POST-HARVEST **PROFILE OF MANDARIN**

सत्यमेव जयते

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GOVERNMENT OF INDIA
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DIRECTORATE OF MARKETING & INSPECTION
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MRIN-01

PREFACE

India has made a fairly good progress on the horticulture map of the world with a total annual production of the Horticulture Crops touching over 149 million tones. India has also been bestowed with wide range of climate and physio-geographical conditions and as such is most suitable for growing various kinds of horticultural crops such as fruits, vegetables, flowers, nuts, spices and plantation crops.

Mandarin *(Citrus reticulate Blanco)* is one of the important Horticultural Crops, grown mainly in Assam, Karnataka, Madhya Pradesh, Maharashtra, Meghalaya, Mizoram, Nagaland, Rajasthan, Tamil Nadu and West Bengal.

The profile on mandarin has been prepared on the recommendation of the Inter-Ministerial task Force on Agricultural Marketing Reform (May-2002). The main object of the profile is aimed at to facilitate producers to know when, where and how to market the produce to get better prices on one hand and also to help .the traders as well as the research scholars on other hand.

The profile covers all aspects of Post-harvest management i.e. collection. curing, pretreatment, grading, packaging, pre-cooling, low temperature storage. pallet loading, transportation, market practices, marketing channels, marketing problems, institutional facilities, marketing services, marketing information and extension, various government schemes, etc.

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The Directorate of Marketing and Inspection acknowledge the assistance and coordination extended by the Regional and sub-offices of the Directorate and various institutions /organizations in supplying the relevant data/ information required for compilation of this profile.

The Govt. of India should not be regarded as assuming responsibilities for any of the statements/contents, in this profile.

Faridabad
Date: 12/11/2010

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POST-HARVEST PROFILE OF MANDARIN

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1.0 INTRODUCTION

Mandarin is a group name for a class of oranges with thin, loose peel. These are treated as members of a distinct species, *Citrus reticulata Blanco*. The name "tangerine" could be applied as an alternate name to the whole group, but in the trade, it is usually confined to the types with red-orange skin. Mandarins include a diverse group of citrus fruits that are characterized by bright coloured peel and pulp, excellent flavor, easy-to-peel rind and segments that separate easily

The exact location of origin of Mandarin fruits is not clearly identified. It is believed that Mandarins is a native of southeastern Asia and the Philippines. The spread of Mandarins from Asia to Europe was slow. First, it was taken to North Africa and then probably by the fall of the Roman Empire, it entered the South of Europe, where it flourished in the Middle Ages. It is also believed that Mandarins were brought to America by the Spaniards (Columbus took seeds of citrus fruits with him in his second trip) and then by the Portuguese in their exploration trips of the New World, around year 1500. In Asia, it is most abundantly grown in Japan, southern China, and India.

Mandarin is very important fruit crop, second only to banana. It is usually consumed in raw form or in fruit salads as well as juice. The fruit consists of three layers.

1) The outer yellow/orange peel is with oil glands which exude the essential oils, producing the typical orange odor.

2) The whitish thread like mesocarp.

3) The endocarp consisting of 8 - 10 segments filled with juice sacs (vesicles).

Mandarins are rich in Ascorbic acid (13 – 54 mg per 100 g of edible portion) and Calcium (25 – 46 mg per 100 g of edible portion). They are a great source of Vitamin C. One orange actually has all the Vitamin C that one needs for the day. The water content in the fruit is nearly 80 per cent to 90 per cent of edible portion. The chemical composition of the Mandarin is as under.

Table No. 1
Chemical Composition of Mandarin
(Per 100 g of edible portion)

Moisture	82.6-90.2 g
Protein	0.61-0.215 g
Fat	0.05-0.32 g
Fiber	0.3-0.7 g
Ash	0.29-0.54 g
Calcium	25.0-46.8 mg
Phosphorus	11.7-23.4 mg
Iron	0.17-0.62 mg
Carotene	0.013-0.175 mg
Thiamine	0.048-0.128 mg
Riboflavin	0.014-0.041 mg
Niacin	0.199-0.38 mg
Ascorbic Acid	13.3-54.4 mg

Source: Morton, J. 1987. Mandarin, Fruits of warm climates. Julia F. Morton, Miami, FL.

1.1 Comparative composition of Mandarins of different places:

The composition of Mandarins may differ, depending upon the place of growing, A comparative statement of composition of mature Mandarins, grown at different places, is given in table No. 2

Table No. 2
Composition of mature Mandarin

Composition	Nagpur Mandarins		Coorg Mandarins		Kinnow	
	Mrig bahar	Ambia bahar	Main crop	Monsoon crop	Outer fruit	Inner fruit
Average weight of fruit (g.)	100	125	101	97	145	189
Peel (g.)	27	20	2.62	2.67	0.46	0.45
Juice(g)	45	55	49.5	54.0	38.6	40.2
Pomace (g.)	28	25	-	-	42.0	39.3
TSS (^{0} Brix)	11-14	8-10	11.5	10.0	9.5	9.0
Acidity (as anhydrous citric acid) (%)	0.3	0.5	0.87	1.1	0.77	0.64
Essential oil (%) (v/w)	2.2	3.1	-	-	-	-
Pectin (%) (fresh wt. basis)	4.5	3.5	-	-	-	-
Ascorbic acid (mg/100 ml juice)	35.0	33.6	40.2	41.6	18.8	18.7

Source: Mandarin in India- CFTRI, Mysore

1.2 MORE THAN VITAMIN C:

Citrus is most commonly thought of as a good source of vitamin C. However, fruits also contain an impressive list of other essential nutrients, including both glycaemic and non-glycaemic carbohydrate (sugars and fibre), potassium, folate, calcium, thiamin, niacin, vitamin B_6, phosphorus, magnesium, copper, riboflavin, pantothenic acid and a variety of phytochemicals. Citrus contains no fat or sodium. The average energy value of fresh citrus is also low, which can be very important for consumers concerned about putting on excess body weight. A medium orange contains 60 to 80 kcal, a grapefruit 90 kcal and a tablespoon (15 ml) of lemon juice only 4 kcal (Whitney and Rolfes, 1999).

Table no 3.
Nutritional facts about citrus fruit

	Orange	Grapefruit	Tangerine
Weight *(g)*	131	236	84
Energy *(kcal)*	62	78	37
Fibre content *(g)*	3.1	2.5	1.7
Ascorbic acid *(mg)*	70	79	26
Folate *(mcg)*	40	24	17
Potassium *(mg)*	237	350	132

Source: Gutherie and Picciano, 1995.

1.3 Economic Importance:

Mandarins are rich in vitamin A, B, C and phosphorus, which are consumed fresh or in the form of juice, jam, squash and syrup. It is one of the main source of peel oil and citric acid.

1.4 Botanical description

Kingdom: **Plantae**
Division: **Magnoliophyta**
Class: **Magnoliopsida**
Subclass: **Rosidae**
Order: **Sapindales**
Family: **Rutaceae**
Genus: ***Citrus***
Species: ***reticulata***

Mandarin is a citrus fruit of the species *Citrus reticulata.* It is distinguished from other citrus species by the relatively loose skin of the fruits, the relative ease with which the segments can be separated, and (in most cultivars) the green cotyledons.

Mostly, the Mandarin tree is more erect than other kinds of citrus trees and many exhibits a drooping habit because of rather long, willowy branches. The wood is somewhat more brittle than other citrus and branch breakage is common under heavy fruit bearing unless some support is provided. Most varieties of Mandarin are self-pollinated, but some of the hybrids are self-incompatible and will produce few fruit in the absence of suitable varieties for cross pollination. Mandarin tends to alternate bearing, with a heavy crop in one year followed by a lighter crop in the next season.

2.0 PRODUCTION

2.1 MAJOR PRODUCING COUNTRIES IN THE WORLD:

2.1.1 Area:

Mandarins are grown in the tropical/sub tropical region 35^0 N to 35^0 S of equator. Brazil, China, Egypt, Japan, India, Iran, Italy, Mexico, Spain, Thailand, Turkey, and USA are the main Mandarin producing countries. During 2009, the total acreage under the Mandarin was 2159.170 thousand hectares. The area under Mandarin in China was maximum i.e., 1374.162 thousand hectares (63.64 per cent), followed by Spain 122.000 thousand hectares (5.65 per cent). The area under Mandarin in Italy was 38.300 thousand hectares (1.77 per cent) and in Argentina, it was 32.000 thousand hectares (1.48 per cent)

The important country-wise area under Mandarin, from 2007 to 2009 is given in table No 4.

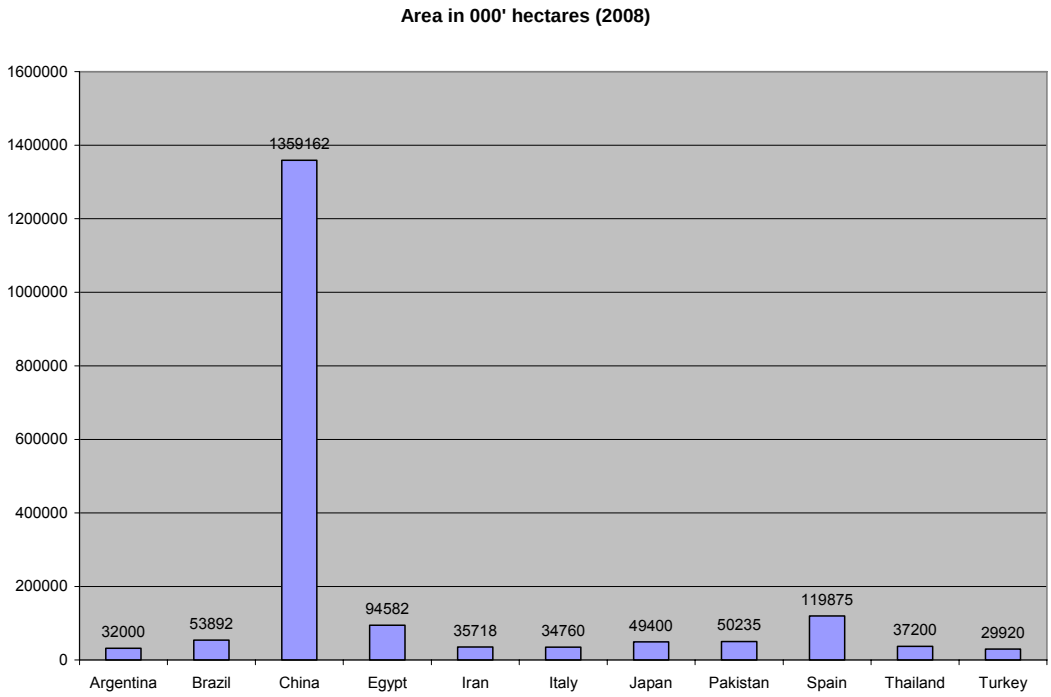
Table No 4.

Area of Mandarins during 2007, 2008 and 2009

Quantity in '000 hectares.

Sl. No	Country	2007	2008	2009
1	**Argentina**	32.000	32.000	32.000
2	**Brazil**	59.637	53.892	NA
3	**China**	1360.399	1359.162	1374.162
4	**Egypt**	93.346	94.582	NA
5	**Iran**	38.000	35.718	NA
6	**Italy**	36.124	34.760	38.300
7	**Japan**	49.400	49.400	NA
8	**Pakistan**	50.235	50.235	NA
9	**Spain**	121.727	119.875	122.000
10	**Thailand**	37.200	37.200	NA
11	**Turkey**	29.790	29.920	30.770
12	**Others**	238.693	242.682	561.938
13	**World**	2146.551	2139.426	2159.170

Source: FAO



Source: FAO

2.1.2 Production:

The total production of Mandarin during 2009 was 30587.778 thousand tones. The share of China in world production was 17772.593 thousand tones (58.10 per cent) and was the highest. During the same period, the production of Mandarin in Spain was 2026.200 thousand tones (6.62 per cent) and in Italy, it was 880.500 thousand tones (2.88 per cent).

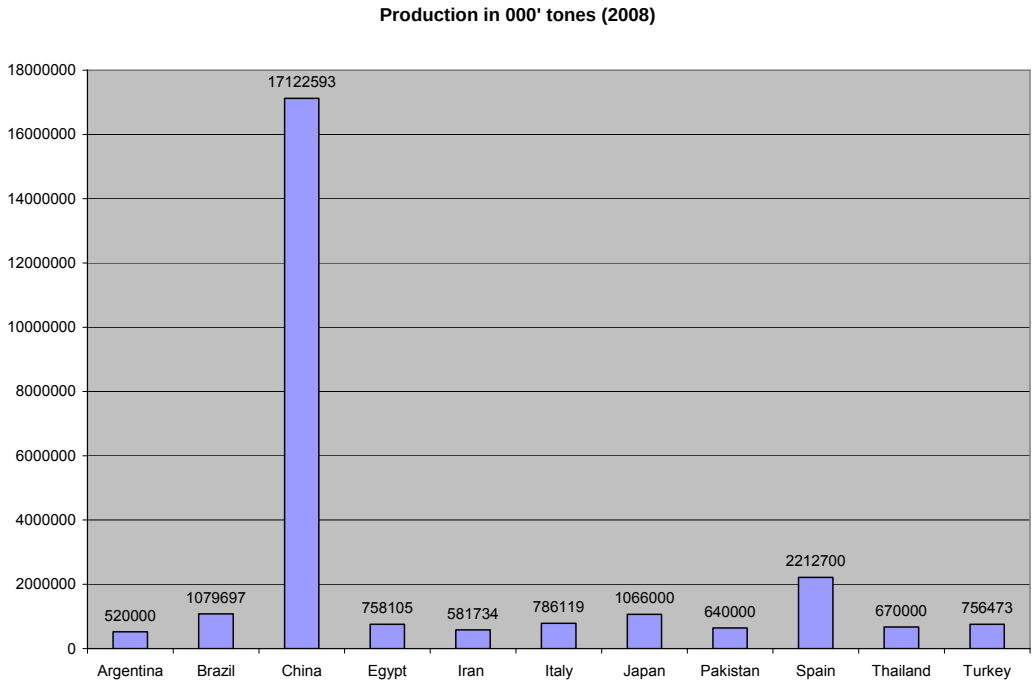
Table No 5, shows the country-wise production of Mandarin, during 2007, 2008, and 2009.

Table No. 5

Production of Mandarin during 2007, 2008 and 2009 Quantity in '000tones

Sl. No	Country	2007	2008	2009
1	**Argentina**	520.000	520.000	520.000
2	**Brazil**	1205.580	1079.697	NA
3	**China**	15184.608	17122.593	17772.593
4	**Egypt**	748.395	758.105	760.000
5	**Iran**	622.000	581.734	NA
6	**Italy**	591.526	786.119	880.500
7	**Japan**	1066.000	1066.000	NA
8	**Pakistan**	640.000	640.000	NA
9	**Spain**	1987.432	2212.700	2026.200
10	**Thailand**	670.000	670.000	NA
11	**Turkey**	744.339	756.473	846.390
12	**Others**	3824.060	3842.378	7782.095
13	**World**	27803.940	30035.799	30587.778

Source: FAO



Source: FAO

2.1.3 Productivity:

Though, during 2009, China and Spain stood first and second respectively in area and production of Mandarin but in respect of productivity, Turkey was the leading country having the yield (275069 Kg./hact.) followed by Italy (229895 Kg./hact.). The productivity of Mandarin, in Egypt, during the same period was the lowest i.e. 80353 Kg. / hact. The overall production per hectare of Mandarin in the world was 141664 Kg. /hact.

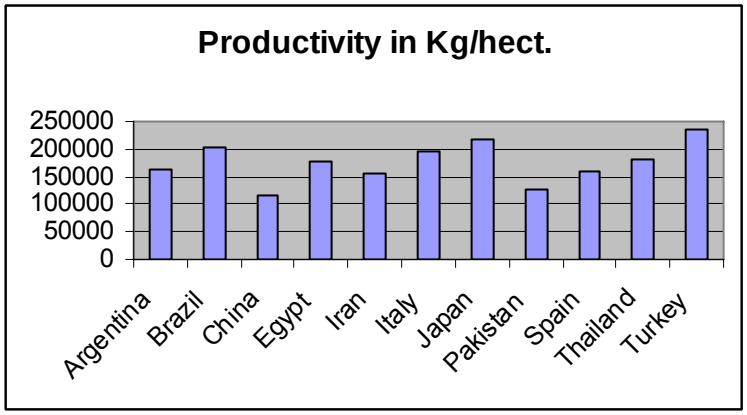
The country-wise yield of Mandarin, during 2007, 2008 and 2009 is given in table No 6.

Table No 6.

Productivity of Mandarin during 2007, 2008 and 2009 (Kg/ha)

Sl. No	Country	2007	2008	2009
1	**Argentina**	162500	162500	162500
2	**Brazil**	202153	200344	200344
3	**China**	111618	125979	129334
4	**Egypt**	80174	80153	80353
5	**Iran**	163684	162868	162868
6	**Italy**	163748	226156	229895
7	**Japan**	215789	215789	215789
8	**Pakistan**	127401	127401	127401
9	**Spain**	163269	184583	166081
10	**Thailand**	180107	180107	180107
11	**Turkey**	249862	252831	275069
12	**World**	129528	140391	141664

Source: FAO



Source: FAO

2.2 MAJOR PRODUCING STATES IN INDIA:

Assam, Karnataka, Madhya Pradesh, Maharashtra, Mizoram, Nagaland, Rajasthan and Tamil Nadu are the main Mandarin producing states in India.

In Maharashtra, the Mandarins are mainly grown at Satpura hills (Vidharba region) while in West Bengal they are grown at the hilly slopes of Darjeeling. In Karnataka, Coorg is the main producing area. In Tamil Nadu, Wynad, Nilgiri, Palney and Shevroy hills are the major Mandarin growing belts. The hills of Meghalaya (Khasi, Dusha, Garo, Jaintia), Mizoram, Tripura, Sikkim and Arunachal Pradesh are the others Mandarin growing states. Similarly, Assam, Brahmaputra valley and Dibrugarh districts are famous for Mandarin production.

The state-wise Mandarin growing belt is given in the table No. 7

Table No. 7

State-wise Mandarin growing belt

State	**Growing and Potentials belts**
Assam	Tinsukia, NC Hills, Karbi Anglong, Kamrup, Goalpara, Dhemaji, Jorhat
Karnataka	Chikmagalore, Kodagu, Hassan, Bijapur, Gulbarga, Bagalkot
Madhya Pradesh	Chhindwara, Mandsaur, Betul, Ujjain, Shajapur, Khandwa, Khargone, Dhar, Ratlam
Maharashtra	Nagpur, Akola, Amravati, Wardha
Meghalaya	East & West Khasi, Ri-Bhoi, Garo hills, Jaintia hills
Mizoram	Aizwal
Nagaland	Wokha, Tuensang
Orissa	Gajapati, Ganjam, Keonjhar, Kalahandi, Phulbani, Mayurbhanj, Sundergarh, Bargarh, Sambalpur

Rajasthan	Jhalawad, Kota
Tamil Nadu	Dindigul, Salem, Nilgiris
West Bengal	Darjeeling

2.2.1 AREA:

The total area of Mandarin, during 2008-09 was 245.49 thousand hectares in the country. Maharashtra is the main Mandarin producing state in the country, having the highest area 126.00 thousand hectares (51.33 per cent), followed by Madhya Pradesh, 31.47 thousand hectares (12.82 per cent) and Meghalaya 10.06 thousand hectares (4.09 per cent) during the same period. More than 65 per cent of the total area under Mandarin in India is in these three important Mandarin growing states. In other Mandarin growing states, the area was less than 4 per cent, of the total area covered under Mandarin in the country. The state-wise area of Mandarin is given in table No. 8

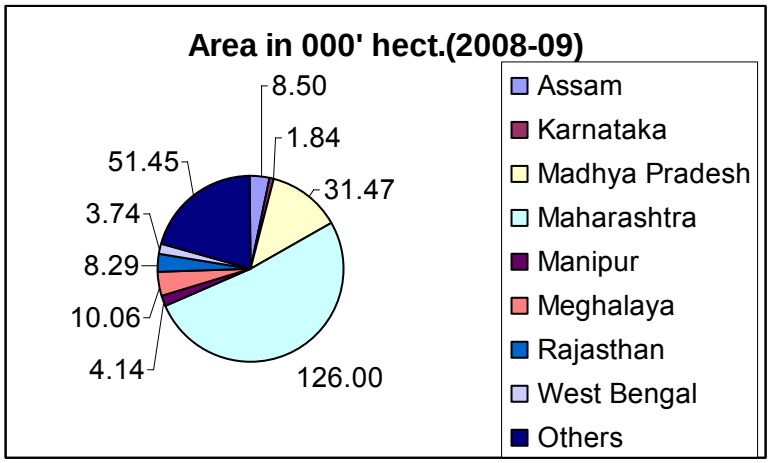
Table No 8.

State-wise area under Mandarin for the year 2007-08 and 2008-09

Area in '000 hectares.

Sl. No.	State	2007-08	2008-09
1	Assam	8.20	8.50
2	Karnataka	1.73	1.84
3	Madhya Pradesh	16.56	31.47
4	Maharashtra	125.66	126.00
5	Manipur	3.84	4.14
6	Meghalaya	8.31	10.06
7	Rajasthan	7.60	8.29
8	West Bengal	3.74	3.74
9	Others	42.44	51.45
10	Total	218.13	245.49

Source: National Horticulture Board



Source: National Horticulture Board

2.2.2 Production:

The total production of Mandarin in India during 2008-09 was 1633.95 thousand tones. The share of Maharashtra in Mandarin production was the highest with 39.41 per cent (644.00 thousand tones) of the total production of the country, followed by Madhya Pradesh, Rajasthan, Assam with 30.82 per cent, 9.64 per cent, and 5.71 per cent respectively. These four states account for more than 85 per cent of Mandarin production in India.

The production of Mandarin for the year 2007-08 and 2008-09 is given in table No. 9

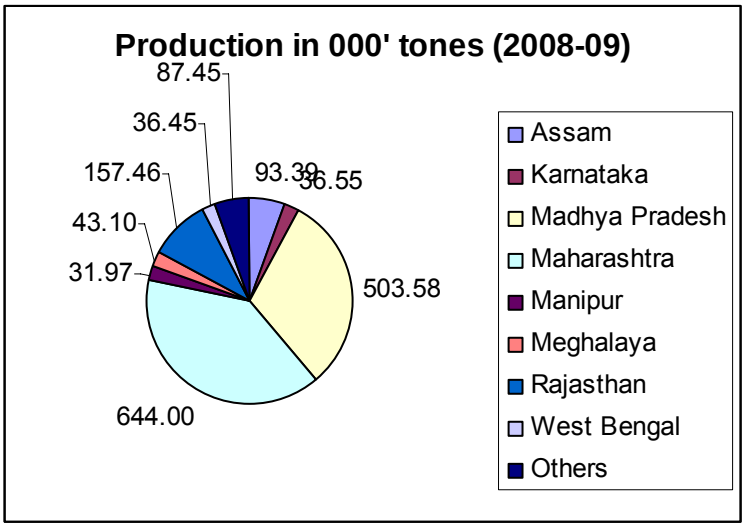
Table No 9.

State-wise production of Mandarin for the year 2007-08 and 2008-09

Production in '000 tones.

Sl. No.	State	2007-08	2008-09
1	Assam	89.92	93.39
2	Karnataka	35.48	36.55
3	Madhya Pradesh	264.94	503.58
4	Maharashtra	796.06	644.00
5	Manipur	28.38	31.97
6	Meghalaya	34.85	43.10
7	Rajasthan	96.00	157.46
8	West Bengal	36.45	36.45
9	Others	79.65	87.45
10	Total	1461.74	1633.95

Source: National Horticulture Board



Source: National Horticulture Board

2.2.3 Productivity:

During 2008-09, the productivity of Mandarin was highest in Karnataka state i.e. 19.8 tones/hect. and in Rajasthan it was 19.0 tones/hect. Though Maharashtra was highest Mandarin producing state but the productivity was only 5.1 tones/hect.

The state-wise productivity of Mandarin, during 2007-08 and 2008-09 is given in table No. 10.

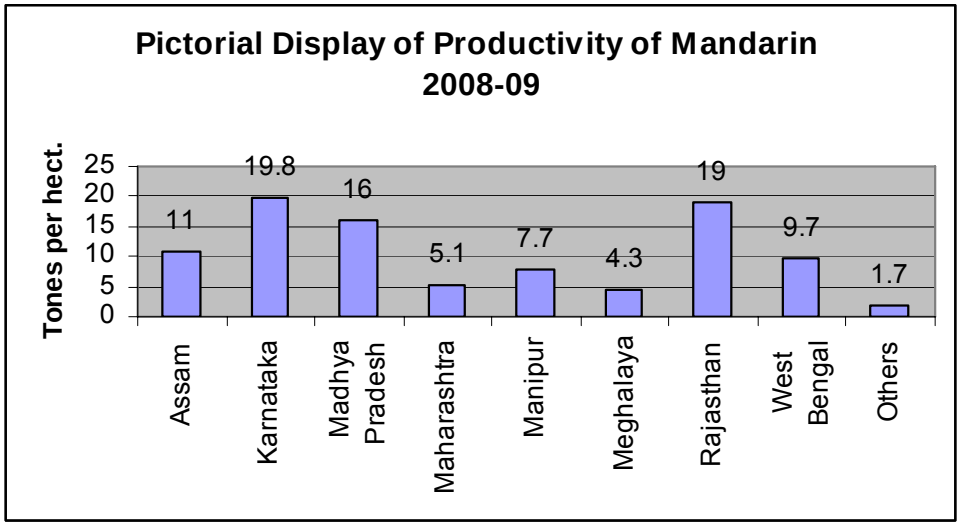
Table No 10.

State-wise Yield of Mandarin for the year 2007-08 and 2008-09

Productivity in tones per hectare.

Sl. No.	State	2007-08	2008-09
1	Assam	11.00	11.00
2	Karnataka	19.80	19.80
3	Madhya Pradesh	16.00	16.00
4	Maharashtra	6.30	5.10
5	Manipur	7.40	7.70
6	Meghalaya	4.20	4.30
7	Rajasthan	12.60	19.00
8	West Bengal	9.70	9.70
9	Others	1.90	1.70
10	Total	6.70	6.70

Source: National Horticulture Board



Source: National Horticulture Board

2.3 Varieties:

The state-wise and location-wise important Mandarin varieties grown in India are as under.

States	Actual Locations	Varieties
Assam	Tinsukia and Dibrugarh districts: Nagajanka in Jorhat district, Majbat in Darrang district, Jatinga valley in north Cachar hill district; and in Kamrup district	Khasi orange, Assam orange
Haryana	Sirsa, Hissar, Jind. Ambala and Kurukshetra	Kinnow orange (hybrid Mandarin)
Karnataka	Coorg, Hassan and Chickmangalur districts	Coorg Mandarin and Kodagu Kittale
Maharashtra	Nagpur, Amraoti and Wardha districts	Nagpur Santra
Orissa	Hilly areas of Koraput, Ganjam, Phulbani and Dhenkanal and Sambalpur	Mandarin
Tamil Nadu	Nilgiri, Palni, Shevroy and Yerkaud falls.	Nagpur Graft, Kodai / Kamala and Coorg
West Bengal	Three hill-sub divisions of Darjeeling district	Khasi orange, Mandarin orange or Darjeeling orange
Punjab	Kinnow orange successfully grown throughout the state.	Kinnow orange (hybrid Mandarin).

In Maharashtra and Tamil Nadu, Nagpur Santra variety is grown, while in West Bengal and north-east states Khasi orange variety is grown. In Karnataka, Coorg variety is popular. In Haryana and Punjab Kinnow orange (hybrid Mandarin) is grown.

2.3.1Characteristics:

The characteristics of important Mandarin varieties are as under

Name of the Variety/ Area	Characteristics
Khasi Orange (Assam and Meghalaya)	Fruits globose to oblate, surface smooth, colour orange-yellow to bright orange, rind thin with very little adherence, segments usually 10, pulp vesicles uniformly orange, texture coarse, juice abundant with well-blended flavour.
Coorg Orange (Karnataka)	Fruits oblate, colour bright yellow and uniform, rind medium thick with little adherence, segments usually between 9 to 11, pulp yellow with fine texture and abundant juice
Kinnow Orange (Punjab and Haryana)	The fruit is medium-size somewhat oblate in shape, rind moderately thick, adherence with the pulp quite strong, thick mesocarp, easily peelable surface, smooth and glossy, fruit colour yellowish orange at full maturity, segments 9 to 10, firm, pulp yellowish orange, very juicy somewhat acidic. The variety is cold resistant.
Darjeeling Orange (West Bengal and Sikkim)	Fruits are comparatively smaller in size somewhat flat in shape, colour yellowish to orange when fully ripe, rind thin, adherence little, juice abundant and sweet flavour.
Nagpur Oranges (Maharashtra, Tamil Nadu Bihar)	Fruits are yellowish green to orange, oblate, rind thin, fine texture and good flavour and taste. Size is medium and the skin is easily peelable.

3.0 POST-HARVEST MANAGEMENT

Post harvest management is the technology of handling of an agricultural produce after harvest to prolong the shelf life, freshness and an attractive appearance. Nearly, 20-25 per cent of fruits are wasted due to faulty Post-harvest management during harvesting, packaging, storage, grading and transportation etc. Proper scientific post-harvest management can minimize these losses. Like post-harvest management, the proper pre-harvest steps such as use of proper harvesting tools and assessment of maturity also improve the shelf life of the fruits and reduce the post-harvest losses to a great extent.

3.1 Pre-harvest factors influencing the post-harvest management:

Once the fruits are harvested, then the overall quality of fresh fruits can hardly be improved. The final market value of the produce depends upon the grower's ability to apply best available pre-harvest technology and subsequent harvesting and then post-harvest technology.

The pre-harvest technology, like use of fertilizers, pest control, growth regulators, climatic conditions like wet and windy weather and tree conditions, influences the fruit potentiality for storage by modifying physiology, chemical composition and morphology of fruits. In pre-harvest treatment, if the spray (10 ppm) of Gibberellic acid is done at colour break stage, it delays colour development, maintain firmness, thereby allows to extend harvesting period. Similarly, the use of potassium fertilizers extends the shelf life of the fruits.

3.2 Maturity – (Harvest maturity and Physiological maturity):

3.2.1 Harvest maturity:

A critical time for producers is the assessment of right maturity, as to when to harvest a crop. Normally, any type of fresh produce is ready for harvest when it has developed all ideal conditions for consumption. This condition is usually referred to a harvest maturity. Harvest maturity of horticultural produce depends mostly on the purpose and distance of market for which they are harvested. The deciding factors of harvest maturity are appearance (colour, size, and shape), texture, glossiness, hardness, pulpiness, smell (aroma or odour), and tastes (sweetness, sourness, bitterness).

3.2.2 Physiological maturity:

In physiological sense, however, maturity refers to attainment of final stage of biological function by a plant part or plant as a whole. Thus the physiological maturity differs from harvest maturity

The maturity of harvested fruits has an important role on shelf life, quality and market price. Hence, certain standards of maturity must be kept in mind while harvesting the fruits. However, the most commonly used measures to access maturity for harvesting the Mandarin is peel colour. Fruits are considered mature, if they have a yellow orange colour on 25% or more of the fruit surface. Fruit quality for harvesting depends upon SS (soluble solids contents, sugar) and acidity of the juice. The juice should have a SS of 8.5% or higher. SS content is determined by squeezing a few drops of juice on a hand-held refractometer.

3.3 Harvesting:

Mandarins are mostly hand plucked, using ladders rested on bamboo support, to prevent the tearing of branches bearing fruits. The quality of the produce is greatly affected by the damages/injuries during the harvesting. Therefore, great care should be taken during harvesting/plucking the fruits.

The plucking of fruits should not be carried out during wet weather or early morning when fruits are turgid and can easily be bruised, leading to decay during subsequent handling. Mandarin fruit tend to "plug" when snapped from the tree, i.e., a piece of the peel from the fruit remains attached to the stalk. It is preferable to use clippers to clip the fruit from the tree to avoid damage. The other cause of deterioration in the fruit quality is harvesting of immature or over mature fruits. Similarly, fruits are spoiled when they are harvested by pulling the fruit, causing rupturing of the peel of loose skin of the fruits. Harvested fruits need careful handling, till they reach the consumers.

3.3.1 Harvesting stage:

Generally, the Mandarins are harvested in 32-36 weeks after the fruit is set. In Coorg district, the fruits are harvested in 36-38 weeks; otherwise there is every possibility of shriveling of fruits and heavy drops. The colour of the rind also indicates the time of harvesting of the fruits. The criteria, depending on colour of rind for assessing the fruit maturity in some of the states are as under.

Place	**Colour of rind**
i) West Bengal	
High altitude	Greenish tinge
Low altitude	Orange yellow
ii) Arunachal Pradesh	Colour changes from green to orange
iii) Haryana	colour changes from green to dark yellow
iv) Meghalaya	colour changes from green to deep orange
v) Punjab	Yellow
vi) Madhya Pradesh	Colour changes from green to orange
vii) Maharashtra	Colour changes from green to orange

3.3.2 Harvesting technique:

Suitable application of harvesting technique is very important to prevent the losses during post-harvest handling. Fruits should be clipped in such a way that the button remains intact with the fruits. Sometimes, longer stalk portion of the clipped fruits left during harvesting, pierces into other fruits and causes injuries in them that paves the way for attack of wound pathogen. Therefore, while clipping the stalk should be cut close to the fruit, so as to preclude it from puncturing the rind of other fruit during harvest and handling.

3.3.3 Precautions during harvesting:

Harvesting is considered to be the most important factor, governing the post-harvest management. Therefore, following precaution should be taken during harvesting.

i) Harvesting should be done by using appropriate instruments like clippers or by carefully twisting and pulling the fruit from the tree.
ii) The harvesting under wet conditions should be avoided, since wet fruits are more susceptible to microbial growth and soil particles may cling to wet crops, exposing them to soil-borne rot organisms.
iii) Harvesting of fruits is best done in the late morning, because in the early morning the oil glands of the fruits are full and cause immediate discolouration.
iv) Care should be taken at the time of plucking the fruit that the button remains attached to the fruit.
v) Stalk left on the fruit should be cut off close to fruit because they can puncture other fruit, causing injury and fruit spoilage.
vi) The tree should never be shaked to harvest the fruits. Do not allow the fruit to fall on the soil, as the impact leads to mechanical injury, that makes fruit more prone to decay.
vii) After harvesting, fruits should never be left in direct sunlight and must be kept in the shade
viii) To avoid contact with the soil, the harvested fruits should be carefully put into padded field crates, well-ventilated plastic containers, or picking bags.
ix) Picking bags made with a quick-opening bottom, should be either strapped around the waist or put over the shoulder of the picker.
x) Picking bags should be so designed to empty from the bottom so that fruits can roll out of the sack onto the bottom of a larger field container or atop fruits already present.

The state-wise season of harvesting and method of harvesting of Mandarin is given in table No. 11

Table No. 11

Season and method of harvesting

Sl. No.	State	Start of season	End of season	Method of harvesting
1	2	3	4	5
1	Assam	October	February	Use of clippers and twisting
2	Haryana	November	March	Hand plucking
3	Karnataka Summer Monsoon	 December June	 February August	 Twisting angularly or using a pair of clippers
4	Madhya Pradesh I II	 January November	 February December	 Hand plucking
5	Maharashtra I II	 October February	 January end Mid May	 Hand plucking
6	Meghalaya	November	February	Hand plucking
7	Mizoram	November	January	Hand plucking
8	Nagaland	November	January	Traditional hand plucking
9	Punjab	November	March	Hand plucking, cutting with scissors
10	Rajasthan	January	April	Hand plucking
11	Tamil Nadu Kodai Hills Main season Off season Shevray Hills Main season Off season Nilgiris Main season Off season	 November 15 July November 15 July November July	 January 15 September January 15 September February September	 Hand plucking
12	Tripura I II	 November December	 January February	 Hand plucking
13	West Bengal	November	January	Hand plucking

Source: DMI survey

It is evident from the table No 10. , that in the states like Karnataka, Madhya Pradesh, Maharashtra, Tamil Nadu and Tripura, the harvesting of Mandarin is undertaken twice a year. In Karnataka, the season of harvesting is December to February (summer crop), and June to August (Monsoon) crop. While in Madhya Pradesh, both the harvesting seasons are of very short duration i.e., November to December (I season) and January to February (II season). In Maharashtra, the first harvesting commences in

October and lasts till the end of January/February (Ambia season), the period of second harvesting is from February to mid May (Mrug Bahar). Similarly, in Tamil Nadu, the main season commences in November and lasts up to January / February, the period of second season namely 'off season' is from July to September. In Tripura the duration of first season is from November to January and second season is from December to February.

In rest of the Mandarin producing states, the harvesting of fruits is done only once in a year, as in Assam (October to February), Haryana and Punjab (November to march), Meghalaya (November to February), Mizoram (November to January), Nagaland and West Bengal (November to January) and Rajasthan (January to April).

Regarding method of harvesting, the traditional method i.e., hand plucking method is generally used in all the Mandarin growing states. In this traditional method, the fruits are twisted angularly and plucked. In the states like Assam and Karnataka, the clippers are also used for plucking of the fruits.

3.4 Post Harvest operations:

The adoption of best post-harvest management technique can extend shelf-life and quality of the fruits. Curing and washing, degreening, grading, packaging, storage, transportation and marketing etc., are the main post harvest operations.

3.4.1 Curing and washing:

During the curing, field heat of the fruit is brought down, this helps in stabilizing the metabolic process. The fruits are spread on the floor in orchard's yard, having the cushion of paddy straw for nearly 24 hrs and then washed to remove the dirt. By washing the original colour and luster of the fruits is also recovered.

The application of food grade wax, kaolin or similar coating, can also be used to enhance the appearance and minimize water loss. To prevent the fungal growth, proper fungicide in prescribed quantity is used while giving wax treatment.

The post packing treatment like fumigation and gamma-ray irradiation are generally practiced for high priced fruits.

3.4.2 Degreening:

Degreening constitutes conversion of chlorophyll of the peel without influencing the internal quality of the fruit.

In de-greening, the yellow-orange fruits with green spots could be de-greened in 48 hours at 26-28 ^{0}C and 90-95 RH at nearly 5 ppm ethylene concentration.

3.4.3 Grading:

Grading is one of the most important procedures to be followed in post harvest handling, as it determines the quality, shelf life and price of the fruit. During grading, the produce is sorted according to the fixed grade standard, taking into consideration various quality factors to make a homogenous lot.

Post-harvest grading of Mandarin is rarely practiced at the producer's level. At the most, the fruits are sorted out, based on physical characteristics like weight, size, colour, shape and degree of damage on fruits. This type of grading is done by hand in small operations.

In pack houses handling large volume of the produce, semi- automatic grading machines are also used, wherein the fruits are passed down on a slow moving conveyor. This semi automatically grading is very efficient with respect to time, space and quantity. The N.R.C.C., Nagpur has developed a machine for mechanical sorting, washing, waxing and sizing operations.

Some times, hand-held rings called “Fruit Sizer” of different diameters are used to check the different size categories and help in packing of same size fruits in the one container.

It is a common experience, the traders generally place best quality fruits at the top of containers, but this practice neither helps the growers nor traders. Therefore, the grading of fruits as per accepted quality standards helps farmers, marketing functionaries, processors, traders and consumers in efficient marketing.

The state-wise grading parameters used for grading of Mandarin and per centage share graded by different agencies are given in table No 12.

Table No 12.

Grading Parameters used for grading of Mandarins

Sl. No.	State	Agency	Parameters used for grading	Quantity graded (%)
1	Assam	All functionaries	Size and colour	N.A.
2	Haryana	All functionaries	Size and colour	Nil
3	Karnataka	Producers	Size and colour	15
		Wholesalers	Size and colour	30
		Commission agents	Size and colour	46
		Cooperatives, Processors	Size and colour	1
		Retailers	Size and colour	22
4	Madhya Pradesh	All functionaries	Size and colour	N.A.
5	Maharashtra	Producers	Size and colour	-
		Wholesalers	Size and colour	80-85
		Commission agents	Size and colour	80
		Exporters	Size and colour	100

6	Meghalaya	Retailers	Size and colour	N.A.
7	Mizoram	Producers	Size and colour	N.A.
8	Nagaland	Producers	Size and colour	20
		Wholesalers	Size and colour	50
		Retailers	Size and colour	30
9	Punjab	Wholesalers	N.A.	60-65
		Cooperatives		4-5
		Processor		N.A.
		Exporters		100
		Others	No	Nil
10	Rajasthan	Producers	Size and colour	10
		Wholesalers	Size and colour	40
		Commission agents	Size and colour	60
		Cooperatives	Size and colour	40
		Retailers	Size and colour	25
11	Tamil Nadu	Producers	Shape, Size and colour	100
		Commission agents	Shape, Size and colour	0
		Wholesalers	Shape, Size and colour	100
		Retailers	Shape,Size and colour	100
12	Tripura	Retailers	Size and colour	25
13	West Bengal	Producers	Shape,Size and colour	100

Source: DMI survey

From the above table No. 12, it is observed that practice of grading, based on scientific grade standards is not being followed by any of the agency engaged in marketing of Mandarins, in the country. At the best, the growers do sorting out to remove immature, rotten or diseased fruits from the bulk and grade according to colour, shape and size.

It is common practice in almost all the Mandarin producing states that the producers sell the orchards to the preharvest contractors before commencement of the harvesting season. These merchants harvest the fruits and carry them to different

markets without undertaking any grading, for sale. In the markets, the grading is generally done on the basis of colour, shape and size.

3.4.3.1 Advantages of Grading and standardization:

i) Grading is beneficial to the farmers, traders as well as to the consumers, as it provides common standard to all.

ii) Grading of the produce before sale enables farmers to get better price for their produce.

iii) Grading assists the producers and other intermediaries in preparing fresh produce for market with appropriate labeling.

iv) Grading helps the consumers to get standard quality produce at fair price.

v) It facilitates the consumer to compare the prices of different qualities of a produce in the market.

vi) It assures the quality of the produce and also reduces the cost of the marketing and transportation.

vii) Produce of similar grade can be stored in bulk.

viii) Market values are better understood.

ix) Commodities can be bought and sold without inspection, through e-trading.

x) Grading provides an authentic and scientific basis in promoting and managing the marketing system.

xi) It serves as a realistic and common basis for market intelligence and reporting.

xii) It facilitates the settlement of quality disputes between buyers and sellers.

3.4.3.2 Grading at producers' level:

Though there is no grading of Mandarin at producers level, but there is an increasing recognition to the fact that producers need to be assisted in grading their produce before sale so that they may get better price. For securing adequate returns to the producer/seller, the scheme of "Grading at Producers' Level" was introduced in 1962-63 by Directorate of Marketing and Inspection. The main objective of this scheme is to subject the produce to simple test and assign a grade before it is offered for sale. After grading, the producers get prices commensurate with the quality of the produce. The programme is being implemented by the States/Union Territories. At present, some fruits are graded at producer's level, mainly in the regulated markets of Andhra Pradesh, Gujarat, Maharashtra, Tamil Nadu, Uttar Pradesh and West Bengal etc. Up to 31-03-2006, 2051 grading units have been set up in the country.

The total number of producers' level grading units, as on 31-03-07 are 2143.

3.4.3.3 Benefits of Grading at producers' level:

1. Grading of the produce at producers' level enable farmers to get higher price for their produce as well as it helps the consumers to get standard quality produce at fair price.

2. Grading not only facilitates the dissemination of prices and market information but also assist the machinery of distribution at all stages.

3. Grading at producers level helps them to develop suitable marketing strategy.

3.4.4 STANDARDS FOR GRADING OF MANDARINS:

3.4.4.1 CODEX STANDARD FOR CANNED MANDARIN ORANGES 1

CODEX STAN 68-1981

1. **DESCRIPTION**

1.1 **Product Definition**

Canned Mandarin oranges is the product:

(a) prepared from sound, mature Mandarin oranges conforming to the characteristics of *Citrus reticulata* Blanco (including all the suitable commercial varieties for canning);

(b) packed with water or other suitable liquid packing medium; and

(c) processed by heat in an appropriate manner before or after being sealed in a container so as to prevent spoilage. Before processing, the fruit shall have been properly washed and peeled and the membrane, fibre strands originating from albedo or core, and seeds (if any) shall have been substantially removed from the segments.

1.2 **Style or Form**

Canned Mandarin oranges may be packed as:

(a) Whole Segment Style - consists of fruit segments which are practically intact and also retain their original form but may be split just slightly.

(b) Broken Segment Style - consists of portions of segments which retain at least one half of the original apparent size, or which are large enough to remain on a screen having 12 mm square openings, formed by a wire of 2 mm diameter.

(c) Pieces Style - consists of portions of segments that are large enough to remain on a screen having 8 mm square openings formed by a wire of 2 mm diameter.

1.3 **Other Styles**

Any other presentation of the product shall be permitted provided that the product:

(a) is sufficiently distinctive from other forms of presentation laid down in this standard;

(b) meets all relevant requirements of this standard including requirements relating to limitations on defects, drained weight, and any other requirements in this standard which are applicable to that style in the

standard which most closely resembles the style or styles intended to be provided for under this provision;

(c) is adequately described on the label to avoid confusing or misleading the consumer.1 Formerly CAC/RS 68-1974.

1.4 **Sizes in Whole Segment Style**

1.4.1 **Designation in accordance with size**

Canned Mandarin oranges in whole segment style may be designated according to size in the following manner:

Uniform single size

"Large" - 20 or less whole segments per 100 grammes of drained fruit
"Medium" - 21 to 35 whole segments per 100 grammes of drained fruit
"Small"- 36 or more whole segments per 100 grammes of drained fruit
Single sizes shall also meet the uniformity requirements of paragraph 2.2.5.

Mixed sizes

A mixture of two or more single sizes.

1.4.2 Compliance with single size designation

1.4.2.1 When the product is declared, presented or offered as conforming to the uniform size designation in paragraph 1.3.1 - other than "Mixed sizes" - the sample unit shall conform to the size classification specified for each single size. In the determination of compliance with size classifications, broken segments are disregarded.

1.4.2.2 Any sample unit or container that does not meet the count and uniformity requirements of the foregoing paragraph 1.3.2.1 shall be considered a "defective" for size classification.

1.4.2.3 A lot will be considered as meeting the criteria for a uniform size designation when the number of "defectives" as defined in paragraph 1.3.2.2 does not exceed the acceptance number (c) of the appropriate sampling plan in the Joint FAO/WHO Codex Alimentarius Sampling Plans for Prepackaged Foods (1969) (AQL-6.5) (CAC/RM 42-1969) (see Codex Alimentarius Volume 13).

2. **ESSENTIAL COMPOSITION AND QUALITY FACTORS**

2.1 **Basic Ingredients**

Mandarin oranges and packing media appropriate to the product as follows:

2.1.1 **Packing Media** 1

(a) ***Water*** - in which water is the sole packing medium;
(b) ***Citrus juice*** - in which Mandarin orange juice, or any other citrus juice, is the sole packing medium;

(c) ***Mixed citrus juices*** - in which two or more citrus juices, which may include 1 See Appendix to Part I. Mandarin orange juice are combined to form the packing medium;

(d) ***Water and citrus juice(s)*** - in which water and Mandarin orange juice, or water and any other citrus juice (singly or in combination) are combined to form the packing medium:

(e) ***With sugar(s)*** - any of the foregoing packing media (a) through (d) may have one or more of the following sugars added: sucrose, invert sugar syrup, dextrose, fructose, fructose syrup, dried glucose syrup, glucose syrup, invert sugar.

2.1.2 **Classification of packing media when sugars are added**

2.1.2.1 When sugars are added to Mandarin orange juice or other citrus juices, the liquid media shall be not less than 14^0 Brix and shall be classified on the basis of the cut-out strength as follows:

Lightly sweetened (name of fruit) juice - not less than 14^0 Brix
Heavily sweetened (name of fruit) juice - not less than 18^0 Brix

2.1.2.2 When sugars are added to water or water and Mandarin orange juice or water and other citrus juices the liquid media shall be classified on the basis of the cut-out strength as follows:

(a) Basic syrup strengths

Light syrup - not less than 14^0 Brix
Heavy syrup - not less than 18^0 Brix

(b) Optional packing media
When not prohibited in the country of sale, the following packing media may be used:
Slightly sweetened water)
Water slightly sweetened) not less than 10^0 Brix but less than 14^0 Brix
Extra light syrup)
Extra heavy syrup more than 22^0 Brix

2.1.3 The cut-out strength of sweetened juice or syrup shall be determined on sample average, but no container may have a Brix value lower than that of the minimum of the next category below, if such there be.

2.2 **Quality Criteria**

2.2.1 **Colour**

The colour of the segments shall be a rich yellow to orange, typical colour of properly prepared and properly processed fruit, free from any brown tinge and the liquid packing medium shall be reasonably clear except when it contains juice.

2.2.2 **Flavour**

Canned Mandarin oranges shall have a normal flavour and odour free from flavours and odours foreign to the product.

2.2.3 **Texture**

The texture shall be reasonably firm and characteristic for the canned product and reasonably free from dry cells or fibrous portions affecting the appearance or edibility of the product.

2.2.4 **Defects and allowances**

Canned Mandarin oranges shall be substantially free from defects within the limits set forth as follows:

Defect Maximum Limit in the Drained Fruit

(a) Broken segments and pieces (as defined in 1.2) (Whole segment style) 7% m/m
(b) Pieces (as defined in 1.2 (Broken segment style) 15% m/m
(c) Membrane (Aggregate area) 7 cm2/100 g (based on sample average)
(d) Fibre strands (Aggregate length) 5 cm/100 g (based on sample average)
(e) Seeds (that measure more than 4.0 mm in any diameter) 1/100 g (based on sample average)

2.2.5 **Uniformity of size (Whole segment style - single sizes)**

In the 95 per cent, by count, of units (excluding broken segments) that are most uniform in size, the weight of the largest unit shall be no more than twice the weight of the smallest unit.

2.2.6 **Classification of "defectives"**

A container that fails to meet one or more of the applicable quality requirements, as set out in paragraphs 2.2.1 through 2.2.5 (except those based on sample average), shall be considered a "defective".

2.2.7 **Acceptance**

A lot will be considered as meeting the applicable quality requirements of paragraph 2.2 when:

(a) the number of "defectives" as defined in paragraph 2.2.6 does not exceed the acceptance number (c) of the appropriate sampling plan in the Joint FAO/WHO Codex Alimentarius Sampling Plans for Prepackaged Foods (1969) (AQL-6.5) (CAC/RM 42-1969 (see Codex Alimentarius Volume 13); and
(b) the requirements of paragraph 2.2.5, which are based on sample average, are complied with.

3. FOOD ADDITIVES

Maximum level

3.1 **Acidifying agent** Citric acid Limited by GMP
3.2 **Anti-clouding agent** Methyl cellulose 10 mg/kg

4 CONTAMINANTS

Lead (Pb) 1 mg/kg
Tin (Sn) 250 mg/kg calculated as Sn

5. HYGIENE

5.1 It is recommended that the product covered by the provisions of this standard be prepared and handled in accordance with the appropriate sections of the Recommended International Code of Practice - General Principles of Food Hygiene (CAC/RCP 1-1969, Rev. 2 (1985) Codex Alimentarius Volume 1), and other Codes of Practice recommended by the Codex Alimentarius Commission which are relevant to this product.

5.2 To the extent possible in Good Manufacturing Practice, the product shall be free from objectionable matter.

5.3 When tested by appropriate methods of sampling and examination, the product:

- shall be free from microorganisms in amounts which may represent a hazard to health;
- shall be free from parasites which may represent a hazard to health; and
- shall not contain any substance originating from microorganisms in amounts which may represent a hazard to health.

6. WEIGHTS AND MEASURES

6.1 Fill of container

6.1.1 Minimum Fill

The container shall be well filled with fruit and the product (including packing medium) shall occupy not less than 90% of the water capacity of the container. The water capacity of the container is the volume of distilled water at 20oC which the sealed container will hold when completely filled.

6.1.2 Classification of "Defectives"

A container that fails to meet the requirement for minimum fill (90 per cent container capacity) of paragraph 6.1.1 shall be considered a "defective".

6.1.3 Acceptance

A lot will be considered as meeting the requirement of paragraph 6.1.1 when the number of "defectives", as defined in paragraph 6.1.2, does not exceed the acceptance number (c) of the appropriate sampling plan in the Joint FAO/WHO Codex Alimentarius Sampling Plans for Prepackaged Foods (1969) (AQL-6.5) (CAC/RM 42-1969) (see Codex Alimentarius Volume 13).

6.1.4 Minimum drained weight

6.1.4.1 The drained weight of the product shall be not less than the following per centages, calculated on the basis of the weight of distilled water at 20oC which the sealed container will hold when completely filled. Whole segment style 55% Broken segment and Pieces styles 58%

6.1.4.2 The requirements for minimum drained weight shall be deemed to be complied with when the average drained weight of all containers examined is not less than the minimum required, provided that there is no unreasonable shortage in individual containers.

7. **LABELLING**

In addition to the requirements of the General Standard for the Labelling of Prepackaged Foods (CODEX STAN 1985 (Rev. 1-1991) Codex Alimentarius Volume 1) the following specific provisions apply:

7.1 **The Name of the Food**

7.1.1 The name of the product shall be "Mandarin Oranges".

7.1.2 (a) The style, as appropriate, shall be declared as a part of the name or in close proximity to the name: "Whole segments" "Broken segments" "Pieces"

(b) In the case of mixed sizes, such size designation shall be declared in close proximity to the style designation, e.g. "mixed sized whole segments".

7.1.3 **Other styles**: If the product is produced in accordance with the other styles provision (subsection 1.3), the label shall contain in close proximity to the name of the product such additional words or phrases that will avoid misleading or confusing the consumer.

7.1.4 The packing medium shall be declared as part of the name or in close proximity to the name.

7.1.4.1 When the packing medium is composed of water or water and one or more citrus juices in which water predominates, it shall be declared as: "In water" or "Packed in water".

7.1.4.2 When the packing medium is composed solely of Mandarin orange juice, or any other single citrus juice, it shall be declared as: "In Mandarin orange juice" or "In (name of citrus) juice".

7.1.4.3 When the packing medium is composed of two or more citrus juices, which may include Mandarin orange juice, it shall be declared as: "In (name of citrus) juice" or "In citrus juices" or "In mixed citrus juices"

7.1.4.4 When sugars are added to Mandarin orange juice or other citrus juices, the packing medium shall be declared as:

"Lightly sweetened (name of citrus) juice" or
"Heavily sweetened (name of citrus) juice(s)" or
"Lightly sweetened citrus juices" or
"Heavily sweetened mixed citrus juice(s)",
as may be appropriate.

7.1.4.5 When sugars are added to water, or water and a single citrus juice (including Mandarin orange juice) or water and two or more fruit juices, the packing medium shall be declared as:

"Light syrup" or "Heavy syrup" or
"Water slightly sweetened" or "slightly sweetened water" or
"Extra light syrup" or "Extra heavy syrup", as may be appropriate.

7.1.4.6 When the packing medium contains water and Mandarin orange juice or water and one or more citrus juice(s), in which the fruit juice comprises 50%

or more by volume of the packing medium, it shall be designated to indicate the preponderance of such fruit juice, as, for example:

"Mandarin orange juice and water" or
"(name of citrus) juice(s) and water".

7.2 **List of ingredients**

7.2.1 A complete list of ingredients shall be declared on the label in descending order of proportion in accordance with the General Standard for the Labelling of Prepackaged Foods CODEX STAN 1-1985 (Rev. 1-1991) Codex limentarius Volume 1), except that water need not be declared.

7.2.2 In the case of fruit juices made from concentrate, the fact of reconstitution shall be declared in the list of ingredients as follows "(name of fruit) juice made from concentrate" or "reconstituted (name of fruit) juice" or "(name of fruit) juice made from concentrated (name of fruit) juice".

7.3 **Optional Declarations**

7.3.1 **Size classification of whole style**

A size classification for Whole Segment style may be stated on the label if the pack complies with the appropriate requirements of paragraph 1.3.1 of this standard.

7.3.2 **Size classification of whole style in uniform sizes**

If the pack complies with the appropriate requirements of paragraph 1.3, a size classification for Whole Segment style in uniform sizes may be stated on the label as:

(a) "Large", "Medium", or "Small" as appropriate; and/or
(b) the number of units present in the container shown by a range of count, e.g. (number) to (number) whole segments".

3.4.4.2 AGMARK Standards:

The AGMARK standards for grading of Mandarins are under preparation.

3.4.5 Packaging:

The packaging of fruits is required for efficient handling and marketing, better eye appeal and better shelf life by reducing mechanical damage and water loss. The proper packaging protects the fruits from pilferage, dirt, physiological and pathological deterioration during further handling. Efficient packaging of horticultural produce in uniform size reduces the need for repeated weighing and can facilitate handling, stacking, loading, unloading, better storage, long transportation, transshipment and marketing.

The use of traditional baskets, sacks, boxes and trays to carry the produce to the market is very much common, as a packaging material. These are locally fabricated, low cost and made out of cane and bamboo, dried grass, palm leaves and teak leaves. Though, they serve the purpose of carrying fresh produce to short distances, they can not be used for long distance transportation. Large quantities of produce need better

packaging to minimize the losses and achieve the most economical use of conveyance. During the packing, the immature, overripe, damaged and diseased fruits should be sorted out, only sound fruits should be packed.

While selecting and opting out for specific packaging material for a particular produce, precaution should be taken to prevent transit hazards caused by the packaging material. Nature of such damages is cut or punctures, shock/impact, compression, vibration, heat damage, chilling or freezing damage and chemical contamination.

The different types of packaging material that can be used for packing fresh horticultural produce comprises of

i) Natural materials (traditional containers made of cane and bamboo, straw, and palm leaves etc.),
ii) Wooden boxes,
iii) Corrugated fiber board boxes,
iv) Molded plastics sacks or bags made out of natural or synthetic fibers (e.g. jute, sisal, polypropylene polyethylene) and
v) Paper or plastic films.

Recyclable boxes molded from Higher Density Polythene (HDP) are widely used for transporting of produce. These can be specially designed and fabricated to meet the specific requirements of transport. They are strong, rigid, smooth, easily cleaned and stacked to conserve space. Paper of plastic films is often used for lining of packing boxes in order to reduce transportation loss and prevent friction damage. Plastic-film bags or wraps are widely used in marketing of fruit, especially in consumer size packs. Packaging operations may be done manually or mechanically using various methods viz; loose-fill jumble packing, multilayer pattern pack with size grading, multilayer size graded pack using separator trays and single layer pack for high value produce.

3.4.5.1 Type of packaging:

There are two types of packaging i.e. i) Conventional packages and ii) Modern packages.

In conventional packages, wooden boxes, bamboo boxes and jute gunny bags are used.

In modern packaging card board boxes, plastic crates, poly bags, wire bags, C.A.P. (Controlled Atmospheric Packaging) is generally used. C.A.P. allows certain gaseous components from atmosphere to replace the ones released by the produce or checks the gaseous exchange around fruit pack and thus enhances the shelf life.

It is seen that for the local markets, the Mandarins are packed in sacks, bags, bamboo baskets and wooden boxes. Some times, the Mandarins are also packed in telescopic cardboard boxes. The corrugated boxes, which are cost effective due to its reusability, are also being used as packaging material while transporting the fruits.

For export of Nagpur Mandarins usually 2 pieces, telescopic, corrugated fiberboard boxes of three ply or five ply are used. The size of the box may vary according to the requirement of the importing country. Normally a box size of 49.5 x

29.5 x 17.5 cm having 10 kg capacity is recommended. The boxes must have 5% area punched as holes for ventilation. To immobilize the movement of fruits inside the box, three ply wax treated dividers having ventilation holes are used.

During the survey it is found that there are no standard parameters of any pack and may differ from place to place. Usually, the fruits are placed in layers one above the other, with a straw padding in-between.

The state-wise packaging material used, mode of packaging and their capacity, are furnished in table No 13.

Table No 13

Mode of packaging of Mandarins

Sl. No	State	Agency	Mode of packaging	
			Type	Capacity (kg.)
1	2	3	4	5
1	Assam	All functionaries	No packing	Loose
2	Haryana	Producers	No packing	Loose
		Wholesalers	Plastic crates	18-20
		Commission agents	Corrugated boxes	8-10
		Cooperatives		
		Processor	No packing	Loose
		Exporters	Wooden boxes	8-10
		Retailers	No packing	Loose
3	Karnataka	Producers	No packing	Loose
		Commission agents	Corrugated fiber board	24 fruits per pack
		Cooperatives		
4	Madhya Pradesh	Wholesalers	Basket	20-25 Kg.
		Commission agents	Basket	20-25 Kg.
		Cooperatives	Box	10-15 Kg.
		Producers	No packing	Loose

5	Maharashtra	Wholesalers	Wooden box and Plastic crates	20-25 Kg.
		Exporters	Carton box	10-15 Kg
		Retailers	Loose	Loose
6	Meghalaya	Producers	Bamboo baskets	30 Kg
		Wholesalers	Bamboo baskets	30 Kg
		Retailers	Bamboo baskets	8 Kg
7	Mizoram	Producers	Gunny bags	30 Kg
		Wholesalers	Gunny bags	50 Kg
8	Nagaland	All functionaries	No packing	Loose
9	Punjab	Producers	No packing	Loose
		Wholesalers	Plastic crates	18-20
		Commission agents	Corrugated boxes	8-10
		Cooperatives	Wooden boxes	25-27
		Processor	Plastic crates	10-15
		Exporters	Corrugated boxes	8-10
		Retailers	Jute bags	8-10
10	Rajasthan	Producers	Crates	20-22 Kg.
		Wholesalers	Wooden box	20-22 Kg.
		Commission agents	Wooden box	20-22 Kg.
		Cooperatives	Wooden box	20-22 Kg.
		Retailers	Loose	Loose
11	Tamil Nadu	Producers	Carton boxes, Bamboo baskets, Plastic crates boxes	5-10 Kg. 5-15 Kg. 20 Kg.
		Commission agents	Plastic crates/ boxes	10-20 Kg.
		Wholesalers	Plastic crates/ boxes Cartons, Loose	10-20 Kg. 10-15 Kg.
		Retailers	Plastic crates/ boxes, Bamboo baskets	10-20 Kg. 10-15 Kg.

12	Tripura	Producers	Bamboo baskets	100 Nos.
		Wholesalers	Bamboo baskets	100 Nos.
13	West Bengal	Producers	Bamboo baskets, Gunny bags, Polythene bags	15-20 Kg.
		Wholesalers	Wooden boxes	100-110 Nos.
		Commission Agents	Wooden boxes	100-110 Nos.

Source: DMI survey

The producers generally sell the orchards to pre-harvest contractors. The producers, who do not sell the produce to pre-harvest contractors, transport Mandarins in loose to the nearby markets. The packaging material like Bamboo baskets, Gunny bags, Polywoven bags Plastic crates, Cartons and Corrugated fiber board boxes etc and sometimes wooden boxes are used in carrying the produce to the markets by the wholesalers and commission agents.

3.4.5.2 Parameters of packaging material:

The size, type and capacity of the packaging material depend mostly upon the locally available raw material, distance of the markets and type of transport to be used. Generally, the packing material of different size made of bamboo boxes, corrugated fiber boxes, telescopic boxes, wooden boxes and plastic crates are used for packing of Mandarins.

The information regarding capacity of the packages, approximate weight per package used, number of layers and count of Mandarins kept in the packages, material used as packaging cushion etc, are given in table No 14.

Table No 14.

Parameters of Packaging material

Sl. No	State	Market	Type of packaging	Capacity of packaging			Shape	Packaging meant for
				Weight (Kg.)	Count (No.)	No. of layers		
1	2	3	4	5	6	7	8	9
1	Assam	-	No packaging is done.	N.A.	N.A.	N.A.	N.A.	N.A.
			Corrugated boxes	8-10	45-105	3-4	Rectangular	Interstate and export. Local

2	Haryana	All markets	Wooden boxes	25-27	150-350	3-4	Rectangular	sale is done in loose.
			Plastic crates	12-18	3-4	3-4	Rectangular	
3	Karnataka	Madikere	Corrugated Fiber Board	2.50	24	2	Rectangular	Local
		Hassan	Bamboo Baskets	50	250-300	4	Conical	Local
		Chikman -galur	Bamboo Baskets	50	250	3	Conical	Local
4	Madhya Pradesh	All markets	Corrugated Fiber Board	1	7-8	2	Rectangular	Local/ Interstate
			Wooden Boxes	10	90-100	10	Rectangular	Local/ Interstate
			Plastic Crates	20	120-150	5-6	Rectangular	Local/ Interstate
			Carton Boxes	10-15	50-60	5-6	Rectangular	Local/ Interstate
5	Maharashtra	Achalpur	Wooden boxes	21-24	150 -250	4	Rectangular	Interstate / long distance
		Chandur Bazar	Wooden boxes Plastic crates	20-28 20	100-210 120 - 165	5-6 3 - 4	Rectangular Rectangular	and export Local and small distances
		Warud	Wooden boxes	20 - 25	150 - 225	4 - 5	Rectangular	Interstate / long distance
		Narkhed, Katol	Plastic crates, Wooden boxes	20 - 25	150 - 225	4 - 5	Rectangular	Interstate / long distance
		Nagpur	Carton boxes	10 - 15	45 - 50	4 - 5	Rectangular	Interstate and export
6	Meghalaya	All markets	Bamboo baskets	30	200	N.A.	Conical	Local

7	Mizoram	All markets	Bamboo baskets	30 50	200 350	N.A.	Conical	Both local and interstate
			Gunny bags	50	350	N.A.	Round	Both local and interstate
8	Nagaland	All markets	No packaing	-	-	-	Loose	-
9	Punjab	All markets	Corrugated boxes	8-12	45-108	3-4	Rectangular	For interstate and export
			Wooden boxes	20-25	100-300	4-6		
			Plastic crates	18-20	90-250	4-5		For local market
			Plastic envelops	10-15	50-140	5-6	Round	
			Jute bags	8-10	50-100	5-6		
10	Rajasthan	Bhiwani Mandi	Wooden Boxes	20 - 22	140 - 205	5	Rectangular	Interstate
			Plastic Crates	20 - 22	140 - 205	5	Rectangular	Local
11	Tamil Nadu	Madurai, Dindigul, Palani, Oddanch-atram, Kodai Road, Mettupal ayam	Wooden Boxes Bamboo Baskets Plastic Crates Carton Boxes Loose	14 5 - 30 10- 20 5 – 20 2 – 3 tons	N.A.	N.A.	Rectangular Oval Rectangular Rectangular -	Interstate Local Local / interstate Local / interstate
12	Tripura	All markets	Bamboo boxes	26-28	100	N.A.	Conical	Both local and interstate
13	West Bengal	Kalimpong	Wooden box	5-10	100-110	4-5	Rectangular	Interstate

Source: DMI survey

3.4.5.3Qualities of packaging material:

Since, a package as a container offers accommodation to the contents for storage and transportation, therefore the packages must have the following basic qualities.

i) It must protect quality and quantity.

ii) It must prevent spoilage during transit and storage.

iii) Labeling of package must indicate about quality, variety, date of packing, traceability, weight and price etc.

iv) It must be convenient in handling operations.

v) It must be convenient to stack.

vi) It must be cheap, clean, hygienic and attractive.

vii) It must be biodegradable

viii) It must be free from adverse chemicals.

ix) It should be reusable.

x) It should immobilize the fruits placed inside.

xi) Quality and hygienic cushioning material must be used to protect fruits from impact, injury and compression.

xii) It should offer good ambient conditions to the fruits congenial for storage and transportation.

xiii) It should meet optimum requirements of ventilation vis-à-vis temperature and relative humidity management.

3.4.5.4 Packaging material suggested by Market Planning and Design Center:

Market Planning & Design Centre of Directorate and Inspection has suggested the corrugated paper boxes for the packaging of Mandarins. It has the following advantages.

1) These packages can be arranged in the truck with minimal residual space.

2) The unit capacity is comfortable, compared with conventional wooden box.

3) The counts of each package can very well be presented in terms of unit dozen or multiple thereof, which will facilitate price negotiations and auction. .

4) The weight of each package in terms of gross weight and net weight will be less than that of the conventional wooden box and hence the package is likely to be safe from various surges in the transit.

5) The handling cost at loading point will be comparable with the conventional wooden boxes.

6) The unit cost of transportation will be reduced, because of more space generated for the cargo in the load.

3.4.5.5Precautions to be taken before packaging:

i) Mandarins should be plucked at appropriate maturity, keeping in view the time span of the market.

ii) Mandarins should be sorted and graded as per accepted quality standards, before packing. Only sound fruits should be packed.

iii) Before packing, post-harvest treatment with wax and fungicides should be resorted to as a prophylactic measure against pathogenic invasion in transit.

iv) For prevention of bruising/abrasion injuries, paper liners, pads, trays or tissue wraps may be used. As an alternative, cushioning with easily available paddy straw keeps the packing cost minimum. It will maintain a level of R.H. because of moisture absorbing tendency of the paddy straw and keep the temperature down.

v) Careful placement of Mandarins in the cartons is necessary to avoid bruising. The use of telescopic boxes can overcome this problem very well.

vi) For securing packages, use of adhesive tape (3 to 4 cm) may be used. The packages can also be secured with thin rope of coconut fiber, or polythene sutli, as an alternative.

3.4.5.6 Precautions during packing:

During packing, fruits should never be packed loosely in order to avoid shaking of fruits which leads to friction among fruits surface and thereby causing damage. In wooden boxes or cartons, filling should be done with little pressure so that during transit period when the volume of the fruits gets reduce due to dehydration and adjustment of space due to jerks in transit, the pack structure does not get loose.

It is also observed that during the packaging, sharp edges of the packing material damage the fruits. Therefore, care should be taken so that they do not come out of the containers, resulting in bruising, puncturing and damaging the fruits.

Similarly, there should not be too much ventilation which can affect the quality of fruits due to shrinkage, loss in weight, colour, etc.

3.4.5.7 Shrink-wrapping:

This is a relatively new technique in which heat shrinkable poly film is used to wrap the individual fruit and over wrapping of trays. Polyethylene is the best for using it as wrapping, as it is least expensive and extend the shelf life by three weeks.

3.4.6 Storage:

The production of the fruit is seasonal, but its demand remains for a longer period. Therefore, storage is very essential for extending the consumption period of fruits, as well as for regulating their supply to the markets. The principal aim of storage is to ensure better returns to the growers.

The storage of Mandarins, at different markets, is given in table No.15

Table No 15.

Storage of mandarins

Sl. No	State	Agency	Type of storage (ambient/cold storage)	Period of storage	Method of storage
1	Assam	Producers/All functionaries	Simple storage	N.A.	Loose
2	Haryana	Producers	Not in practice	-	-
		Wholesalers / Commission agents	Cold storage	30-60 days	In plastic crates
3	Karnataka	Producers/All functionaries	Simple storage	5-10 days	Corrugated boxes, Bamboo boxes, Loose
4	Madhya Pradesh	Producers/All functionaries	Simple storage	N.A.	Corrugated boxes, Bamboo boxes, Loose
5	Maharashtra	Producers/All functionaries	Simple storage	2-3	Wooden boxes, Plastic crates, Loose
		Processors	Cold storage	3-5	In boxes
6	Meghalaya	Producers	Simple storage	2-3 days	Gunny bags, bamboo baskets
		Wholesalers	Simple storage	2-3 days	
		Retailers	Simple storage	5-8 days	
7	Mizoram	Producers	Simple storage	2-3 days	Bamboo baskets
		Wholesalers	Simple storage	2-3 days	Gunny bags, bamboo baskets

		Retailers	Simple storage	4-7 days	Loose
8	Nagaland	Producers/All functionaries	Simple storage	2-3 days	Loose
9	Punjab	Wholesalers / Commission agents, Retailers	Cold storage	30-45 days 3-5 days	Plastic crates
10	Rajasthan	Producers/All functionaries	Simple storage	N.A.	Loose
11	Tamil Nadu	Wholesalers/	Cold Storage	4 -5- months	5,10 & 15 Kg.
12	Tripura	Retailers	Simple storage	5-20 days	Loose
13	West Bengal	All functionaries	No storage	N.A.	N.A.

Source: DMI survey

From the table No 15, it is revealed that the Mandarins are also kept in cold storage in states like Haryana, Maharashtra, Punjab and Tamil Nadu. In other states, the Mandarins are kept in ambient storage. In Haryana and Punjab, plastic crates are used for storing the Mandarins. In Maharashtra and Tamil Nadu, wooden boxes and plastic crates are in use for storing of the fruits. In North Eastern states, bamboo baskets, gunny bags are used for storing the fruits.

3.4.6.1 Requirements for safe storage:

The following are the requirements for safe storage of Mandarins:

1) Selection of site (location):

i) The storage structure should be located on a raised well-drained place.

ii) It should be easily accessible.

iii) The structure should be protected from excessive humidity, excessive heat, direct sunrays, and pests.

iv) It should be constructed on a well-built platform at a height of not less than 1 foot from ground level to prevent dampness.

2) Cleaning of storage structures:

i) The storage structures should be properly cleaned before storing fruits.

ii) There should be no left over, cracks, holes and crevices in structure, which may harbour insects.

iii) Before storage, the storage structure should be cleaned and fumigated.

3) Cleaning and Drying of fruits:

i) Before storage, the Mandarins should be properly cleaned and dried.

ii) The damaged fruits should be discarded to avoid quality deterioration and pest attack.

4) Separate storage of new and old stock:

To check infestation and to maintain hygienic condition of godown, the new and old stock should be stored separately.

5) Cleaning of vehicles:

The vehicles used for transporting the fruits should be properly cleaned with pesticides.

7) Proper aeration:

There should be proper ventilation and circulation of air to avoid accumulation of gases such as CO_2, Ethylene etc.

8) Regular inspection:

Regular inspection of stored fruits should be carried out to check infestation. It is necessary to maintain proper health and hygiene of the stock.

3.4.6.2 Post-harvest chemical changes during storage:

During the storage at ambient temperature (24-28^{o}C, RH 68%), vitamin C content in monsoon Coorg Mandarin decreases from an initial value of 41 mg/100ml. to 36 mg/100ml. of juice by 22nd day of storage. The firmness of the fruit is also reduced due to degradation of insoluble protopectin to the more soluble pectic acid and pectin. The acidity is increased from the initial value of 0.76% to a final value of 0.86%, reducing sugars from 4.226% to 5.028%, total sugars from 7.36% to 9.79% and sugar acid ratio from 8.6 to 12.5 (CFTRI, Mysore).

3.4.7 Transportation:

Transportation is considered as backbone and lifeline of the agricultural marketing. Transport starts right from the field till produce reaches the consumer. It is a vital requirement for bulk movement, distribution and marketing of fresh and processed products.

Insulated and/or refrigerated trucks with elaborated intake capacity are ideal for long distance road transport. Mandarins are transported as head loads, animal packs in difficult hilly regions of North East and by carts, motor vehicles and railways in other parts.

Rail transport has certain advantages over road transport. In rail transport, the damage to the produce is less as compared with that of transporting on rough roads. The transport cost is also much less in this mode of transport.

In-land, waterways can be used as an effective means of transport for fresh fruits and vegetables in the North east states.

Although marine transport is relatively slow which consume a fairly more time in comparison to other means of transportation to cover long destinations, but the inter-continental transportation, the ship is the cheapest and most energy efficient. To survive long distance transportation in waterways, most of the produce requires low temperature environment with enough ventilation to minimize carbon dioxide and ethylene accumulation. Refrigerated modular containers should be used for the purpose, which can be loaded at the packing house/centre and transported on trucks to the port, for onward transportation.

Air transportation is the fastest but most expensive mode of transport. However, this is essential for high-value short-life commodities. Generally, refrigeration facilities are not available and, on the contrary, low pressure environment with low RH are encountered at high altitude. This increases the rate of water loss of the produce. For air transportation, providing polyethylene Film liner with perforation within the box or over-wrapping of unit load is necessary. The packed produce, coming in for air transportation has to be pre-cooled sufficiently to counterpoise the lack of refrigeration facility. As there are no cold storage facilities at most of the airports in India, it is necessary to transport the pre-cooled produce in insulated or refrigerated trucks or vans to the airport to obviate possible delays in loading due to late arrivals or non-availability of required space on a particular flight. Perishable cargo handling centre at airports are required for transportation of perishable horticultural produce.

For shorter distances, Mandarins are generally transported as head load, while within a radius of 10-20 Km, the bullock cart/tractor trolley are commonly used. Other means of transportation of fruits to the nearby markets are Auto Rickshaw and Mini Lorry. For carrying the fruits to the distance more than 100 Km., the use of trucks/Railway are found to be the most convenient mode of transport due to its easy approach from the orchards to the market

In the trucks sometimes excessive pressure is exerted on the fruits due to faulty stacking and also do not possess temperature regulating devices. Therefore, it is essential

to design and develop suitable transport system to overcome such defects. For long distance transportation and for export purposes it advisable that refrigerated vans are used, to reduce the post harvest losses.

It is observed that for the local markets, the harvested fruits are transported by trucks in loose form.

The mode of transportation used for transporting Mandarins from 'Farm to assembling markets, Assembling markets to consuming markets, Average distance covered, and Method of transportation' by producers and by others, in different states, are given in table No. 16

Table No. 16
Mode of transportation used and average distance covered

Sl. No.	State	Farm to assembling market/ assembling market to consuming market	Mode of transport	Average distance covered (Km.)	Packing (Loose /Packaged)	
					Loose %	Packaged %
1	2	3	4	6	6	7
1	Assam	Farm to assembling market	Truck	50	100	No
		Farm to consuming market	Mini Truck	40	100	No
		Assembling market to consuming market	Mini Truck	N.A.	50	50
2	Haryana	Farm to assembling market	Trucks	20-30	100	No
		Farm to consuming market	Trucks	50-200	5	95
		Assembling market to consuming market	Trucks	50-200	Nil	100
3	Karnataka	Farm to assembling market	Truck, Mini lorries, Vans	30-50	100	Nil
		Farm to consuming market	Truck, Mini lorries, Vans	Up to 300	100	Nil
		Assembling market to consuming market	Vans	5-10	100	Nil
4	Madhya Pradesh	Farm to assembling market	Bullock carts, Mini trucks, Tractors	15-20	85-90	10-15
		Farm to consuming market	Trucks, Rail	500-600	90	10
		Assembling market to	Trucks, Rail	500-1000	95	05

		consuming market				
5	Maharashtra	Farm to assembling market	Trucks, Tempo	30-205	80-90	10-20
		Farm to consuming market	Cart, Tractor	8-50	100	-
		Assembling market to consuming market	Small Vehicles	5-50	70-75	25-30
6	Meghalaya	Farm to assembling market	Head load, Jeep	8 12-15	20	80
		Farm to consuming market	Head load, Bus, Jeep	10-30	10	90
		Assembling market to consuming market	Head load, Bus, Jeep	55	20	80
7	Mizoram	Farm to consuming market	Head load, Trucks, Bus, Jeep	35-50	Nil	100
8	Nagaland	Farm to assembling market	Head load, Jeeps	5 75	100	Nil
		Farm to consuming market	Bus, Jeeps, Trucks	1-130	100	Nil
		Assembling market to consuming market	Trucks	10-150	100	Nil
9	Punjab	Farm to assembling market	Tractor, Trucks	10-15	100	Nil
		Farm to consuming market	Tucks, Mini Trucks	200-1000	Nil	100
		Assembling market to consuming market	Tucks, Mini Trucks	200-1000	Nil	100
10	Rajasthan	Farm to assembling market	Trolley, Mini trucks	50-80	70	30
		Farm to consuming market	Mini trucks	125-500	50	50
		Assembling market to consuming market	Truck, Mini trucks	500-750	30	70
11	Tamil Nadu	Farm to assembling market	Horse/ Donkey	5	No	100
		Assembling market to Commission manday	Lorry/ Tempo/ Vans	60-120	No	100
		Commission mandy to Wholesalers	Tempo/ Vans	5	50	50

		Commission Mandy to Wholesalers / Retailers	Tempo/Vans / Tricycle	15	No	100
12	Tripura	Farm to assembling market	Truck / Mini trucks	120	90	10
		Farm to consuming market	Truck / Mini trucks	150	90	10
		Assembling market to consuming market	Truck / Mini trucks	30	98	2
13	West Bengal	Farm to assembling markets	Head load, Metador, Bus	10-15	30-40	60-70
		Farm to consuming markets	Head load, Metador, Bus	40-60	30-40	60-70
		Assembling markets to consuming /terminal markets	Truck, Bus	More than 100	No	100

Source: DMI survey

3.4.7.1 Transportation from farm to assembling markets:

3.4.7.1.1 Type of packaging used in transportation:

The transportation of Mandarins from farm to assembling markets is generally done in loose form.

3.4.7.1.2 Distance covered and mode of transportation used:

The distance covered to bring the produce from farm to assembling market varies from state to state. It is 10 to 15 kms in Punjab, which is the minimum distance and up to 80 Kms in Rajasthan. In hilly areas like Meghalaya, Mizoram and Nagaland, the assembling markets are comparatively at a shorter distance of 4- 8 Km. from the orchards. In Assam and Tripura, the producers carry the produce up to a distance of 50-120 Km.

The trucks, mini trucks, lorry, bus, and tractors are used as a mode of transportation to carry the produce from farm to assembling markets. In hilly areas, where the assembling markets are in nearby places, the produce is also carried by head load (Meghalaya, Mizoram and Nagaland).

3.4.7.2 Transportation from farm/assembling market to consuming markets:

3.4.7.2.1 Type of packaging used in transportation:

Mandarins are also sent to the Indian consuming markets, situated at a far distance from the farm by trucks, mini trucks and buses. In Madhya Pradesh, in addition to trucks, the rail is also used in transportation of the fruits.

3.4.7.2.2 Distance covered and mode of transportation used:

Mandarins are grown in few states, but are consumed throughout the country. From Rajasthan, Mandarins are dispatched to a distance of 750 km and from Punjab they are dispatched up to a distance of 1000 km. Similarly, from Madhya Pradesh, it is found that the Mandarins are sent to the consuming markets at a distance of 500- 600 km, whereas in Haryana, they are sent to the consuming markets, up to a distance of 200 km. In other states, Mandarins are sent to the consuming markets at a distance of 20- 50 km. In all Mandarin producing states, it is transported in loose form by road except in states like Madhya Pradesh, Meghalaya, Punjab, Rajasthan, and Tamil Nadu, where Mandarin is transported partly in loose and partly in packed form by road.

3.4.7.3 Selection of Mode of Transportation:

Since, the body of the vehicle is also a container, therefore following points should be considered for the selection of mode of transportation:

a. The mode of transportation should be cheaper among available alternatives.

b. It should immobilize the packages placed inside.

c. It should not cause damage to packages, because of uneven surface or protrusions in the body due to nuts and bolts.

d. It should work as a safe carrier of the packages placed inside.

e. It should be convenient during loading and unloading.

f. It must protect the Mandarins during transportation from adverse weather conditions.

g. It should be safe from pilferage, etc.

h. It should deliver the fruits to consignee in stipulated period.

i. It should be easily available, particularly during post harvest period.

j Distance of the market should be considered for selecting the mode of transportation.

3.4.7.4 Precautions to be taken while loading:

It is observed that the workers, engaged in loading the trucks place the packages without taking proper care. The packages are roughly handled. It is also seen that the wooden boxes are forcibly placed in trucks to fix them in the stack. Such practice is likely to damage the box, so also the adjoining boxes. Therefore, such practices should be avoided. The following precautions should be taken while loading in the trucks.

1. The workers, engaged in loading of Mandarins, should be sensitized through informal training to handle the packages carefully so that the mechanical injury at the time of loading/ unloading is minimum.

2. The stacking should be done in such a manner that the packages get locked with each other in a stack. This will help to immobilize the packages within the truck.

3. Provide cushioning with clean paddy straw on all sides to the extent possible, so that there is no damage to the packages because of the protrusions of nuts/bolts, angles, etc., in the body of the trucks at various places.

4. Instead of dark coloured tarpaulin used for securing packages, white tarpaulin should be used. This will help to keep the packages cool to some extent because of heat reflection.

3.4.8 Cool Chain:

Cool chain is essential during the transport of quality Mandarins all the way from the farm to the customer. This helps in maintaining the temperature inside the box at the same low level as in the cold storage.

The various stages of the cool chain are:

1. Pre- cooling and cold store at the farm.

2. Refrigerated truck from farm to the airport

3. Cold store at the airport.

4. Building up of the pallet in a cold store at the airport.

5. Loading the aircrafts directly from the cold store in a short time.

6. Cargo aircraft maintains cold store temperature in transit.

7. Off loading direct into a cold store in the receiving country.

8. Refrigerated truck to the air cooled departmental stores.

3.4.9 Preparation for the Market:

During the survey, it was observed that producers do not carry out any special preparation for bringing Mandarins to the markets. At the most, Mandarins are washed and cleaned before carrying them to the markets. Moreover no chemical treatment is given for ripening of the fruits, as is done in case of other fruits like banana and mangoes.

3.5 Post Harvest Losses:

3.5.1 Nature and Causes of Post-Harvest Losses:

Post-harvest losses of horticultural produce may occur due to a variety of reasons. Some of the common reasons for post-harvest losses are as under.

(i) Mechanical injury:
(ii) Injuries due to thermal shock;
(iii) Disease and pest attack;
(iv) Microbial attack; and
(v) Physio-biochemical reasons.

Fresh fruits are inherently perishable. During the process of distribution and marketing, substantial losses are recorded which range from a slight loss of quality to total spoilage. Post harvest losses may occur at any point in the marketing process, from the initial harvesting, grading, packaging, transportation from the field to storage, storage to assembly point, during storage and distribution to the final consumer.

A large number of intermediaries play an important role in the system between farmer and the retailer like local retailer, transporter, wholesalers and distributor, etc, and at every step significant waste is noticed.

3.5.2 Losses at different stages:

3.5.2.1 Losses during harvesting:

The nature, causes and percentage of losses reported by different states during harvesting are given in table No 17

Table No 17.

Nature, causes and percentage of losses during harvesting

Sl. No.	State	Losses during harvesting		
		Nature/ Type	Causes	Percentage
1	2	3	4	5
1	Assam	Bruises, injuries	Improper handling, Falling of fruits	Negligible
2	Haryana	Rottoning,	Fungal attack, Poor handling	1-2
3	Karnataka	Physical damage, Bruises, Cuts, Over ripen, Immature	Improper harvesting, Falling of fruits, Improper handling	5
4	Madhya Pradesh	Scratches, Puncture of	Improper harvesting, Infestation	3

		fruits, Insect infestation		
5	Maharashtra	Bruises, Cuts	Falling of fruits, Improper handling	1-2
6	Meghalaya	Bruises, Scratches	Improper handling	Negligible
7	Mizoram	Bruises, Scratches	Improper handling	Negligible
8	Punjab	Bruises, Softness, puncturing of fruits.	Falling from height, open stacking, not proper cutting of stalk.	1-5
9	Rajasthan	Scratches, Puncture of fruits	Improper plucking, Over heaping	2.5
10	Nagaland	Bruises	Falling of fruits	5
11	Tamil Nadu	Physical injury, Bruised	Falling of fruits, Stalkless fruits, Improper harvesting	4-8
12	Tripura	Bruises, Scratches	Improper handling	Negligible
13	West Bengal	Damaged, Insect infestation, Bruises	Due to fall of fruits, cracked and spoiled fruits	1-4

Source: DMI survey

The main nature of losses and their causes during harvesting are physical damage, bruises, punctures to the fruits during plucking, falling of fruits, insect infestation etc.

The maximum percentage of losses i.e., 10 per cent, during harvesting is reported in Maharashtra state followed by by 4-8 per cent in Tamil Nadu. In North-East states, the losses are negligible, during harvesting.

3.5.2.2 Losses during grading:

Scientific grading of Mandarins is not done by any of the functionaries. At the most, the fruits are cleaned and then sorted out according to size, shape and colour. There are hardly any losses in the process of grading, but due to improper handling of the fruits or due to over ripened fruits, there are likely losses of the fruits at the time of grading. Some times, fruits also get infected due to injuries and resulting in huge losses during grading. The state-wise losses of Mandarins during grading are given in table No 18.

Table No.18

Percentage of losses during grading

Sl. No.	State	Losses during grading	
		Losses at different stages	Percentage of losses during grading
1	2	3	4
1	Assam	No grading	Nil
2	Haryana	Producers / all functionaries	Nil
3	Karnataka	Producers	2
		Wholesalers	5
		Commission agents	5
		Cooperatives/Processors	0.50-5
		Retailers	0.50-5

4	Madhya Pradesh	Producers	5-8
5	Maharashtra	Producers	1-2.5
		Wholesalers	2
		Commission agents	2
		Exporters	0.5
6	Meghalaya	No grading	Nil
7	Mizoram	No grading	Nil
8	Nagaland	Producers	Up to 5
		Wholesalers	Up to 5
		Commission agents	Up to 5
		Cooperatives/Processors	Up to 5
		Retailers	Up to 5
9	Punjab	Producers and other functionaries	Negligible
10	Rajasthan	Producers	1.5
		Wholesalers	0.50
		Commission agents	0.50
		Cooperatives	1.0
		Retailers	1.0
11	Tamil Nadu	Producers	5-10
		Wholesalers	2-5
		Commission agents	Up to 2
12	Tripura	No grading	Nil
13	West bengal	All functionaries	Nil

Source: DMI survey

In Madhya Pradesh, the losses during the grading are reported 5-8 per cent and are maximum.

3.5.2.3 Losses during packaging:

Improper handling, overloading and dropping of the fruits during weighment are the main factors of losses during packaging. The producers generally sell the produce before commencement of the harvesting season and do not undertake the packaging of the fruits. If necessary, they either carry the Mandarins in loose or at the most they carry the fruits in baskets and sometimes in gunny bags.

The losses during packaging in states and their causes are given in table No 19.

Table No. 19

Nature, causes and percentage of losses during Packaging

Sl. No.	State	Losses during packaging		
		Losses at different stages	Causes	Losses %
1	2	3	4	5
1	Assam	Producers	Improper handling	Negligible
		Wholesalers	Improper handling	Negligible
		Retailers	Improper handling	Negligible

2	Haryana	Producers / other functionaries	Improper handling	Negligible
3	Karnataka	Producers	Improper handling	5
		Commission agents / cooperatives		5
4	Madhya Pradesh	Wholesalers	Improper handling	1
		Commission agents		1
		Cooperatives		5
5	Maharashtra	Producers	Fruit rapture, decay, infestation, disease, injuries	0.5-1
		Wholesalers		0.5
		Commission agent		0.5
		Exporters		0.2
		Retailers	Sun burn, over heaping	1-2
6	Meghalaya	Producers	Improper handling	Negligible
		Wholesalers	Improper handling	Negligible
		Retailers	Improper handling	Negligible
7	Mizoram	Producers	Bruises	Less than 7
		Wholesalers	Bruises	Less than 7
8	Nagaland	Producers	Improper handling	5
		Wholesalers/ Commission agents	Improper handling	5
9	Punjab	Producers	Fungal attack due to bruising	0.1-0.2
		Commission agent	Mishandling	0.5-1
		Processor	Delay in packing	1-2
10	Rajasthan	Producers	Rough handling, overloading	0.50
		Wholesalers		0.25
		Commission agents		0.25
		Cooperatives		0.25
		Retailers		0.50
11	Tamil Nadu	Producers	Rough handling, overloading	1-5
		Commission agents	Improper handling	Up to 1
		Wholesalers	Fungus	1-5
		Retailers	Fungus	1-10
12	Tripura	Producers	Injuries	Less than 2
		Wholesalers	Injuries	Less than 2
13	West Bengal	Producers	Over pressure	2-3
		Wholesalers	Fungal/Bacterial	3-4
		Commission Agents	Fungal/Bacterial	3-4

Source: DMI survey

The losses during packaging in most of the states are negligible. In Mizoram, the losses during packaging are maximum (up to 7 per cent), while in Karnataka and Nagaland they are nearly 5 per cent and in West Bengal, the losses are 3-4 per cent. The main reasons of losses are improper handling, damages due to dropped fruits during weighment and transportation, injuries, fungal/ bacterial infections, and compression of fruits due to stacking, etc.

3.5.2.4 Losses during preparation of markets:

The producers generally do not undertake any special preparation for markets. They simply wash and cool the fruits before bringing them to the markets. Most of the losses in preparing for the markets are at wholesaler, commission agents and retailers level. This may be due to the fact of over ripening of fruits, improper handling during packaging, falling of the fruits, shrinkage and rottening of fruits etc.

The details of losses during preparation for the markets are given in table No 21.

Table No. 21

Nature, causes and percentage of losses during preparation for the market

Sl. No	State	Functionary	Causes of losses	Losses at different stages (%)
1	2	3	4	5
1	Assam	Producers	Fungus	1
2	Haryana	Producers	Fungus	1
		Commission agents	Improper handling	1
		Processor	Improper handling	1
3	Karnataka	Producers	Over ripened	2
		Wholesalers	Packaging, transportation and handling	5
		Commission agents	Handling	5
		Retailers	Handling and transportation	5-10
4	Madhya Pradesh	All functionaries	Improper handling	Negligible
5	Maharashtra	Producers	Loose handling, Over heaping	2
		Wholesalers	Fallen and diseased fruits	1-2
		Exporters	Transportation and handling	2
6	Meghalaya	All functionaries	N.A.	N.A.
7	Mizoram	All functionaries	N.A.	N.A.
8	Nagaland	Wholesalers	Rough handling	2
		Commission agents		2
9	Punjab	Producers	Carelessness during plucking, microbial attack, delay in transit	0.1-0.2
		Commission agent		0.1-0.2
		Processor		1-2
10	Rajasthan	Producers	Bruises, Rough handling	5
		Wholesalers		5
		Commission agents		5
		Cooperatives		5
		Processor		2
		Exporters		2
		Retailers		5
11	Tamil Nadu	Al.l functionaries	-	Nil
12	Tripura	Not available	Not available	-
13	West Bengal	Producers	Mishandling, shrinkage, rotten	1-4

Source: DMI survey

In preparation for the market, the losses of Mandarins are not significant.

3.5.2.5 Losses during transportation:

If the transportation is not well planned and managed, then it can cause damage to fresh produce, reducing the consumer's acceptability, resulting in overall economic losses. The possible damage and most frequent losses, incurred during non-refrigerated transportation are generally caused by mechanical damage and over-heating.

Vibration and bouncing of packages due to uneven road conditions are the main reasons for losses in road transportation. This, in turn, severely disturbs stacking and imposes considerable compression strains on the packages. The size and design of packages be in such a way so that interpackage space is kept at minimum and vehicle space is completely utilized. Loading and unloading of vehicles should be properly supervised to prevent careless handling of packages.

The losses in transportation of Mandarins from field to assembling markets and assembling markets to consuming markets/ terminal markets, in different states are given in table No 20.

Table No. 20

Causes and percentage of losses during transportation

Sl. No	State	Losses during transportation				Total losses (%)
		Field to assembling market		Assembling market to consumer/terminal market		
		Causes of losses	Percentage of losses	Causes of losses	Percentage of losses	
1	2	3	4	5	6	7
1	Assam	Mechanical	Negligible	Mechanical	Negligible	Negligible
2	Haryana	-	Negligible	Pressing and bursting of fruits	2-4	2-4
3	Karnataka	Mechanical damage	5-10	Mechanical damage	10-15	15-25
4	Madhya Pradesh	Mechanical damage	10	Mechanical damage, Fungus infestation	7-10	Up to 20
5	Maharashtra	Rottening, Rapturing, Sun burn, Diseases, Mishandling	1-2	Rottening, Rapturing, Sun burn, Diseases, Mishandling	2-3	3-5
6	Meghalaya	Mechanical	Negligible	Mechanical	Negligible	Negligible
7	Mizoram	Mechanical	Negligible	Mechanical	Negligible	Negligible
8	Nagaland	Mechanical damage	3	Mechanical	Negligible	3
9	Punjab	-	Negligible	Fungal attack, improper loading	15-30	15-30
10	Rajasthan	Overloading, Over heat, Bruises	5-7	Mechanical	5	Up to 12
11	Tamil Nadu	Physical damage	5-10	Desiccation and physical damage	1-4	6-14
12	Tripura	Mechanical	Negligible	Mechanical	Negligible	Negligible
13	West Bengal	Bruises	4-5	Over pressure, spoiled	3-6	7-11

Source: DMI survey

In comparison to other losses, the losses during transportation are found to be on higher side. In Karnataka, the total losses are 15-20 per cent, while in Madhya Pradesh, they are up to 20 per cent and in Punjab, they are 15-30 per cent. These losses may be attributed to bad shape of roads, unsuitable trucks/vehicles, improper handling of the fruits etc.

3.6 Main Causes of Post Harvest Losses:

The post harvest losses at different stages and their reasons are as under.

A) <u>During Harvesting:</u>

i) Harvesting of fruits at improper maturity.

ii) Harvesting not done properly.

iii) Harvesting equipments are not clean.

iv) Harvesting during warmest part of the day.

v) Exposures to unnecessary high temperature.

B) <u>Transportation:</u>

i) Careless Driving.

ii) Too high loading/stacking.

iii) Poor roads.

iv) Unsuitable transport containers.

v) Overloading with other fruits and vegetables (in some cases people even sit on top of the load)

vi) Lack of link roads, leading to highways or collection centers.

Viii) Heat accumulation or very poor ventilation within the transport vehicles.

ix) Virtual absence of refrigerated and insulated trucks.

C) <u>Grading / Packing:</u>

i) Lack of quality standards or minimum requirement.

ii) Rough handling.

iii) Unsuitable packaging material.

iv) Overfilling of containers.

D) Assembling:

Assembly points are not properly/ adequately prepared.

E) Loading / Unloading:

i) Rough handling.

ii) Loading too high.

iii) Bad stacking.

iv) Improper cushioning of carrier.

F) Storage:

i) Inadequate ventilation in packages and carrier used.

ii) Storage temperature is too high.

iii) Rough handling.

iv) Too high heaps or stacks.

G) Ripening:

i) Lack of uniformity and homogeneity of the produce.

ii) Inadequate equipment and ripening method.

iii) Rough handling.

3.7 Technology for reducing post-harvest losses:

Post-harvest losses can be minimized by adopting certain pre-harvest strategy and post-harvest management/technology. The principal pre-harvest strategy and post-harvest technology for reducing the post-harvest losses are as under.

(i) Pre-harvest treatment
(ii) Correct stage of harvesting
(iii) Proper harvesting method
(iv) Proper curing
(iii) Washing, cleaning and grading;
(iv) Scientific packing
(v) Pre-cooling
(vi) Cold storage
(vii) Suitable means of transport and
(viii) Efficient marketing.

Brief description of the principles and methodologies of pre-harvest strategy and post-harvest management of horticultural produce are as follows.

3.7.1 Pre-Harvest Treatment:

Use of fertilizers, pest control, growth regulators, climatic conditions like wet and windy weather and tree conditions influence the shelf life of the Mandarins by regulating physiology and chemical composition of fruits.

In pre-harvest treatment, if the spray (10 ppm) of Gibberellic acid is done at colour break stage, it delays colour development, maintain firmness thereby allows extend harvesting i.e., tree storage. Similarly the use of potassium fertilizers extends the shelf life of the fruits. These chemicals can curtail storing cost due to uniform ripening and prolong the shelf-life.

3.7.2 Post-harvest Treatment

3.7.2.1 Washing and cleaning:

Washing and air-drying improve the appearance of the fruits and avoid wilting. During washing, the rotten, diseased insect damaged, discoloured and deformed fruits should be sorted out carefully.

Fruits are cleaned manually by hand rubbing individual fruit dumped in a tank of sanitized water. The water used for washing should be sanitized with 150 p.p.m hypochlorous acid, maintained at a pH of 6.5. Fruit can also be cleaned mechanically by passing them over a series of roller brushes wetted from above with spray nozzles. Benomyl (500 p.p.m), imazalil (1000 p.p.m), or thiabendazole (1000 p.p.m) are the most effective post harvest fungicides and can be applied at high-pressure sprays after washing or during waxing.

3.7.2.2 Gentle handling

In order to reduce the post harvest losses, the fruits should be handled gently to minimize bruising and breaking of the skin. The breaking of the skin stimulates dehydration of the fruits and make site for microbial attack. By reduction of number of handling of commodity, the mechanical damage can be reduced significantly.

3.7.2.3 Temperature control:

The temperature control (Pre-cooling) is very much necessary to remove field heat and to retard the ripening of the fruit after harvesting, particularly when harvesting is undertaken in hot weather. It minimizes the storage losses considerably. The low pressure vacuum cooling technique is another option for temperature control. Cooling of the fruit, not only extends storage life by reducing the rate of physiological change, but also retards the microbial growth. Even low-cost cooling or refreshing the product is better than no cooling at all. If the temperature between 2°C to 3°C (36°F to 38°F) is maintained, the market period may be extended up to 4 months, if harvesting is carried out at right maturity. For short-term storage and during transit period, 10°C (50°F) is adequate to minimize the decay of the fruits.

Storing at high temperature causes rapid moisture loss, flavour deterioration, resulting in decay of the fruits. It is preferable to store fruits at their optimum relative humidity (RH) of 90% to 95%. At a low RH, the peel becomes thin, dry, and shriveled.

There are several ways of reducing the storage temperature of fruits.

a) Protect the fruits from direct sun rays.

b) Cool promptly after harvest.

c) Use of natural cooling, e.g., harvesting during the cool early morning hours, open stores for ventilation during the night,

d) Evaporative cooling, obtained by drawing dry air over a moist surface.

e) Mechanical refrigeration

3.7.2.4 Precaution during storing in cold storage:

There are four basic principles which must be correctly applied for successful refrigeration of perishable crops like Mandarins:

i. **Select only healthy Mandarins:** Refrigeration does not destroy pathogens responsible for deterioration, but only slows down their activity. It also does not improve produce quality, only maintains it. A damaged fruit will deteriorate more quickly than a healthy one even in refrigerated storage. Hence, store only sound produce in refrigeration.

ii. **Timely cooling:** Since, refrigeration slows the development of micro-organisms and physiological changes, responsible for deterioration of the fruits. Allow the produce to cool, soon after harvesting.

iii. Adhere closely to optimal conditions for temperature and relative humidity.

iv. **Uninterrupted cooling:** Refrigeration should be applied from the point of harvest to the point of consumption.

3.7.2.5 High humidity

High humidity retards loss of moisture and maintains the crop in better condition. Horticultural produce can be stored best in an atmosphere that has a relative humidity of 90 per cent.

3.7.2.6 Waxing of the surface

Waxing is one such technology suitable for preservation of fruits. By this method, the shelf life of the fruit can be enhanced by more than two weeks. This gives breathing time for marketing.

The shine on the outer surface of the fruit is due to natural wax. Most of the natural wax on the peel surface is removed during washing. When this wax is removed, fruit tend to lose moisture. Wax prevents evaporation of water from the produce and gives shine to the surface. Food grade wax can be applied manually by rubbing it onto the fruit surface or by spraying/dripping it on a bed of slowly rotating horsehair-grade brushes.

3.7.2.7 Controlled atmosphere storage

In the Controlled atmosphere storage, the fruit is placed in the gas-tight refrigerated chamber allowing the natural respiration of the fruit. This decreases the oxygen content and increase the percentage of carbon dioxide in the chamber. This controlled atmospheric storage extends the storage life of the fruit.

3.7.2.8 Shorten the time between harvest and consumption

The losses of the fruits can also be reduced to a large extent by reducing the marketing channel. Shorter is the marketing channel, lesser will be losses during the process of marketing.

3.7.2.9 Sanitation

Proper sanitary conditions must be maintained during the operation like handling, storage, cleaning and washing equipment, used for the fruits to minimize the risk of spreading microbial growth. Diseased or damaged fruits should be sorted out and properly disposed off to prevent the likely the growth of fungi and bacteria on sound fruits. Insects infesting culled fruits may migrate to good fruits and introduce pathogenic organisms and increase losses.

Water used for washing should also be changed at regular intervals before it becomes contaminated with fungi and bacteria, which spreads infection. The chlorinated water or chemically treated water reduces the count of viable organisms.

3.7.2.10 Peel De-Greening:

Ethylene, which is a naturally produced plant growth hormone, is also effective as a de-greening agent. It breaks down the green chlorophyll pigment. This treatment also improves the external skin color and export market acceptance. This treatment is solely cosmetic in effect and does not alter the flavor of the fruit.

The de-greening process involves exposing green-skinned Mandarin fruit of uniform grade to low levels of ethylene (usually between 1 ppm to 10 ppm) at 20°C to 25°C (68°F to 78°F) and 90% Relative Humidity. Good internal air movement is needed, so that, the air circulates every 2 to 3 minutes. The carbon dioxide level inside the treatment chamber should not rise above 2000 ppm. Fruits should not be washed before de-greening. Ethephon (500 ppm for 1 minutes), ethylene-releasing liquid compound, can also be applied by dipping the fruit in a tank of sanitized water at room temperature. Higher concentration of ethylene is, however, injurious to fruits.

It is always better, if the ethylene treatment is given immediately after harvest. Care should also be taken that the fruits do not dry before treatment. Ethylene must be applied prior to waxing.

3.7.2.11 Evaporative cool chamber:

For short duration storage at small scale, evaporative cool chamber (7.5’ X 6’ X 7’), having drip system for watering and fan for air movement has been developed at NRCC, Nagpur. This chamber has maximum 1.5 ton fruit storage capacity. The storage cost is very less and small farmers can hold the fruit up to 25 days.

4.0 Post-Harvest Diseases and Disorders

Post-harvest diseases and disorders generally develop due to infestations before harvest. Insect damage is usually caused by insect holes through produce e.g. Fruit fly. Losses from post-harvest diseases in fresh fruits can be both quantitative and qualitative. These diseases are mainly caused by fungi and bacteria. Initially, only a few pathogens may invade and break down the tissue systems, followed by subsequent attack of weak pathogens. High temperature and humidity accelerate the process of post harvest decay by microorganisms.

The severity of infection and degree of damage, however differ, depending upon the region of cultivation, season and even the root stock used for grafting. The fruits dropped on the ground due to physiological disorders are infected by pathogenic organisms and have poor storability.

Harvest injury, defective handling, inappropriate temperature and humidity affect the storage life of the fruits. The presence of blemished fruits with sound ones also contribute to decay and damage.

4.1 Principal Post harvest Diseases and Disorders:

Sl. No.	Diseases	Season and places	Characteristics of affected fruits	Control measures
1	Sour Rot (*Geotrichum candidum)*	Maharashtra (Oct.-Jan.) Vidharba (Feb.-May)	Fruits show water soaked skin, soft texture with oozing liquid and fermented odour	Treatment with combination of callxin (1000 ppm) and Benlate-50 (0.1 %) emulsion before storage: by dipping fruit for 2 minutes
2	Fruit Rot (*Phytophthora nicotianae)*	Coorg Wynaad (Rainy weather, June-Sep.)	Affected fruits soft, covered with whitish fungus growth	Spraying with Bordeaux mixture (2-3 sprays) (1 %) or Difolaton (0.3 %): defollated leaves and fruits burnt; water logging to be avoided

3	Powdery Mildew *(Acrosporium tingitanium)*	Coorg and Malnad in Karnataka, Nilgiries (Sep-Oct. and Mar.-Aprl.)	Premature fruit drop	Fortnightly spray (during flush period) with any of the following fungicides. a) Cosan (0.2 %) b) Thiovit (0.2 %) c) Sulfex (0.2 %) d) Karathane (0.2 %) e) Morestan (0.05 %) f) Bavistan (0.1 %) g) Callxin (0.1 %)
4	Stem End Rot *(Alternaria citri)*	Vidharbha	Seen in stored fruits; discolouration of stem and rotten area in the core; part of segment shows black sporulate)	Use of imazalil or 2,4-D (or both) on harvested fruit. Use of the growth regulator 2,4-D delays the onset of senescence of the fruit button, thereby delaying or restricting the movement of the pathogen into the fruit.
5	Brown Rot *(Phytophthora citrophthro)*	Vidharbha	Brown colour spot on infected fruits; infected fruit does not become soft and pulpy	Copper fungicide sprays applied to the soil and the lower part of the tree canopy prior to anticipated wet weather help to prevent brown rot. Brown rot can be controlled by submerging fruit in hot water (50°C) for 2-4 min. Storage of fruit at about 5°C significantly delays the development of brown rot.
6	Wither Top / Anthroacnose *(Collectotrichum gloeosporioides)*	Coorg, Vidharbha (Aug-Sep)	Serious on orange tree-Die back of twings; or sheding of leaves, flowers and fruitdrop; brown spot on rind; pink colour in infected portion of segment	Pruning of affected portion and spraying with Bordeaux mixture. Proper irrigation and timely fertilization essential.

7	Pink Disease *(Pellicularia salmonicolor)*	Coorg, Vidharbha	Affected Mandarin tree show gumminess of bark; appearance of pink coloured mycillial growth on diseased portion; and drying of whole bark.	Pruning and burning of affected portion. Scraping of diseased tissue and application of Bordeaux mixture in dry season.
8	Other storage Rots *(Phytophthora nicotianae, Geotrichum sp, Penicillium sp, Rhizopus sp, Phomopsis citri, Diplodia natalensis and Sclerotium)*	Coorg Mosoon and summer crops)	____	Post harvest dip treatment of mosoon fruits with TBZ, Bavistan and Benlate check losses upto 26 days. Likewise, dipping of summer season fruits in Benlate, Callxin, and Bavistan or TBZ restricted the rot to less than 10 %.
9	Leaf Fall *(Phytophthora nicotianae)*	Vidharbha (Mrig Bahar)	Young fruits develop water soaked chocolate brown lesion	Spraying Bordeaux mixture (0.1 %) before the onset of rains and spraying the remaining mixture during rainy season during dry spell.
10	Kolsi or Sooty Mold *(Capnodiumsp)*	Karnataka (June-Sep.) Vidharbha (Early winter)	Fruits show reduced size and discolouration	1. Spraying monocrotophos or dimethoate combined with Copper oxy chloride or mancozeb helps in prevention of the disease. Spraying of diluted glue or a detergent can wash off the black coating.
11	Blue and Green Mold *(Penicillium italicum and P. digitatum)*	Pune, Vidharbha (July-Aug)	Soft, water soaked skin covered by blue, green mouldy growth)	Harvesting the fruit after the rain and fog; careful handling; spraying boric acid; adding sodium carbonate during the washing of fruit.

Source: Mandarin Orange in India. Central Food Technological Research Institute, Mysore.

5.0 MARKETING

Marketing is the key to horticultural development of the region. The absence of a proper marketing plan and organisational arrangements, agro processing facilities, which otherwise have high potential for indigenous production to the extent of self-sustainability is a cause of great concern and is a disincentive to the local growers.

Efficient marketing system plays a crucial role in getting the remunerative prices to the producers. In present scenario, it is observed that the producers do not pay proper attention for various components of marketing. The producers usually spend whole of the year on production and part with the produce to the pre-harvest contractors, that results in low share in consumer's price.

Majority of producers sell Mandarins to pre-harvest contractors, while a few sell the fruits to the wholesalers in the market yards or send their produce directly to the different cities. The method of sale of produce to pre-harvest contractor in either "Hunda method (Pre-harvest contract of whole of the orchard) or Count method". The produce is sold to pre-harvest contractors at "Flowering to maturity stage or after maturity". The main reasons for sale of produce to the pre-harvest contractor are as under.

i) High risk of spoilage of fruits from natural calamity.
ii) No assurance of higher prices in markets.
iii) Delay in getting payment of produce.
iv) Pressing need of money for immediate payments.
v) Higher transportation cost.
vi) Lack of the market information.

Sometimes it is observed that sale of produce to pre-harvest contractor causes the following inconvenience to the producers.

i) Delayed harvesting of the fruits.
ii) Delayed payment to the producers by the pre-harvest contractors.
iii) No guarantee of sticking to the contract by the pre-harvest contractors.
iv) Deductions in payment by the pre-harvest contractors, in the event of loss of fruits, due to dropping
v) Financial losses to the producers due to wrong estimates by the pre-harvest contractors.

The main reasons for sale of fruits in the market premises are as under.

i) Higher net prices expected in the markets.
ii) No contract could have been settled with pre-harvest contractors.
iii) There is no alternative except to sell in the market.
iv) Small quantities of produce.

Similarly, there are following problems, faced by the producers to sell the fruits in the market premises.

i) High commission, transportation, loading / unloading and other charges.
ii) No assurance of remunerative prices.
iii) Sometimes delayed payment by commission agents.
iv) Sometimes unauthorised deduction by the commission agents.

Due to high degree of perishability, producers sell the produce as early as possible. But, it would better if the produce is sold where the market have a better accessibility, supported by efficient transport and communication facilities.

In marketing of Mandarins, not only the producers face the problems, the pre-harvest contractors, wholesalers, pack house owners and retailers also face similar problems , as given below.

5.1 Pre-harvest contractors:

i) Mismanagement of gardens, resulting in deterioration of quality and yield of fruits.
ii) Risk of losses due to natural calamity like storms, rains, pest, etc.
iii) Improper storage and transportation, lack of skilled labourer, absence of mechanical grading facilities, etc.

5.2 Wholesalers:

i) Costly, improper and inadequate road transportation facilities.
ii) Labor problems
iii) Costly packing material
v) Lack of infrastructural facilities

5.3 Packing center owners:

i) Costly packing materials
ii) Lack of skilled workers
iii) Non availability of cold storage

5.4 Retailers:

h) Losses due to spoilage of fruits
i) Costly transportation
j) Lack of proper air cooled shops in the local markets

5.5 Marketing Channels:

The main channels followed for marketing of Mandarins are as under:

- ***Growers – Pre-harvest contractors – Commission Agents – Retailers – Consumers.***
- ***Growers – Wholesalers – Commission Agents – Retailers – Consumers.***
- ***Growers – Commission Agents— Processing Industries - Retailers – Consumers.***
- ***Growers – Retailers – Consumers.***
- ***Growers– Exporters.***

5.5.1 Criteria for selection of channels:

1. The channel, which ensures the higher share to producer and also provides cheaper price to consumer, is considered as the most efficient channel.

2. Selection should be for shorter channel, to reduce marketing cost.

3. Avoid the longer channel, having more intermediaries, causing higher marketing cost and reduced producer's share.

4. Select the channel which distributes the produce appropriately at low expense and secure the desired volume of disposal.

5.6 Strategy for efficient marketing:

The strategy for efficient marketing is as under.

i) Producer's organisations and co-operative societies should be formed for marketing of Mandarins fruits.
ii) Fruits should be harvested at proper maturity only.
iii) Precautions should be taken for avoiding injuries at the time of harvesting and transportation of fruits to the markets
iv) There is need to develop alternative marketing channel involving co-operative societies to help the Mandarin growers.
v) Steps should be taken to link production, marketing and processing of Mandarins to avoid seasonal gluts in the markets.
vi) Considering the fragileness of the fruit, careful harvesting and handling of harvested fruits are of critical importance to maintain their 'Sales appeal" and delicate flavour.
vii) Ways and means should be explored for providing cheap and locally available packing material and transport facilities.
viii) Advance marketing credit/loan facilities should be provided by the banks to the Mandarins producers.
ix) In the absence of organised system of marketing and crop insurance policy, the citrus growers get poor returns. Therefore, the minimum support price of Mandarin fruits, during the productive years should be declared.
x) There is need to ensure remunerative price to the Mandarin producer, reduction in marketing cost and also to ensure supply of fruits at reasonable price to the consumer throughout the year.

6.0 MARKETING COSTS AND MARGINS

6.1 Marketing Costs:

Marketing Costs are the actual expenses required in bringing goods and services from the producer to the consumers. The marketing cost normally includes

(i) Handling charges at farm level,

(ii) Assembling charges,

(iii) Transport and storage costs,

(iv) Handling charges by wholesalers and retailers,

(v) Expenses on secondary services like financing, risk taking and market intelligence, and

(vi) Profit margins of different agencies.

The marketing cost incurred by farmers and traders at Regulated market includes i) Market fee, ii) Commission, iii) Taxes, and iv) Other miscellaneous charges.

i) Market fee: Market fee is collected by the market committee of the markets. It is charged either on the basis of weight or on the basis of the value of the produce. It is usually collected from the buyers. The market fee differs from state to state. It varies from 0.5 per cent to 2.0 per cent ad valorem.

ii) Commission: It is paid to the commission agent for assisting in carrying out the transactions, and may be payable either by seller or by the buyer or sometimes by both. The charge is usually made in cash and varies considerably.

iii) Taxes: Different taxes are charged in different markets such as toll tax, terminal tax, sales tax, octroi etc. These taxes differ from market to market in the same state and also from state to state. These taxes are usually payable by the seller.

iv) Miscellaneous charges: In addition to the above-mentioned charges, some other charges are levied in marketing of produce. These includes handling and weighment charges (weighing, loading, unloading, cleaning etc.), and charity etc. These charges may be payable either by the sellers or by the buyers or by both.

6.1.1 Marketing cost borne by producers and other functionaries:

6.1.1.1 Producers:

The producers sell the fruits to pre-harvest contractors or sell themselves in the market premises. When farmers sell their produce to the pre-harvest contractors, they have to bear no cost on the marketing of fruits. The pre-harvest contractors make the payment for each post-harvest operation.

On contrary, if producers sell the produce themselves in the market premises or to a distant place , then they have to bear the expenses on labour for plucking of fruits, transportation, octroi, commission charges, heap making, and other miscellaneous activities.

6.1.1.2 Pre-harvest contractors:

Pre-harvest contractor makes the payment well in advance to the producers, therefore, they have to bear the expenditure on vigil and pre-harvest activities, in addition to post-harvest marketing activities.

The main post-harvest marketing cost borne by the pre-harvest contractors are like sorting and grading, packaging, transportation, octroi, loading and unloading, commission charges, heap making, market cess and other miscellaneous charges.

6.1.1.3 Wholesalers:

The wholesalers are the main purchasing agency in the markets. Generally, they have their own packing centres, located within the premises of the markets. They purchase the produce at their own or on behalf of other big traders. Sometimes, they also act as commission agents.

The wholesalers sell the produce outside of the market. The local sale of the fruits in the market premises is negligible. They have to incur expenditure on packing material, sorting & grading, transportation, octroi, loading / unloading, market cess, establishment and other miscellaneous items. The maximum expenditure of the wholesalers is on establishment and on other miscellaneous items.

6.1.1.4 Retailers:

Retailer is the last functionary of the marketing channel of sale and purchase of the Mandarins. Retailers purchase the fruits from the wholesalers for the final sale to the consumers.

The expenditure of the retailers is found generally on transportation, commission charges, market cess, shop rents, baskets, shades, lighting, and maintenance of hand driven carts.

6.2 Marketing Margins:

Margin refers to the difference between the price paid and received by a specific marketing agency such as retailer or assemblers or by any combination of marketing agencies in the marketing system as a whole.

Marketing Margin = Price Received by Agency- Price Paid by the Agency

The marketing margin varies from market to market, channel to channel, time to time and place to place.

7.0 EXPORT AND IMPORT

Major problem for exports of fresh Mandarins from India is low productivity, prevalence of a low level of pre-harvest care, inadequate adoption of post-harvest technology and existence of distortion in marketing channels.

The Agri-Export Zones (AEZs) are in developing stage to meet the market requirements, especially to provide a specific thrust to the quality and supply chain requirements of the target markets.

Nagpur Mandarin is one of the best Mandarins in the world, which is produced in central and western part of India. Mrig crop (monsoon blossom), which matures in February-March has great potential for export, since arrival of Mandarin fruits in international market is less during this period.

Selection of desired quality fruit as per specific market demand and careful post-harvest handling to retain natural qualities and freshness plays a key role in expanding exports of Nagpur Mandarins. At present fruit consignments are being exported to neighboring countries by road without cooling and giving any other treatment. For viable and sustainable export to distant markets of Europe, Gulf and South East Asia, export by refrigerated container ships is imperative.

7.1 Export:

The total world export, during 2007 was 3651.018 thousand tones. Export from Spain during this period was the maximum i.e., 45.26 per cent (1652.428 thousand tones) of the total world export of Mandarins. China was the highest Mandarin producing country, but export was only 10.96 per cent (399.986 thousand tones) of the world export. Export of Mandarins from Turkey and Morocco, the other important exporting countries was 7.06 per cent and 6.68 per cent of total export. Export of mandarin from India during this period was only 0.002 per cent (0.066 thousand tones). India exported mandarin mainly to Bangladesh and Nepal. USA, Canada and Netherlands were the other countries, where Mandarin was exported from India.

The export of Mandarin s during 2005, 2006, and 2007 are given in table No 22.

Table No 22.
Export of Mandarins

Quantity in '000 tones

Sl.No.	Country	2005	2006	2007
1	Argentina	71.429	81.521	98.625
2	Australia	22.873	18.235	19.485
3	Belgium	38.800	13.588	10.010
4	Brazil	12.475	10.712	6.128
5	China	372.131	337.668	399.986
6	Cyprus	31.128	33.102	31.206
7	France	34.207	30.606	29.633
8	Greece	37.960	39.268	35.298

9	**India**	.307	.005	0.066
10	**Iran**	24.128	39.633	2.058
11	**Israel**	32.405	20.706	40.509
12	**Italy**	61.435	72.167	69.479
13	**Lebanon**	17.097	17.382	15.173
14	**Morocco**	302.452	223.845	243.983
15	**Netherlands**	101.168	88.301	95.689
16	**Pakistan**	78.914	192.528	123.040
17	**South Africa**	85.509	83.734	106.447
18	**Spain**	1512.619	1509.695	1652.428
19	**Turkey**	246.337	299.126	257.935
20	**Uruguay**	44.917	40.703	46.605
21	**Others**	201.180	242.128	367.235
22	**World**	3329.471	3394.653	3651.018

Source: FAO

7.2 Import:

Canada, Germany, Italy, Netherlands, Poland, Russia (Fed.), United Kingdom, USA, and Vietnam are the main importing countries of Mandarins.

Total import of Mandarin, during 2007 was 3436.396 thousand tones. During this period, Russia (Fed.) imported 13.95 per cent (479.331 thousand tones), France imported 10.35 (355.616 thousand tones), Germany imported 10.30 per cent (353.960 thousand tones), of the total world import. Import of Mandarin in the same year by United Kingdom was 8.25 per cent (283.604 thousand tones) and by Netherlands and Poland were 5.42 per cent (186.403 thousand tones) and 4.83 per cent (165.917 thousand tones), respectively. These five countries alone shared more than 40 per cent of total world import of Mandarin, during 2007.

The country-wise import of Mandarin, during 2005, 2006, and 2007 are given in table No 23.

Table No 23.
Import of Mandarins

Quantity in tones

Sl.No.	Country	2005	2006	2007
1	**Austria**	38.153	45.302	39.576
2	**Belgium**	80.820	74.191	64.303
3	**Canada**	109.603	114.177	121.331
4	**Czech (Rep.)**	67.830	63.693	66.548
5	**France**	346.912	340.020	355.616
6	**Germany**	346.212	346.337	353.960
7	**Italy**	96.160	83.022	106.736
8	**Malaysia**	59.183	58.888	77.291

9	**Netherlands**	154.671	192.206	186.403
10	**Philippines**	56.849	58.658	56.284
11	**Poland**	152.512	142.051	165.917
12	**Russian (Fed.)**	335.350	410.542	479.331
13	**Saudi Arabia**	56.759	54.344	36.135
14	**United Kingdom**	295.787	289.896	283.604
15	**USA**	94.963	107.459	112.089
16	**Others**	639.256	830.226	931.272
17	**World**	2931.020	3211.012	3436.396

Source: FAO

7.3 Agri-Export Zones:

With a view to promote agricultural exports from the country and providing remunerative returns to the farming community in a sustained manner, the concept of the agri-export zones (AEZ) was floated. These zones have been set up for 'end to end' development for export of specific products from a geographically contiguous area.

AEZ are identified by the State Government, and evolve a comprehensive package of services provided by all State Government agencies, State agriculture universities and all institutions, and agencies of the Union Government for intensive delivery in these zones. Corporate sector with proven credentials are encouraged to sponsor new agri-export zone or take over already notified agri-export zone or part of such zones for boosting agri-exports from the zones.

Services, which are managed and coordinated by State Government/corporate sector and include provision of pre/post harvest treatment and operations, plant protection, processing, packaging, storage and related research & development etc. APEDA supplements within its schemes and provisions the efforts of various stake holders. State Governments also make efforts for facilitating such exports.

Units in AEZ would be entitled for all the facilities available for exports of goods in terms of provisions of the respective schemes.

The list of the Agri Export Zones of Mandarins is as under:

State	**Districts**
Madhya Peradesh	Chhindwara, Hoshangabad, Betul
Maharashtra	Nagpur and Amrawati

8.0 Processing and Uses

8.1 Processing:

Fruits normally have a poor shelf life and start deteriorating just after plucking. The quality of the fruits get further lowered during transshipment to the markets. Over and above to these, over ripening is also a big problem. In order to overcome these problems, the processing of fruits should be encouraged. This will improve the market efficiency and income to the farmers on one hand and generate employment on the other hand.

The fruits and vegetables processing industry occupy a key position in the agro-industrial development plan of the country. In order to avoid spoilage and ensure availability during off-season and to earn higher income, the surplus quantities must be either preserved or processed. The processing of the fruits also provides a cushion to stabilize the price during the peak harvest period.

The processing industry requires raw material of uniform shape and size. The varieties with a thin and sufficiently hard rind are preferred to soft rind. Mandarins require special handling in the preparation and juice extraction processes.

The products obtained from Mandarins are juice in the concentrated and frozen form, squash, marmalades and slices and by-products like essential orange oil, washed pulp juice, frozen concentrate, concentrate for animals and d-limonene.

Drying, chemical preservation and heat processing are the best methods at small –scale processing. During drying, the moisture content is reduced and consequently it retards the enzyme activities to a considerable extent, as well as the possibilities of microbial decay. The various chemicals such as sugar, salt, vinegar and sodium metabisulphite are generally used for preservation of fruits.

The popularity of Mandarin juice is certainly due to its pleasant and refreshing flavor, nutritional benefits from vitamin C, folic acid and the dietary fibers. Pasteurization and concentration preserve the product's quality and high nutritive value. Continuous technology improvements have enabled the industry to excel on quality with the result that today orange juice of better taste and as good as fresh squeezed juice available in the market.

With a view to help the small and marginal farmers, engaged in production of perishable fruits and vegetables, the National Horticulture Board has been implementing a project namely “Strengthening Post-Harvest Management of Horticulture Produce”.

The project is being implemented in collaboration with the National Cooperative Development Corporation (NCDC) and the National Bank for Agriculture and Rural Development (NABARD). The Board acts as a catalyst to technically and financially support for various programs, under the project implemented by farmers associations and Co-operative societies. Financial support is being extended to such activities as grading, packing, purchase of plastic containers, pre-cooling and short-duration cold storage.

8.2 Processed products:

8.2.1 Mandarin juice:

The extraction of juice from Mandarin is complicated, since it turns bitter after extraction due to limonoids present in the albedo portion and juice sacs. Juice from Mandarin is extracted either by the application of pressure to whole fruit or by reaming or pressing the halves of crosswise cut on a suitable rosette. Various types of equipments have been developed for the extraction purpose, like i) Screw type juice extractor, ii) Halving and burning machines, iii) Plunger type press, iv) CFTRI Citrus juice extractor etc.

For juice processing, it is essential to use varieties with high juice content and a good Brix°-acidity balance. The colour is especially important quality parameter in concentrated Mandarin juices, and in the preparation of citrus product bases. Juices squeezed at different times are usually combined to obtain a product with a balanced colour and taste.

Since vitamin C is the most important nutrient in citrus fruit juice, it should be present in great concentrations in the form of ascorbic acid. Another processing requirement is that, the raw material must not have an excessively bitter flavour or that it does not acquire a bitter flavour, as a result of thermal processing.

8.2.2 Not From Concentrate Juice:

Not-From-Concentrate (NFC) juice is a product that today is the closest match to fresh juice in a convenient ready-to-serve package. It meets consumer's desires for improved flavor, for less-processed products, and for more natural juicy bits of Mandarin.

The product is made by a closely controlled pasteurization process to minimize juice exposure to heat. Excessive heat contributes to cooked flavor development and undesirable changes to delicate aromatic components. Year round supply of the product is possible as a large volume of juice is stored utilizing various storage technologies.

Other important factors in the production of NFC are the control of peel oil and bitterness level in the juice. Excessive peel oil contributes to the undesirable flavor changes that can occur in citrus juices during processing and storage.

8.2.3 General sanitary standards during processing:

Quality, health standards and regulations must be strictly applied, otherwise the product will be exposed to contamination by bacteria, mould and yeasts, thus jeopardizing the expected development of an agro industrial enterprise. These measures must be adopted as early as in the production phase, and must continue in the post-harvest, transportation, storage, preparation and processing phases. Ensure that the fruit is in sound conditions for processing.

In line with these principles, the following sanitary standards must be fulfilled and applied by workers on the production premises:

i) Workers hygiene-workers must wash their hands and clean their nails carefully before engaging in any process. They must keep their nails short, and if possible, use rubber gloves.

ii) To enter the working area, workers must wear a clean smock, a hair net to protect the food from possible contamination by hair, and a mask to avoid microbial contamination.

iii) The working utensils and equipment must be cleaned appropriately to remove any waste or residual organic material and sanitized.

iv)The containers (glass jars and bottles) must be washed with hot water before being filled with food.

v) The waste generated by the production process must be removed from the production area on a daily basis.

vi) Clean and dry the outer surface of the containers with the product before sealing, labeling and storing.

vii) The storage site of the finished product must be hygienic clean and free from all possible contamination (it must have been previously fumigated). It must also be cool and dry.

8.3 Uses:

The Mandarins are having the following uses.

8.3.1 Use for kindling:

Dried Mandarin and lemon peels are a far superior choice for use as kindling than newspaper. Not only do they smell better and produce less creep up than newspaper, but the flammable oils found inside the peels enable them to burn much longer than paper.

8.3.2 As a pomander:

Pomanders have been used for centuries to fill small spaces with a delightful fragrance as well as to combat moths. They are also incredibly easy to make. Take a bunch of cloves and stick them into a Mandarin peel, covering the whole surface. Now suspend pomander using a piece of string, twine, or monofilament fishing line inside a closet or cupboard, and it will keep the space smelling fresh for years.

8.3.3 Simmer for stovetop potpourris:

Houses can be filled with a refreshing citrus scent by simmering several Mandarin and/or lemon peels in 1-2 cups of water in an aluminum pot for a few hours. Add water as needed during the simmering. This process freshens up the pot as well as the air in houses.

8.3.4 Keeps kitties off lawn:

The littering problems of cats can be solved by making a mixture of Mandarin peels and coffee grounds and distributing it around the cats' "old haunts." If they don't take the hint, lay down a second batch and try moistening it with a bit of water.

8.3.5 As mosquito repellent:

Mosquitoes and gnats are totally repulsed by scent of the orange peel.

8.3.6 As ants repellent:

In a blender, make a smooth puree of a few Mandarin peels in 1 cup warm water. Slowly pour the solution over and into anthills to send the little pests packing. This will help in to get rid of the ants in garden, on terrace, and along the foundation of house

8.3.7 As Essential Oils:

Three essential oils are obtained from Mandarins i) Oil of orange, obtained from the rind of the fruit and used principally as a flavoring agent ii) Oil of petigrain, obtained from the leaves and twigs and used in perfumery; iii) Oil of neroli, obtained from the blossoms and used in flavorings and perfumes.

8.4 Other Uses:

8.4.1 Pulp:

Citrus pulp (3/4 being a by-product of orange juice extraction) is highly valued as pelleted stock feed with a protein content of 6.58 to 7.03%. It is a source of edible yeast, non-potable alcohol, ascorbic acid, and hesperidin.

8.4.2 Peel:

In addition to its food uses, Mandarins peel oil is a prised scent in perfume and soaps. Because of its 90-95% limonene content, it has a lethal effect on houseflies, fleas and fire ants. Terpenes extracted from the outer layer of the peel are important in resins and in formulating paints.

8.4.3 Seeds:

Oil derived from Mandarins and other citrus seed is used as cooking oil and in preparation soap as well as in plastic industry. The high-protein seed residue is suitable for human food and an ingredient in cattle feed, and the hulls enter into fertilizer mixtures.

8.4.5 Flowers and foliage:

The essential oils distilled from Mandarin flowers and foliage is important in perfume manufacturing. The oil is distilled from the leaves, flowers, twigs, and small, whole, unripe fruits.

8.4.6 Nectar:

The nectar flow is more abundant than that from any other source in the United States. It is eagerly sought by honeybees and the delicious, light-colored honey is widely favored, though it darkens and granulates within a few months. Citrus honey constitutes nearly 25% of all honey produced in California each year.

8.4.7 Wood:

The wood is yellowish, close-grained and hard, but prone to attack by dry wood termites. It has been valued for furniture, cabinetwork, turnery and engraver's blocks. Branches are fashioned into walking-sticks.

8.4.8 Medicinal Uses:

Mandarins are eaten to allay fever and catarrh. The roasted pulp is prepared as a poultice for skin diseases. The fresh peel is rubbed on acne. Whole Mandarins are much useful because of its protopectin, bioflavonoids and inositol (related to vitamin B). Mandarin contains a significant amount of the vitamin-like glucoside, hesperidin, and 75-80% of it in the albedo, rag and pulp.

An infusion of the immature fruit is taken to relieve stomach and intestinal complaints. Mandarin flower water made in Italy and France as cologne is bitter and considered antispasmodic and sedative. A decoction of the dried leaves and flowers is given in Italy as an antispasmodic, cardiac sedative, antiemetic, digestive and remedy for flatulence. The inner bark, macerated and infused in wine is taken as a tonic and carminative. A vinous decoction of husked orange seeds is prescribed for urinary ailments in China and the juice of fresh Mandarin leaves or a decoction of the dried leaves may be taken as a carminative or emmenagogue or applied on sores and ulcers. Mandarin seed extract is given as a treatment for malaria in Ecuador, but it is known to cause respiratory depression and a strong contraction of the spleen.

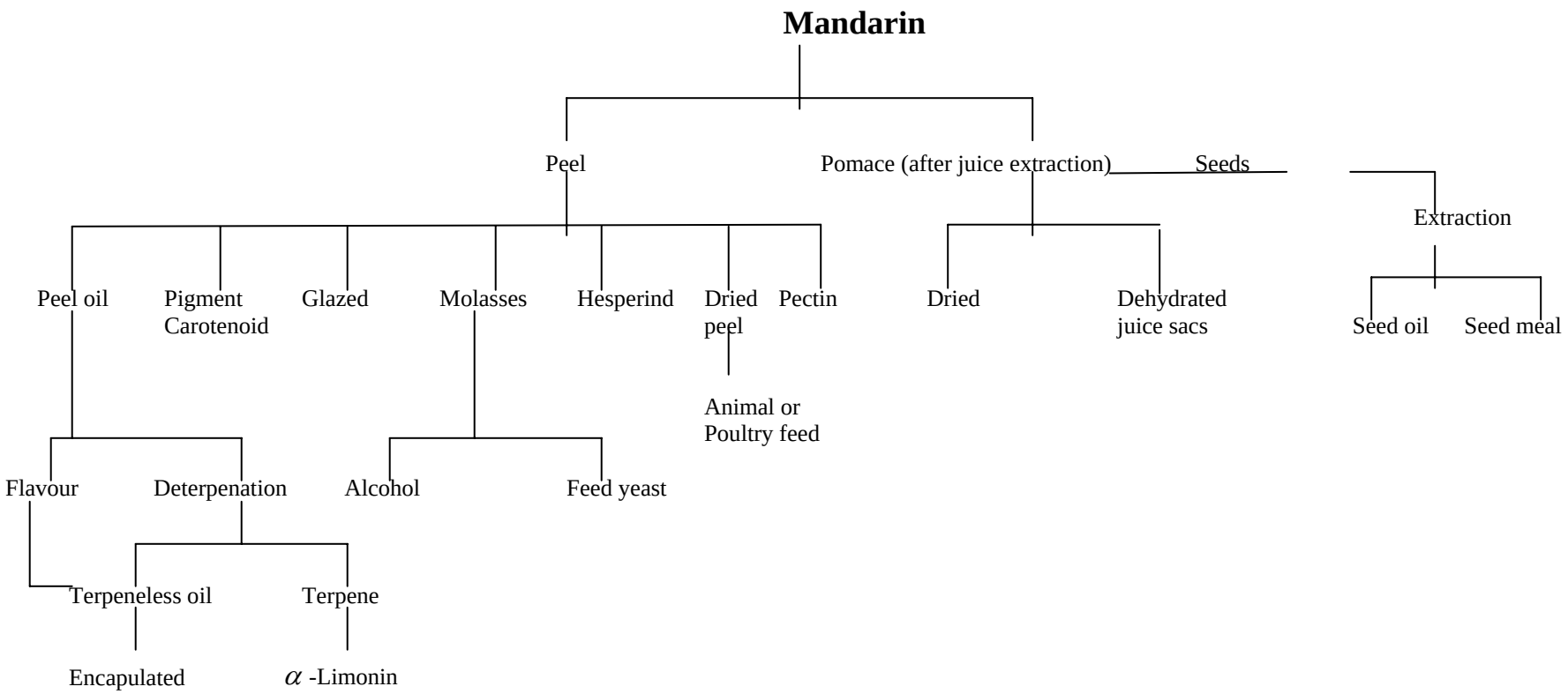
8.5 Citrus By-Products Recovery:

The by-products of citrus are an important economical aspect in citrus processing operations and it is particularly appropriate when a large volume of fruit is processed. The most common by-products derived from citrus are i) Peel oil aroma, an essential oil, ii) Frozen pulp cells and iii) Cattle feed pellets.

8.6 Toxicity

Mandarin trees may have adverse respiratory reactions in close proximity. Sawdust of the wood of orange trees, formerly used for polishing jewelry, may cause asthma. Excessive contact with the volatile oils in Mandarin peel can produce dermatitis. Sucking of Mandarins often cause skin irritation around the mouth. Excess peeling of Mandarin may have rash and blisters between the fingers. Sensitive individuals may have respiratory reactions in proximity to the volatile emanations from broken Mandarin peel.

Flow sheet showing by-products from Mandarin



Source: Central Food Technologyical Research Institute, Mysore

9.0 MARKETING INFORMATION AND EXTENSION

9.1 Marketing information:

Marketing information is indispensable in all the stages of marketing right from farm to ultimate consumption. Marketing information is essential for producers in planning and market led production. Recently, Government of India has launched Agricultural Marketing Research and Information Network Scheme through Directorate of Marketing & Inspection (DMI) to bring out improvement in the present market information system by linking all Agricultural produce wholesale markets in the States and Union Territories in a phased manner. The data received from markets is being displayed on the website ***www.agmarknet.nic.in***.

9.2 Marketing extension:

Market extension is a vital service for enlightening the farmers about proper marketing and improving their awareness on various aspects of post-harvest management for efficient and cost effective marketing. Extension service acts as bridge between farmers and various schemes sponsored by the Central, State Govts., Commodity Boards, etc.

9.2.1 Benefits:

Benefits of Market Extension are:-

- Provides the up-to-date information on the arrivals and prices of agricultural commodities of different markets.
- Helps the producers to take right decision, when, where and how much to market their produce.
- Educates the producers/traders about the post-harvest management i.e.
  a) Harvesting care
  b) Techniques to minimise losses during post-harvest period.
  c) Value addition to the produce by proper cleaning, processing, packaging, storage and transportation.
- Orients the producers/traders/consumers about price trends, demand and supply situation etc.
- Orients the producer regarding the importance of grading, proper storage, co-operative/group marketing, direct marketing, contract farming, etc.
- Provides the information about the sources of credit availability, various Govt. schemes, policies, rules and regulations etc.

9.3 Sources of Marketing Information:

The following are the sources of marketing information available in the country:

Source / Institution	Activities for marketing information and extension
1.Directorate of Marketing and Inspection (DMI), NH-IV, New CGO Complex, Faridabad. Website: www.agmarknet.nic.in	➤ Provides information through nationwide Marketing Information Network ("**AGMARKNET"** portal). ➤ Marketing extension through training to consumers, producers, graders, etc. ➤ Marketing research and surveys. ➤ Publication of reports, pamphlets, leaflets, Agricultural Marketing journal, Agmark standards etc.
2.Directorate of Economics and Statistics, Shastri Bhavan, New Delhi. Website: www.agricoop.nic.in	➤ Compilation of agricultural data on area, production and yield for development and planning. ➤ Dissemination of market intelligence through publication and Internet.
3. Directorate General of Commercial Intelligence and Statistics (DGCIS), 1, Council House Street, Kolkata-1 Website: www.dgciskol.nic.in	➤ Collection, compilation and dissemination of marketing related data i.e. export-import data, inter state movement of food grains etc.
4.Central Warehousing Corporation (CWC), 4/1 Siri Institutional Area, Opp. Siri fort, New Delhi-110016 Website: www.fieo.com/cwc/	➤ Farmers Extension Service Scheme was launched by CWC in the year 1978-79 with the following objectives : i) To educate farmers about the benefit of scientific storage and use of public warehouses. ii) To impart training to the farmers on the techniques of scientific storage and preservation of food grains. iii) To assist farmers in getting pledge loans from the banks against warehouse receipt. iv) Demonstration of spraying and fumigation methods to control pests.

5.Agricultural Produce Market Committees (APMC),	➤ Provide market information on arrivals, prevailing prices, dispatches etc. ➤ Provide market information of adjoining and distant market committees. ➤ Arrange training, tours, exhibitions etc.
6. State Agricultural Marketing Boards,	➤ Provide marketing related information to co-ordinate all the market committees in the state. ➤ Arrange seminars, workshops and exhibitions on subjects related to agricultural marketing. ➤ Provide training facilities to producers, traders and employees of the Boards.
7.Federation of Indian Export Organisations (FIEO), PHQ House(3rd Floor) Opp. Asian Games, New Delhi-110016	➤ Provide information to its members about latest developments in export and import. ➤ Organise seminars, workshops, presentations, tours, buyer-seller meets, sponsoring participation in international trade fairs, exhibitions and provide special advisory services. ➤ Provide information about market development assistance schemes. ➤ Provide useful information on India's export and import with diverse database.
8. Kisan Call Centers (New Delhi, Mumbai, Chennai, Kolkata, Hyderabad, Banglore, Chandigarh and Lucknow)	➤ Provides expert advise to the farmers. ➤ These centers operate through toll free telecom lines throughout the country. ➤ A country-wide common four digit number **1551** has been allotted to these centers.
9. Mass Media Support to Agriculture Extension	➤ Mass media support to agriculture extension has been augmented with three new initiatives. **i)** The first component establishes a cable satellite channel for national broadcast using the existing facilities available with Indira Gandhi National Open University (IGNOU). **ii)** The second component is use of low and high power transmitters of Doordarshan for providing area specific telecast. Initially, 12 locations chosen to launch broadcasting are Jalpaiguri (West Bengal), Indore (Madhya Pradesh), Sambhalpur (Orissa), Shillong

	(Meghalaya), Hissar (Haryana), Muzzafarpur (Bihar), Dibrugarh (Assam), Varanasi (Uttar Pradesh), Vijaywada (Andhra Pradesh), Gulbarga (Karnataka), Rajkot (Gujarat), Daltonganj (Jharkhand). **iii)** The third component is use of FM transmitter network of All India Radio (AIR) through 96 FM stations to provide area specific broadcasting.
10. Agriculture-Clinics and Agri-Business by Agriculture Graduates	➤ A central sector scheme "Establishment of Agriculture-Clinics and Agri-business Managed by Agriculture Graduates" is being implemented since 2001-02. ➤ The aim is to provide opportunity to all eligible agriculture graduates to support agriculture development through economically viable ventures. The scheme is being jointly implemented by NABARD, National Institute of Agricultural Extension Management (MANAGE) and Small Farmers' Agri-business Consortium (SFAC) in association with about 66 reputed training institutes in the country.
11. Different websites on Agricultural Marketing Information	www.agmarknet.nic.in www.agricoop.nic.in www.fieo.com/cwc/ www.ncdc.nic.in www.ikisan.com www.fmc.gov.in www.icar.org.in www.fao.org www.agriculturalinformation.com www.agriwatch.com www.kisan.net www.agnic.org www.nafed-india.com www.indiaagronet.com www.nic.in/eximpol www.agrisurf.com www. Commodityindia.com www.cii.in www.ficci.com

9.4 Kisan Call Centre:

The Department of Agriculture and Cooperation (DAC), Ministry of Agriculture, Government of India launched Kisan Call Centres on January 21, 2004 throughout the country. It has the objective of offering instant solution in local language to the problems faced by the farmers during crop cultivation under diverse challenging situations. The call centres are acting as composite help centres, which consist of a complex tele-communication infrastructure, computer support and human resources organized to

manage effectively and efficiently the queries raised by farmers. The subject matter specialists, using telephone and computer interact with farmers to understand their problems and answer their queries as soon as possible. This is a new dimension in agricultural extension management, which makes the full use of on-going information and communication revolution by connecting the farming community in the remotest areas of the country with the experts in agricultural field.

9.4.1 Progress of Kisan Call Centre:

Call centre based extension service deliver the knowledge and information exactly as per the requirements of the farming community. This system also helps keep a record of what is being delivered to the farmers in terms of knowledge and information. The Kisan Call Centre scheme is available over the complete country. The Kisan Call Centre scheme has been functioning from 21.1.04. The Call Centres can be accessed by farmers all over the country on common Toll Free Number 1800-180-1551.

List of Kisan Call Centres operating in the Country

S.No.	Call Centre Location	States covered
1.	Mumbai	Maharashtra, Goa, Daman, Diu
2.	Kanpur	Uttar Pradesh, Uttranchal
3.	Kochi	Kerala, Lakshadweep
4.	Bangalore	Karnataka
5.	Chennai	T.N. Andaman/ Nicobar
6.	Hyderabad	Andhra Pradesh
7.	Chandigarh	Chandigarh, J&K, Himachal Pradesh, Punjab
8.	Jaipur	Rajasthan
9.	Indore	Madhya Pradesh, Chattisgarh
10.	Kolkata	West Bengal, Bihar, Orissa, Jharkhand
11.	Kolkata	N.E. States
12.	Delhi	Delhi/ Haryana
13.	Ahmedabad	Gujarat and Dadra & Nagar Haveli

List of nodal officers of Kisan Call Centres in the country

Director, Incharge, Directorate of Cotton Development, 14, Ramjibhai, Kamani Marg Ballard Estate, P.B.No.1002 Mumbai – 400038 Director_docd@rediffmail.com	Director, Coconut Development Board, Regional Office, AF 6/2004, 7th Street, 11th Main Road, Annanagar, Chennai – 600040 (Tamil Nadu) cdb@tn.nic.in	Managing Director, National Horticulture Board, Plot No.85, Sector 18,Institutional Area, Gurgaon – 122 015 (Harayana) mdnhb@yahoo.com
Managing Director National Cooperative Development Corporation, Hauz Khas, Institutional Area, New Delhi md@ncdc.stpn.soft.net	Director General National Institute of Agricultural Extension Management (MANAGE), Rajednranagar Hyderabad – 500 030 (Andhra Pradesh) dgmanago@manago.gov.in	Director In-charge Directorate of Pulses Development Vindyachal Bhawan, Bhopal (Madhya Pradesh) dpd@hub.nic.in
Coconut Development Officer Coconut Development Board Ministry of Agriculture, Government of India, Khera Bhawan, SRVHS Road, Cochin-682 011 Kerala cdbkochi@vsnl.com	Director Directorate of Wheat Development C.G.O. Complex-I, 3rd Floor, Kamla Nehru Nagar, Ghaziabad- dwd@hub.nic.in 201 002 (U.P.)	Director Directorate of Jute Development Nizam Palace Campus, 234/4, Acharaya J.C. Bose Road, Kolkata – 700020 djd@hub.nic.in
Director Coconut Development Board, Regional Office-cum-	Director General National Institute of Agricultural Marketing,	Managing Director Small Farmers Agri. Business Consortium

Technology Centre, Hulimavu, Bannergatta Road, Besides Horticulture Farm, Govt.of Karnataka, Bangalore South, Bangalore – 560 076 (Karnataka) Cdb_blr@kar.nic.in	Kota Road, Bambala, Near Sangener, Jaipur-303 906 (Rajasthan) niam@datainfosys.net	(SFAC), NCUI Building, 5th Floor, August Kranti Marg, 3, Siri Institutional Area, Hauz Khas, New Delhi – 110016 sfac@ren02.nic.in

10.0 ALTERNATIVE SYSTEMS OF MARKETING:

10.1 Direct marketing:

Direct marketing is an innovative concept, which involves marketing of produce by the farmer directly to the consumers/millers without any middlemen. Direct marketing enables producers and other bulk buyers to economize on transportation cost and improve price realization. It also provides incentive to large scale marketing companies and exporters to purchase directly from producing areas. Direct marketing by farmers to the consumers has been experimented in the country through *Apni Mandis* in Punjab and Haryana.. At present, these markets are being run at the expense of the state exchequer, as a promotional measure, to encourage marketing by small and marginal producers without the involvement of the middlemen.

10.1.1 Benefits:

- It generates the idea of market oriented production.
- It increases profit of the producer.
- It helps in better marketing.
- It minimizes marketing cost.
- It encourages distribution efficiency.
- It promotes employment to the producer.
- Direct marketing enhances the consumer satisfaction.
- It provides better marketing techniques to producers.
- It encourages direct contact between producers and consumers.
- It encourages the farmers for retail sale of their produce.

10.2 Contract marketing/farming:

Contract marketing/farming is a system of marketing, where selected crop is grown for marketing by farmers under a 'buy-back' agreement with an agency (entrepreneur or trader or processor or manufacturer). In the wake of economic liberalization, it has gained momentum, as the national and multinational companies enter into contracts with farmers for marketing of agricultural produce. They also provide technical guidance, capital and input facility to contracted farmers. Contract marketing/farming ensures continuous supply of quality produce at mutually contracted price to contracting agencies, as well as ensures timely marketing of the produce. Though, the contract marketing/farming is not prevalent in the marketing of Mandarin but, it is beneficial to both the parties i.e. farmers and the contracting agencies.

10.2.1 Advantages to farmers: -

- Price assurance, ensuring fair return to the producer.
- Proper production planning.
- Assured market.
- Availability of cost free production and post- harvest technology.

- Freedom from the clutches of middlemen.
- Fair trade practices.
- Credit facility.
- Crop insurance.
- Exposure to new technology and best practices.

10.2.2 Advantages to contracting agency: -

- Assured supply of produce (raw materials).
- Control on need based production/post-harvest handling.
- Control on quality of produce.
- Stability in price as per mutually agreed contract terms and conditions.
- Opportunities to acquire and introduce desired varieties of crop.
- Help in meeting specific customer needs/choice.
- Better control on logistics.
- Strengthen producer-buyer relationship.

Though, the contract farming is not prevalent in case of marketing of Mandarin, but looking into the benefits of the contract farming, this system may be explored on the trial basis.

10.3 Co-operative marketing:

"Co-operative marketing" is the system of marketing in which a group of producers join together and register them under respective State Co-operative Societies Act to market their produce jointly. The members also deal in a number of co-operative marketing activities i.e. purchasing of produce, grading, packing, processing, storage, transport, finance, etc. The co-operative marketing means selling of the member's produce directly in the market, which fetches remunerative prices. Co-operative societies, market the member's produce collectively and reap the advantage of economy of scale to its members. It also provides fair trade practices and protect against manipulations / malpractices. The main objectives of co-operative marketing are to ensure remunerative prices to the producers, reduction in the cost of marketing and monopoly of traders.

The co-operative marketing structure in the different states consists of;

i) **Primary Marketing Society (PMS) at the Mandi level.**
ii) **State Co-operative Marketing Federation (SCMF) at the State level.**
iii) **National Agricultural Co-operative Marketing Federation of India Limited (NAFED) at the National level.**
iv) **NOGA at Nagpur (A processing unit)**

National Co-operative Development Corporation (NCDC) and State Governments are providing financial assistance and other facilities for development of Co-operative Marketing Societies.

10.3.1 Benefits:

- Remunerative price to producers.
- Reduction in cost of marketing.

- Marketing without commission charges.
- Effective use of infrastructure.
- Credit facilities.
- Reduces malpractices.
- Marketing information.
- Supply of agricultural inputs.
- Collective processing.
- Timely and easy transportation service.

11.0 INSTITUTIONAL FACILITIES

11.1 Marketing related schemes of Government / Public Sector:

Name of the scheme/imple-menting organisation	Facilities provided/salient features/ objectives
1.Marketing Research and Information Network, Directorate of Marketing & Inspection, Head Office, N.H.-IV, Faridabad.	▶ To establish a nationwide information network for speedy collection and dissemination of market data for its efficient and timely utilization. ▶ To ensure flow of regular and reliable data to the producers, traders and consumers to derive maximum advantage out of their sales and purchases. ▶ To increase efficiency in marketing by effective improvement in the existing market information system. The scheme provided connectivity to 3026 nodes comprising the State Agricultural Marketing Department (SAMD) /Boards/ Markets. These concerned nodes have been provided with one computer and its peripherals. These SAMD/Boards/ Markets are to collect desired market information and pass on to respective state authorities and Head Office of the DMI for forward dissemination. The eligible markets will get 100 percent grant by Ministry of Agriculture.
2.Gramin Bhandaran Yojana (Rural Godowns Scheme), Directorate of Marketing & Inspection, Head Office, N.H.-IV, Faridabad.	▶ It is a capital investment subsidy scheme for construction/renovation/expansion of rural godowns. The scheme is implemented by DMI in collaboration with NABARD and NCDC. The objectives of the scheme are to create scientific storage capacity with allied facilities in rural areas to meet the requirements of farmers for storing farm produce, processed farm produce, consumer articles and agricultural inputs. ▶ To prevent distress sale immediately after harvest. ▶ To promote grading, standardization and quality control of agricultural produce to improve their marketability. ▶ To promote pledge financing and marketing credit to strengthen agricultural marketing in the country for the introduction of a national system of warehouse receipt in respect of agricultural commodities stored in such godowns. ▶ The entrepreneur will be free to construct godown at any place and of any size between 100 to 10,000 MT except for restrictions that it would be outside the limits of Municipal Corporation area. In special conditions, godowns upto 50 MT is also eligible for subsidy and in hilly region it may be 25 MT. ▶ The scheme provides credit linked back-ended subsidy @15 per cent of the project cost with a ceiling of Rs. 28.12 lakh per project

	and @ 25 per cent of the project cost with a ceiling of Rs. 46.87 lakh per project. For the projects located in North-Eastern states and hilly areas with altitude of more than 1000 m above mean sea level and those belonging to Women Farmers/ their self help groups/ Co-operatives and SC/ST entrepreneurs and their self help groups/ Co-operatives, maximum subsidy admissible is @33.33 percent of the project cost, with a ceiling of Rs. 62.50 lakhs.
3.Scheme for Development/ Strengthening of Agricultural Marketing Infra-structure, Grading & Standardization, Directorate of Marketing and Inspection, Head Office, N.H.-IV, Faridabad.	▶ To provide additional agricultural marketing infra-structure to cope up with the expected marketable surpluses of agricultural and allied commodities including dairy, poultry, fishery, livestock and minor forest produce. ▶ To promote competitive alternative agricultural marketing infrastructure by inducement of private and co-operative sector investments that sustain incentives for quality and enhanced productivity thereby improving farmers' income. ▶ To strengthen existing agricultural marketing infra-structure to enhance efficiency. ▶ To promote direct marketing so as to increase market efficiency through reduction in intermediaries and handling channels thus enhancing farmers' income. ▶ To provide infra-structure facilities for grading, standardization and quality certification of agricultural produce so as to ensure price to the farmers commensurate with the quality of the produce. ▶ To promote grading, standardization and quality certification system for giving a major thrust for promotion of pledge financing and marketing credit, introduction of negotiable warehousing receipt system and promotion of forward and future markets so as to stabilize market system and increase farmers' income. ▶ To promote direct integration of processing units with producers. ▶ To create general awareness and provide education and training to farmers, entrepreneurs and market functionaries on agricultural marketing including grading and quality certification. ▶ This is Reform linked investment scheme. Applicable only in such states/Union Territories, which undertake reforms in APMC Act to allow "Direct Marketing", "Contract Marketing" and to permit agricultural produce markets in private and co-operative sectors. The scheme provides credit linked back-ended subsidy @ 25 per cent of the capital cost of the project with a ceiling of Rs. 50.00 lakh per project. For the projects located in North-Eastern states, in the

	states of Uttarakhand, Himachal Pradesh, Jammu & Kashmir, hilly and tribal areas, and entrepreneurs belonging to SC/ST and their co-operatives, maximum subsidy admissible is @33.33 percent of the capital cost of the project, with a ceiling of Rs. 60.00 lakhs.
4.Agmark grading and standardization Directorate of Marketing & Inspection, Head Office, N.H.-IV, Faridabad.	▶ Promotion of grading of agricultural and allied commodities under Agricultural Produce (Grading & Marking) Act.1937. ▶ Agmark specifications for agricultural commodities have been framed based on their intrinsic quality. Food safety factors are being incorporated in the standards to compete in the world trade. Standards are being harmonised with international standards keeping in view the WTO requirements. Certification of agricultural commodities is carried out for the benefit of producer and consumer.
5. Capital Investment Subsidy for Construction / Modernization Expansion of Cold Storage and Storage's for Horticulture Produce National Horticultural Board, 85, Institutional Area, Sector – 18 Gurgoan - 122015 (Haryana) Website : www.nhb.gov.in	▶ To promote setting up of cold storages in the country for reducing post harvest losses. ▶ Creation and modernization/rehabilitation of cold storages. ▶ **Pattern of Assistance:** • The assistance will be as credit linked back-ended subsidy @ 40% of the capital cost of project in general areas and 55% in case of Hilly and Scheduled Areas for a maximum storage capacity of 5000 MT per project.
6. Development of commercial Horticulture through Production and Post-Harvest Management, National Horticultural Board, 85, Institutional Area,Sector – 18 Gurgoan - 122015 Website : www.nhb.gov.in	▶ To develop post-harvest management infrastructure; ▶ To develop high quality horticultural farms in identified belts. ▶ To improve linkages between horticulture producers and marketers ▶ To create integrated network for marketing of horticulture produce. ▶ To increase producer's share in consumer price. ▶ To encourage networking of schemes for resource mobilization with all other related agencies/organizations

7. Schemes for Infrastructure Development, Agricultural & Processed Food Products Export Development Authority (APEDA), NCUI Building 3, Siri Institutional Area, August Kranti Marg, New Delhi - 110 016 Website: www.apeda.com	▶ Establishment of common infrastructure facilities. ▶ Assistance for purchase of specialised transport units for animal products horticulture and floriculture sector. ▶ Assistance to exporters / producers / growers / Cooperative organization and federations for horticulture and floriculture sector for : i) Mechanisation of harvest operation of the produce. ii) Setting up of sheds for intermediate storage and grading / storage / cleaning operation of produce. iii) Setting up of mechanized handling facilities including sorting, grading, washing, waxing, ripening, packaging & palletisation etc. iv) Setting up of both pre cooling facilities with proper handling system as well as cold storage for storing. v) Providing facilities for preshipment treatment such as fumigation, X-ray screening, hot water dip treatment, Water softening Plant. vi) Setting up of integrated post harvest-handling system (pack houses / green houses with any two or more of the above facilities). vii) Setting up of specilised storage facilites such as high humidity cold storage deep freezers, controlled atmosphere (CA) or modified atmosphere (MA) storage etc.
8.Schemes for Market Development, Agricultural & Processed Food Products Export Development Authority (APEDA), NCUI Building 3, Siri Institutional Area, August Kranti Marg, New Delhi - 110 016 Website: www.apeda.com	▶ Development of packaging standards and design. ▶ Up-gradation of already developed packing standards. ▶ Assistance to exporters for use of packaging material. ▶ Development and dissemination of market information with base on products, infrastructure etc. ▶ Assistance for conducting surveys, feasibility studies etc.
9. National Horticulture Mission Govt. of India Ministry of Agriculture	▶ To provide holistic growth of the horticulture sector through an area based regionally differentiated strategies which include research, technology promotion, extension, post harvest management, processing and marketing, in consonance with comparative advantage of each State/region and its diverse agro-climatic feature.

Department of Agriculture & Cooperation New Delhi http://nhm.nic.in/	▶ To enhance horticulture production, improve nutritional security and income support to farm households. ▶ To establish convergence and synergy among multiple on-going and planned programmes for horticulture development. ▶ To promote, develop and disseminate technologies, through a seamless blend of traditional wisdom and modern scientific knowledge. ▶ To create opportunities for employment generation for skilled and unskilled persons, especially unemployed youth.
10. Scheme of technology mission for integrated development of horticulture in North Eastern states Jammu & Kashmir, Himachal Pradesh and Uttarakhand (TMNE) Government of India Ministry of Agriculture Department of Agriculture & Cooperation (Horticulture Division) Krishi Bhawan, New Delhi www.dacnet.nic.in/techmissionscheme	▶ To ensure adequate, appropriate, timely and concurrent attention to all the links in the production, post-harvest management and consumption chain in North Eastern states including Sikkim. ▶ To maximise economic, ecological and social benefits from the existing investments and infrastructure created for horticulture development. ▶ To promote ecologically sustainable intensification, economically desirable diversification and skilled employment to generate value addition. ▶ To promote the development and dissemination of eco-technologies based on the blending of the traditional wisdom and technology with frontier knowledge such as bio-technology, information technology and space technology. ▶ To provide the missing links in ongoing horticulture development projects. **<u>The Technology Mission have four Mini Missions:</u>** i) Mini Mission-I: Research: Coordinated and implemented by ICAR. ii) Mini Mission-II: Production and Productivity: Coordinated by DAC and implemented by the Agriculture / Horticulture Departments of the States. iii) Mini Mission–III: Post-harvest management, marketing and export: Coordinated by DAC and implemented by NHB, DMI, NCDC, NAFED and APEDA. iv) Mini Mission-IV: Processing: Coordinated and implemented by MFPI.
11. National Agriculture Development Programme-Rashtriya Krishi Vikas Yojana (RKVY) Government of India	▶ To incentivise the states so as to increase public investment in Agriculture and allied sectors. ▶ To provide flexibility and autonomy to states in the process of planning and executing Agriculture and allied sector schemes. ▶ To ensure the preparation of agriculture plans for the districts and the states based on agro-climatic conditions, availability of technology and natural resources. ▶ To ensure that the local needs/crops/priorities are better reflected

Ministry of Agriculture Department of Agriculture & Cooperation Krishi Bhawan, New Delhi http://india.gov.in	in the agricultural plans of the states. ▶ To achieve the goal of reducing the yield gaps in important crops, through focussed interventions. ▶ To maximize returns to the farmers in Agriculture and allied sectors. ▶ To bring about quantifiable changes in the production and productivity of various components of Agriculture and allied sectors.
12.(i)Scheme for Infrastructure Development Ministry of Food Processing Industries, Ministry of Food Processing Industries, Panchsheel Bhavan,August Kranti Marg, New Delhi-110 049 **Website:** www.mofpi.nic.in	To provide financial assistance for development of facilities like common processing, cold storage, food testing and analysis laboratory, effluent treatment plant, power, water etc. in Food Park, Packaging Centre, Integrated Cold Chain, Value Added Centre, Irradiation Facilities.
12(ii)Scheme for Technology Upgradation /Establishment /Modernization of Food Processing Industries	To provide financial assistance for the cost of plant and machinery/TCW.
12(iii)Scheme for Quality Assurance, Codex Standards and Research & Development	Financial assistance for Setting Up/ Upgradation of Quality Control/ Food Testing Laboratory for implementation of Hazard Analysis and Critical Control Points (HACCP), ISO 9000, ISO14000, Good Manufacturing Practices (GMP) and Good Hygienic Practices (GHP) for Total Quality Management, Bar Coding, Codex Standards Research and Development in Processed Food Sector.
12 (iv)Scheme for Backward and Forward Integration and other	**Backward Linkage**-To increase capacity utilization of Food Processing Industry by ensuring regular supply of raw material through contract farming. **Forward Integration**-To increase capacity utilization of Food Processing Units by ensuring regular market for their products by

Promotional Activities	establishing linkages with the market. **Promotional Activities-** To build awareness among the consumers about the advantages of processed food and their quality assurance mechanism. Dissemination of information about the processed food industry through publications, journals, press advertisements. Financial assistance for seminars/workshops /symposiums, studies/ surveys/ feasibility reports to assess the potential and other relevant aspects of Food Processing Industries.

11.2 Institutional credit facilities:

Institutional credit facilities are the vital factor in agricultural development. The main emphasis is laid down on adequate and timely credit support to the farmers, particularly small and marginal farmers for encouraging adoption of modern technology and improved agricultural practices.

The institutional agriculture credit disbursed through co-operatives was 31 per cent, 60 per cent through Commercial Banks and 9 per cent through Regional Rural Banks during 2003-2004.

The institutional credit to agriculture is offered in the form of short term, medium term and long term credit facilities:

11.3 Short terms and medium term loans:

Name of scheme	Eligibility	Objective/Facilities
1. Crop Loan	All categories of farmers.	➢ To meet cultivation expenses for various crops as short term loan. ➢ This loan is extended in the form of direct finance to farmers with a repayment period not exceeding 18 months.
2.Produce Marketing Loan (PML)	All categories of farmers.	➢ This loan is given to help farmers to store produce at their own to avoid distress sale. ➢ This loan also facilitates immediate renewal of crop loans for next crop. ➢ The repayment period of the loan does not exceed 6 months.

3. Kisan Credit Card Scheme	All agriculture clients having good track record for the last two years.	➢ This card provides running account facilities to farmers to meet their production credit and contingency needs. ➢ The scheme follows simplified procedures to enable the farmers to avail the crop loans as and when they need. ➢ Minimum credit limit is Rs. 3000/-. Credit limit is based on operational land holding, cropping pattern and scale of finance. ➢ Withdrawals can be made by using easy and convenient withdrawal slips. The Kisan Credit Card is valid for 3 years subject to annual review. ➢ It also covers personal insurance against death or permanent disability; a maximum amount of Rs. 50,000 and Rs. 25,000 respectively.
4.National Agricultural Insurance Scheme	Scheme is available to all farmers – loanee and non-loanee both-irrespective of the size of their holding.	➢ To provide insurance coverage and financial support to the farmers in the event of failure of any of the notified crops as a result of natural calamities, pests and diseases attack. ➢ To encourage the farmers to adopt progressive farming practices, high value in-puts and higher technology in agriculture. ➢ To stabilize farm incomes, particularly in adverse periods. ➢ General Insurance Corporation of India (GIC) is the Implementing Agency. ➢ Sum insured may extend to the value of threshold yield of the area insured. ➢ Coverage of food crops (cereals, millets and pulses), oilseeds and annual commercial / horticultural crops. At present, crops like Sugarcane, Potato, Chilies, Ginger, Onion and Turmeric are covered under the scheme. ➢ Provides subsidy of 50 per cent of premium charged from small and marginal farmers. The subsidy is phased out over a period of 5 years on sunset basis.

11.4 Long terms loans:

Name of scheme	Eligibility	Objective/Facilities
Agricultural Term Loan	All categories of farmers (small/medium and agricultural labourers) are eligible, provided they have necessary experience in the activity and required area.	➤ The banks extend this loan to farmers to create assets facilitating crop production/income generation. ➤ Activities covered under this scheme are land development, minor irrigation, farm mechanization, plantation and horticulture, dairying, poultry, sericulture, dry land / waste land development schemes etc. ➤ This loan is offered in the form of direct finance to farmers with a repayment span not less than 3 years and not exceeding 15 years.

11.5 Organisations / agencies providing marketing services:

Name of the organisation and address	Services provided
1.Directorate of Marketing and Inspection (DMI) NH-IV, New CGO Complex Faridabad Website: www.agmarknet.nic.in	➤ To integrate development of marketing of agricultural and allied produce in the country. ➤ Promotion of standardization and grading of agricultural and allied produce. ➤ Market development through regulation, planning and designing. ➤ Promotion of cold storage. ➤ Promotion of rural godowns and market infrastructure. ➤ Training of personnel in agricultural marketing. ➤ Undertakes extension and publicity activities to educate producers, traders and consumers. ➤ Providing agricultural marketing information. ➤ Liaison between the Central and State Governments through its regional offices (11) and sub-offices (26) spread all over the country.
2.Agricultural and Processed Food Products Export Development Authority (APEDA) NCUI Building, 3, Siri	➤ Development of scheduled agriculture products related industries for export. ➤ Provides financial assistance to these industries for conducting surveys, sensibility studies, relief and subsidy schemes. ➤ Registration of exporters for scheduled products. ➤ Adapting standards and specifications for the purpose of export of

Institutional Area, August Kranti Marg, New Delhi-110016 Website: www.apeda.com	scheduled products. ➤ Carrying out inspection of meat and meat products for ensuring the quality of such products. ➤ Improving the packaging of the scheduled products. ➤ Promotion of export oriented production and development of scheduled products. ➤ Collection and publication of statistics for improving marketing of scheduled products. ➤ Training in the various aspects of industries related to the scheduled products.
3.National Agricultural Cooperative Marketing Federation of India Limited (NAFED), Nafed House, Sidhartha Enclave, New Delhi – 110014 Website: www.nafed-india.com	➤ Co-ordinate and promote the marketing and trading activities of its affiliated co-operative institutions; ➤ Make arrangements for the supply of the agricultural inputs required by member institutions; ➤ Promote inter-state and international trade in agricultural and other commodities; ➤ Act as an agent of the government for the purchase, sale, storage and distribution of agricultural products and inputs.
4.Central Warehousing Corporation (CWC), 4/1 Siri Institutional Area, Opp. Siri fort New Delhi -110016 Website : www.fieo.com/cwc/	➤ Provides scientific storage and handling facilities. ➤ Offers consultancy services / training for the construction of warehousing infrastructure to different agencies. ➤ Import and export warehousing facilities. ➤ Provides disinfestations services.
5.National Co-operative Development Corporation (NCDC), 4, Siri Institutional Area, New Delhi-110016 Website: www.ncdc.nic.in	➤ Planning, promoting and financing programmes for production, processing, marketing, storage, export and import of agricultural produce. ➤ Financial support to Primary, Regional, State and National level marketing societies is provided towards; i) Margin money and working capital finance to augment business operations of agricultural produce. ii) Strengthening the share capital base, and iii) Purchase of transport vehicles.

6.Director General of Foreign Trade (DGFT), Udyog Bhavan, New Delhi. Website: www.nic.in/eximpol	➤ Provides guidelines / procedure of export and import of different commodities. ➤ Allot import-export code number (IEC No) to the exporter of agricultural commodities.
7.Mother Dairy Fruit and Vegetable Private Limited Mother Dairy Fruit and Vegetable Private limited Patparganj Delhi 110092 www.safalindia.com	➤ It is a subsidiary company of a wholly owned company of the National Dairy Development Board (NDDB). ➤ Mother Dairy sells the Safal range of fresh fruits & vegetables, frozen vegetables and fruit juices at a national level through its sales and distribution networks for marketing food items.. ➤ The company markets an array of fresh and frozen fruit and vegetable products under the brand name SAFAL through a chain of 295 owned Fruit and Vegetable shops and more than 20,000 retail outlets in various parts of the country.
8.State Agricultural Marketing Board (SAMBs),	➤ Implementation of the regulation of marketing of agricultural and allied commodities in the state. ➤ Provide infrastructural facilities for the marketing of notified agricultural produce. ➤ Grading of agricultural produce in the markets. ➤ To co-ordinate all the market committees for information services. ➤ Provide aid to financially weak or needy market committees in the form of loans and grants. ➤ To eliminate malpractices in the marketing system. ➤ To arrange or organise seminars, workshops or exhibitions on subjects relating to agricultural marketing.

Annexure I

Terminal Markets Complex

Objectives

(a) Main objectives of setting up Terminal Markets Complex (TMC) are:

(i) Link farmers to markets by shortening supply chain of perishables and enhance their efficiency and increase in farmer's income;
(ii) Provide professionally managed competitive alternative marketing structures with state of art technology, that provide multiple choices to farmers for sale of their agricultural produce;
(iii) Drive reforms in agricultural marketing sector resulting in accelerated development of marketing and post harvest infrastructure including cool chain infrastructure in the country, through private sector investment;
(iv) Bring transparency in market transactions and price fixation for agricultural produce and through provision of backward **linkages** to enable farmers to realise higher price and higher income.

Salient Features

(a). Terminal Market Complex (TMC) can be set up in States, which undertake reforms in their laws relating to agricultural marketing, to provide direct marketing and permit the setting up of markets in private and cooperative sectors.
(b). TMC will operate on a Hub-and-Spoke Format wherein Terminal Market Complex (hub) would be linked to a minimum number of Collection Centres (CC) (spokes) which are essentially required to support the Terminal Market Complex project.
(c). Spokes will be conveniently located at key production centres to allow easy farmer access and catchment area of each spoke will be based on meeting convenient needs of farmers, operational efficiency and effective capital utilisation of investment.
(d). TMC will establish backward linkages with farmers through collection centres and forward linkages through wholesalers, distribution centres, retail cash and carry stores, processing units for exporters etc.
(e). Collection Centres in production areas will integrate producers and retailers, processing units and exporters etc. into market system. The number of Collection Centres shall be determined in each case depending on the size of the market, distance from growing areas and other factors.
(f). Electronic auction system will be established to ensure transparency in price fixation and competition.
(g). Scheme would attract and facilitate private sector investment in agribusiness sector by assisting key **s**takeholders in sectors, such as entrepreneurs, processing industries, exporters, producer associations and farmers etc. through provision of subsidy under National Horticulture Mission (NHM).
(h). Producers, farmers and their associations and other market functionaries from any part of the country may use infrastructure and facilities of TMC, directly or through collection centres.
(i). TMC will provide one-stop solution in terms of providing logistics support including transport services and cool chain facility.
(j). TMC Project will be implemented as a separate company/SPV to be registered under Companies Act, 1956 through suitable Private Enterprise (PE) to be selected as Promoter

through process of competitive bidding. PE should offer to provide up to 26% share holding in equity for TMC Project to Producers' Association[1] at inception of project and accordingly make reasonable efforts[2] for ensuring the participation from Producers' Associations.

Producers Association will consist of farmer societies, farmers cooperative societies registered in India engaged in Agricultural and allied activities, Producer Company, registered NGO's empanelled with GOI/State Govt./Planning Commission and SHGs recognized under schemes of Government of India or State Governments and working in agricultural production, Independent Commodity Boards and other registered organizations such as APMCs etc engaged in production, procurement and trading of agricultural commodities. The producer association should be separate from the Lead Technical and Lead Financial Member

(k). The area of operation of the TMC should be clearly defined and any other proposal in future for setting up of TMC within the whole or part of the defined area of operation of the designated TMC and its CCs will not be granted any subsidy under NHM for a period of 10 years.

Eligibility

Terminal Market Complex project would be built, owned and operated by the selected Private Enterprise (PE) through Competitive Bidding process. PE includes individual or consortium, Group of Farmers/Growers/Consumers/Producer Organisations/Producer Company, Partnership/ Proprietary firms, Companies, Marketing Boards, Public Sector Undertaking, Co-operatives, registered NGOs empanelled with GOI/State Govt./Planning Commission, recognised Self Help Groups under the schemes of GOI/State Govts. and other registered bodies engaged in production and trading of agricultural produce. The PE could also be a consortium of entrepreneurs from, *inter-alia*, agri-business, cold chain, logistics, warehousing, agri-infrastructure and related background.

Commodities

The commodities to be marketed by the TMC will include all perishables, inter-alia, fruits, vegetables, flowers, spices, aromatics, herbs, medicinal plants, meat products, poultry products, dairy products and fish and marine products etc. Non-perishables can also be handled in the TMC. However, the annual throughput for perishable horticultural produce such as fruits, vegetables, flowers, medicinal plants, aromatics, herbs etc handled by each TMC should not be less than 70% of the throughput capacity of the TMC. In addition to this, each TMC shall be allowed to handle other perishable products (other than horticultural produce such as milk, dairy, poultry, meat, fish and marine products etc) and Non-Perishables[3] products. Volume of other perishable products (other than horticultural produce) and Non-Perishable products shall not exceed 30% of throughput capacity of TMC.

Release of Subsidy

(a) Subsidy of NHM for Terminal Market Complex Project will be released in following five instalments.

(i) I instalment on completion of 25% of project ------ 15% of the approved subsidy
(ii) II instalment on completion of 50% of project ------ 20% of the approved subsidy
(iii) III instalment on completion of 75% of project ------ 25% of the approved subsidy
(iv) IV instalment on completion of 100% of project ------ 30% of the approved subsidy
(v) V instalment on completion of one year of operation of project 10% of the approved subsidy

(b) Release of subsidy shall be subject to utilization of previous subsidies for this project and Inspection certificate is issued by Joint inspection team comprising of Nodal officer or his representative, IC and a representative of DAC, Ministry of Agriculture for satisfactory 16 completion of prescribed mandatory capital project. Release of subsidy shall also subject to equity participation of Producer Association, as promised by the PE. In case % of equity participation from Producers Association, at time of release of fourth instalment of subsidy, is less than % mentioned at time of submission of technical bid and the PE has not made reasonable effort for ensuring participation of Producer's associations, GoI/State Government shall have the right to withhold release of entire amount of subsidy to PE. Further SHM/State Government may:

(i). Intimate this requirement to PE through written communication within 15 days of the due date of release of first instalment of subsidy,
(ii). Stop release of IV and V instalment of subsidy till the PE fulfils the required equity participation from Producers' Associations

(c) Provided that if the percentage of equity participation by producer association remains below the percentage of equity of the project as promised /quoted, by the PE at the time of bidding and considered at the time of evaluation of the bid, within two years of signing of OMDA or transfer of land to PE whichever is later, despite reasonable efforts made by PE, no restrictions shall be imposed on the PE in this regard and the eligible subsidy shall be released to him as due. (d) This stipulation will not be applicable to successful bidder/PE who has not committed any equity to Producers' Association in his bid.

(For more details visit *www.agmarknet.nic.in*)