateh Ripening Chamber	60	5	12	Opp. Radha Sowami Dera, Bathinda. Punjab	2011-12
3	M/s Balaji Cold Storage	278	8	35	Saferan, Distt. Patiala	2012-13
4	M/s A. K. Fruit Ripening Chamber	62	10	6	At- Sabji Mandi, Ferozepur Road, Faridkot	2012-13
5	M/s Indersen K. K. Lamba & Sons	238	16	15	Village Phangorian, Teh. Pathankot, Distt. Gurdaspur	2012-13
6	M/s Dhillon Fruit Company*	80	6	-	Jandiala Chowk Byepass, Tarn Taran	2012-13
7	Ashok Fruit Company	80	5	18	E 48 Focal Ponit Nawan Shahar	2013-14
8	Shree Ganesh Fruit Ripening Chamber	59	8	7.5	New Sabzi Mandi, Faridkot	2013-14
9	Shree Ganesh Cold Store Ripening Chamber #	76	-	-	Kotkapura, Faridkot	2013-14
10	Punjab Agri-tech Processing Unit*	1800	8	100	Vill. Gagra, Samrala, Distt. Ludhiana	2010-11
		2779				

* Not in working, # under process

Annexure –II

Table 1: Recommended storage conditions for fruits and vegetables

Name of Commodity	Temp(°C)	RH (%)	Approximate Shelf-Life
Apple	1-4	90-95	3-6 months
Asian pear	0-1	90-95	2 months
Grape	0-1	90-95	2 months
Guava	6-10	90-95	2-3 weeks
Mandarin (Kinnow)	5-6	90-95	6-8 weeks
Mango	13-15	85-90	2-4 weeks
Papaya	7-13	90-95	1-3 weeks
Peach	0-1	90-95	2-4 weeks
Plum and prunes	0-1	90-95	2-4 weeks
Cabbage	0-1	90-95	2-3 months
Carrots (topped)	0-1	90-95	3-6 months
Cauliflower	0-1	90-95	3-4 weeks
Cucumber	10-11	85-90	10-14 days
Eggplant	10-12	90-95	1-3 weeks
Okra	7-10	90-95	7-10 days
Peppers	7-10	90-95	2-3 weeks
Tomato	10-13	90-95	1-3 weeks
Potato (seed)	0-1	90-95	5-6 months
Onion	0-1	65-70	4-5 months
Garlic	0-1	65-70	5-6 months

Grouping of fruits and vegetables stored at different temperature and humidity

Group	Temperature	Crops	Status of commodities
Group 1	0-2^{o}C and 90-95% RH	Apple, Apricot, Peach, Asian Pear, Plum, Peach, Prunes	Produce ethylene.
Group 2	0-2^{o}C and 90-95%RH	Asparagus, Leafy greens, Broccoli, Peas, Spinach, Cabbage, Potato, Carrot, Cauliflower, Cherries.	Sensitive to ethylene.
Group 3	0-2^{o}C and 65-70% RH	Garlic, Onions dry.	Moisture will damage these crops.
Group 4	5-7^{o}C and 90-95% RH	Cantaloupes, Mandarin, Tangerines.	
Group 5	8-10^{o}C, 85-90% RH	Beans, Cucumber, Brinjal, Okra, Pepper.	
Group 6	13-15^{o}C, 85-90% RH	Mango, Banana, Tomato ripe	