Estimation Loss of Horticulture Produce due to Non-availability of Post Harvest & Food Processing Facilities in Bihar & UP

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Socio-Economic Research
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PREFACE

The study 'Estimating loss of horticulture produce due to non-availability of post harvest and food processing facilities in Bihar and Uttarpradesh' was commissioned by the planning commission to the Association for Social and Economic Transformation(ASET).

The study has attempted to analyse various aspects of post harvest losses as well as to quantify the exact losses of horticulture produce dueto lack of post harvest storage and processing facilities. This study has also focussed on huge employment potential of this sector.And, at last remedial measures have been suggested to minimise unwarrantably high rate of loss of these produce.

The final report is outcome of the effort of many people.The ASET has got substantial support from different sources. Though, it is not practically possible to name each of them, I can not resist temptation to name few of them. First of all, I must express my gratitude to Dr. S.P.Gupta, member, Planning Commission for his interest in this study, right from beginning. In same whiff, I must say that this report would not have got its present shape without valuable suggestions of Mr. S.G.Raoot, joint adviser,VSI. We are also grateful to Mr. P.K.Agrawal for his cooperative attitude and responsiveness, which helped us in accomplishing this study in time.

At last but definitely not the least imporant contribution to this study was made by the numerous researchers, farmers and the people of Bihar and Uttar Pradesh, who helped in conducting field surveys and gave invaluable information, that is backbone of this study.

We are also thankful to Ajit Kumar Jha and Kuntal, who helped in tabulation of the data collected by the field surveyors. In this regard I want to give my special thanks to Suman and Kanika for their support in course of this study.

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Executive Summary

There is no link between production of horticulture produce and its demand in the market. Main reason behind this occurrence is lack of commercial awareness. As a result, main objective behind cultivation of horticulture is- particularly of small and marginal farmer- self consumption. For commercial and other purpose, they rely mainly on other crops, such as wheat, paddy etc.

Traditional sugar cane grower farmers of Uttar Pradesh, though want to switch over from sugar cane to horticulture, but lack of market is constraining them.

Horticulture producers of both states are in a very bad shape because of excess production, therefore central and state, both governments should act in resonance and make urgent efforts to export surplus produce.

Whole orientation of farmers in both states is towards production. Their negligent attitude towards post harvest losses, lack of quality consciousness and absence of food processing units and unavailability of modern cold storages are responsible of huge post harvest losses.

Cold storages of both states have been built primarily for preservation of potato only. Therefore, other horticulture products can not be kept there. Therefore, modern cold storages should be built and old one should be upgraded, so that other products also can be kept there.

Most of the cold storages of both states are of a big size and generally located in a city centre , therefore, small sized cold storages should be built near agriculture field itself. This will reduce transportation cost and as a result more farmers will be encouraged to use this facility.

Post harvest loss of horticulture produce vary between 5-39 per cent of total production. In case of brinjal, cauliflower, guava, chilly and papaya post harvest loss was found lower. Main reason behind this phenomenon was lower level of production. On the contrary in case of mango, onion, tomato and potato, loss was too high.

Lack of quality consciousness on the part of horticulture producers increase post harvest losses, on the other hand lack of the same, saves many produce from complete wastage because consumers purchase them on a relatively lower price. Thus, though it reduces quantitative loss of horticulture produce, it is hazardous for human health.

Biggest obstacle in the proper functioning and development of cold storages and food processing industries is poor power supply in states. Therefore both governments should increase power supply.

Methodology

This study is based on the field survey that took place in selected districts of Bihar and Uttar Pradesh between 15th March and 18th June, 2003. Total 1085 farmers, 9 horticulture officers, 35 cold storage owners/managers and 11 senior executives of food processing industry were interviewed by five sub-groups of investigators, comprising 2-3 investigators in each sub-group. So far coverage of the study is concerned, 11 important horticulture produce were selected for this purpose. Selection of districts, blocks and villages were made by sampling method. After selecting districts from both states same method was adopted to select blocks and villages out of them. From each districts 80-100 farmers were interviewed for this purpose. This includes marginal, big and small, all three kinds of farmers. Besides, collecting data from farmers and other concerned officials, researchers' on the site observations and noting have also been included.

In this study, the term 'loss' has been used to indicate any change in the availability, edibility, wholesomeness or quality of the food that prevents it from being consumed by people, which ultimately results either in complete wastage or monetary devaluation of the produce.

Since prime focus of this study was estimation of loss not of production, therefore, anomalies in production figure can not be ruled out.

Since the amount of loss has been estimated and has not been obtained by actual measurements, some arbitrariness and inaccuracy can not be completely ruled out. Though, given the size and spread of sample, it can not have any serious impact upon our conclusion.

Often, there is the temptation to cite "worst case" figures to dramatize the problem, to avoid it, only average occurrence of wastage has been calculated.

Last and not least important fact is that this study is an extensive study of districts, not an intensive of any particular district. Therefore, this data may not be much useful for any particular district separately.

Estimating loss of Horticulture Produce due to non -availability of

Post Harvest & Food Processing Facilities in Bihar and Uttar pradesh

"…. opportunities for foodgrain export will gradually diminish. Fruits and vegetables are the food of the future." Dr M. S Swaminathan, eminent Indian scientist .

Introduction

Post-harvest huge losses of fruits and vegetables is a matter of grave concern for India's agriculture sector. But this is a general phenomenon and it is happening in almost every developing countries and this also used to happen in developed country as well. An additional constraint to improving this situation is that in most developing countries including India, the number of scientists concerned with post-harvest food losses is significantly lower than those involved in production research. In the early days of horticulture in most developed countries, heavy losses occurred in much the same manner as they do today in India. Increasing industrialization in technologically advanced nations gradually brought about improvements in crop handling. Elaborate harvesting equipment replaced the crude harvesting tools. Collection centres were strategically established in major producing areas. Containers were remodelled to add more protection to the produce. Commercial storage plants were installed and grade standards adopted. Engineers and economists became more and more aware of raw material behavior. Concomitant advances in Refrigeration Technology in the developed countries have made possible establishment of cold chains for the entire post-harvest and handling operations. At the institutional level post-harvest research was initiated. And a number of packing houses were installed, coupled with the development of intensive training programmes. The improvement of product quality and reduction in post-harvest losses became the main concern of producers, middlemen, marketing specialists and consumers. Today, enormous volumes of quality horticultural crops produced in technologically advanced countries are made available to millions of people through improved post-harvest handling. Thus, historically and by necessity, post-harvest technology is part of the normal development processes in agriculture.

These handling procedures are not fully recognized in less developed countries. Here agriculture may be characterized as disjointed. Production is not linked with marketing. With perishable crops like fruits and vegetables, storage, packaging, transport and handling technologies are practically non-oxiatant, Hence, considerable amount of produce are wastage. In Uttar Pradesh, according to an estimate, surplus production of potato is to the tune of 4 million ton. No one knows that what will be the fate of this extra four million, because new Potato crops has started to come into the market.

Appropriate production practices, careful harvesting and proper packaging, storage and transport all contribute to the good produce quality. Once a crop is harvested it is impossible

to improve its quality. The horticultural crops, because of their high moisture content are inherently more liable to deteriorate especially under tropical conditions. Moreover, they are biologically active and carry out transpiration, respiration, ripening and other biochemical activities, which deteriorate the quality of the produce. Losses during post harvest operations due to improper storage and handling are enormous and can range from 5 -35 percent. Post harvest losses can occur in the field, in packing areas, in storage, during transportation and in the wholesale and retail market. Severe losses occur because of poor facilities, lack of know-how, poor management, market dysfunction or simply the carelessness of farmers. Proper storage conditions, temperature and humidity are needed to lengthen the storage life and maintain quality once the crop has been cooled to the optimum storage temperature.

It is distressing to note that so much time is being devoted to the culture of the plant, so much money spent on irrigation, fertilization and crop protection measures only to be wasted about a week after harvest. It is, therefore, important that post-harvest procedures be given as much attention as production practices the stages from planting until the product a roach the consuming public must be a mutual undertaking between the growers and those who will handle the products after harvest.

Importance of Horticulture Sector

Horticultural crops not only provide us with nutritional and healthy foods, but also generate a cash income to growers. It has full potential to become an alternate cash crop for sugarcane grower farmers of Uttar Pradesh and Bihar .

On the other hand, all countries are veering towards self-reliance in foodgrains. This trend may well augur the gradual diminishing of foodgrain exports. On the other hand, the demand for fruits and vegetables is steadily increasing. And India has the unique distinction of being able to grow almost all fruits and vegetables. However, export-oriented production is still at the planning stage: most Indian producers have yet to adopt world standards of quality.

So far as its contribution to Indian economy is concerned, fruits and vegetables are grown only on 7 – 8 per cent of gross cropped area but contribute more than 18.8% of the gross value of agricultural output and 52% export earnings from total agricultural produce.

During the last few years, considerable emphasis has been given to this sector: Accordingly areas under fruit production increased by 172% from 1961 - 1993, productivity per hectare was nearly doubled, leading to an increase in production to the tune of 320%.

Though, huge employment and export potential of horticulture has been fully recognised by the successive governments, still it is not getting the kind of priority it actually deserves. As the Tenth Plan draft acknowledges that the ‘ horticulture sector contributes about 24.5 per cent towards agriculture GDP from only about 8 per cent of the cultivated area’. It further says, ‘ besides, providing nutritional and livelihood security and helping poverty alleviation

and employment generation , this sub-sector sustains a large number of agro – industries, which generate huge additional non –farming employment opportunities'. Despite all these admissions, in practice while Rs. 22467 crore was allocated to agricultural sector in Eighth Plan , only Rs. 1000 crore was earmarked, out of that for horticulture. In Ninth Plan also situation could change only marginally. While total allocation to agriculture sector was almost doubled from Rs.22467 to Rs. 42462 crore, out of which amount allocated to horticulture sector was raised from Rs. 1000 crore to meagre Rs. 1400 crore

Higher Export Earning Potential

Fruits and vegetables have been shown to earn 20-30 times more foreign exchange per unit area than cereals due to higher yields and higher price available in the international market.

In spite of the large scale production, India's fresh produce has not made major dent in the international trade so far, except for spices, cashew nut and recently grapes. This is primarily due to the fact that horticultural crops were treated as one of the several means of land use of secondary importance, with food grain crops receiving prime attentions and consequently heavy investments.

Horticulture Scores in Employment Generation

The average labour requirement for fruit production is 860 man days per hectare per annum as against 143 man days for cereal crops. Crops like grapes, bananas and pineapple generate much larger employment roughly from 1000-2500 man days per hectare per annum .

The vast opportunities for investment in fruits and vegetable processing units exist. It is established that fresh agri-produce loss reduction is cheaper than equivalent increase in production so far as economy, energy and impact on environment is concerned. Theoretically, one per cent post-harvest loss reduction of horticulture produce is expected to save Rs 230 crores annually.

If the consumption level shoots up from the current 100 gm of fruit and 200 gm of vegetables per capita per day to at least the recommended dietary level of 140 gm and 270 gm respectively by 2010, the domestic market for fresh fruits and vegetables could be as large as Rs 50,000 crores at today's price structure.

Status of Post – Harvest Handling of Horticulture Produce in Bihar

Insufficient allocation of money in proportion to its contribution to GDP and generation of employment opportunities, is reflected in inadequate infrastructure for horticulture produce . Initial indication of this survey points towards complete negligence of horticultural infrastructure facilities in some districts of Bihar, while in other parts , situation is comparatively better. It was found that, while there is only one cold storage in Saharsa , that cater the necessity of all neighboring districts' horticulture producers. Though it caters the

necessity of local horticulture producers to some extent, it can not fulfil the necessity of far - flung rural areas of even saharsa district, forget necessity of other adjoining districts. Another important point regarding horticulture sector of this region has been noticed that main purpose behind production is not a commercial one but self-consumption. Main reason behind this mindset is their traditional bias towards other crops. Generally, a particular community called 'Kujra' only produce vegetables for commercial purpose. Level of low commercial awareness among farmers about the importance of horticulture produce is also one of the reason.

When surveyors went to the villages and asked about cold storage facility, some of them were not even aware of that existing facility. But some of the farmers who were aware of it , but were not willing to use this facility because only cold storage of that area was situated in the city centre and distance between the city centre and the village (production centre of the horticulture produce), given the bad transportation facilities, actually made it unattractive for the horticulture producers to keep their produce in cold storage. Even farmers of saharsa district, on average will have to carry their produce from 10 to 50 kilometers to keep their horticulture produce in that cold storage. If farmers of the neighborhood districts decide to use the same facilities, on average they will have to carry it from 30 to 125 kilometers. And all this will only add to the cost of their produce and that will ultimately result in either low profit or no profit at all.

Lack of capital also force farmers to ignore the use of cold storage, even when available and effectively managed. Many growers depend on almost daily sales for their income and hence may be forced to accept a lower price immediately, rather than to store their produce in the anticipation of a higher price. There is also the storage rental price which the farmer may not be willing to pay unless he is thoroughly convinced that he will not only recover his investment, but will also profit.

Another problem is the lack of access to the big market. Since most of the horticulture produce of these areas, do not have direct access to the big cities, as a result either they produce for self-consumption or for local market, size of which market is very small. As a result, only a fraction of farmers are involved in commercial production of fruits and vegetables.

Main horticulture produce of these districts are Mango, Litchi, Banana, Guava , Brinjal, Potato, Cabbage, Tomato, Lady finger, Cauliflower, Parval etc.

Our researchers found that sometimes some horticulture produce, because of its perishable nature and lack of storage and processing facilities, are being sold below cost of its production. According to our estimate, total loss of horticulture produce in these districts may vary between 25 –33 per cent of total horticulture produce, due to improper handling of harvest and post-harvest management techniques resulting in a loss of thousands of crore every year. Though, post – harvest handling of horticulture produce is better in Muzaffarpur,

Begusarai and Hajipur, still a lot of scope for value addition and processing exist. According to our casual estimate for these districts , it may vary between 25 – 30 per cent of total horticulture produce.

As far as state of the horticulture produce in other and comparatively developed districts of Bihar is concerned, over the years losses have been reduced sharply because of phenomenal increase in total number of cold storage and processing units as well. Though, barring few, most of the processing units are of small size. They have advantage of a big nearby market of Patna and of comparatively better transportation facilities as well. But frequent power cuts and loadshedding is a cause of concern for them.

Another stumbling block on the path of development of food processing industries is deteriorating law and order situation. As a result, it is very difficult for an entrepreneur to decide to invest in any industry of Bihar. Even many cases of capital flights have been noticed. Therefore, before taking any other step, secured and terror free environment should be created.

Survey of Post- Harvest Wastage of Horticulture produce in Bihar

Horticulture Survey of Supaul

Table No.1

Geographical (sq.km.)	**Net Sown Area (000hect.)**	**Net Sown Area once (000hect.)**	**Estimated more than horticulture produce (000hect.)**	**No. of Cold Storage land under**
2374.82	183	153	17	Nil

Table N0. 2

Name of Fruits & Vegetables	**Total Estimated Production (in ton)**	**Total Estimated Wastage (in Per cent)**	**Total Estimated Wastage (in lac Rs)**
Mango	130050	38	3000
Banana	8200	18	29
Litchi	2150	22	24
Papaya	675	15	2
Guava	8450	19	98
Cauliflower	7555	21	22
Brinjal	12576	11	32
Onion	4750	29	21
Tomato	8575	38	55

Chilly	875	5	7
Potato	36075	32	222
Total Estimated Post- Harvest Wastage			3512

Horticulture Survey of Shaharsa

Table N0. 3

Geographical (sq.km.)	**Net Sown Area (000hect.)**	**Net Sown Area once (000hect.)**	**Estimated more than horticulture produce (000hect.)**	**No. of Cold Storage land under**
2415.3	187	143	13.4	1

Table N0.4

Name of Fruits & Vegetables	**Total Estimated Production (in ton)**	**Total Estimated Wastage (in Per cent)**	**Total Estimated Wastage (in lac Rs)**
Mango	41050	28	425
Banana	3950	18	32
Litchi	650	19	11
Papaya	575	12	5
Guava	4675	18	10
Cauliflower	13435	21	42
Brinjal	18150	14	29
Onion	7175	26	79
Tomato	7880	39	52
Chilli	1850	5	3
Potato	44665	23	175
Total Estimated Post-Harvest Wastage			860

Horticulture Survey of Madhepura

Table No. 5

Geographical (sq.km.)	Net Sown Area (000hect.)	Net Sown Area once (000hect.)	Estimated more than horticulture produce	No. of Cold Storage land under (000hect.)
1788	163	123	16.5	Nil

Table N0.6

Name of Fruits & Vegetables	Total Estimated Production (in ton)	Total Estimated Wastage (in Per cent)	Total Estimated Wastage (in lac Rs)
Mango	83850	35	143
Banana	5750	18	32
Litchi	2275	26	35
Papaya	681	11	6
Guava	14674	17	29
Cauliflower	14135	25	33
Brinjal	18320	16	19
Onion	4381	27	23
Tomato	4370	36	47
Chilli	2175	5	4
Potato	53445	29	313
Total Estimated Post-Harvest Wastage			684

Horticulture Survey of Purnia

Table No. 7

Geographical (sq.km.)	Net Sown Area (000hect.)	Net Sown Area once (000hect.)	Estimated more than horticulture produce	No. of Cold Storage land under (000hect.)
3202.31	221	171	17	5

Table N0.8

Name of Fruits & Vegetables	Total Estimated Production (in ton)	Total Estimated Wastage (in Per cent)	Total Estimated Wastage (in lac Rs)
Mango	53050	29	415
Banana	5150	17	27
Litchi	2450	18	21
Papaya	1450	14	9
Guava	3375	17	16
Cauliflower	18750	19	106
Brinjal	23350	16	37
Onion	27150	27	95
Tomato	32175	37	144
Chilli	4239	5	31
Potato	81025	21	290
Total Estimated Post-Harvest Wastage			1191

Horticulture Survey of Begusarai

Table No. 9

Geographical (sq.km.)	Net Sown Area (000hect.)	Net Sown Area once (000hect.)	Estimated more than horticulture produce	No. of Cold Storage land under (000hect.)
3375	203	141	17	10

Table N0.10

Name of Fruits & Vegetables	Total Estimated Production (in ton)	Total Estimated Wastage (in Per cent)	Total Estimated Wastage (in lac Rs)
Mango	22020	23	506
Banana	5175	16	25
Litchi	2350	14	18
Papaya	2750	11	14
Guava	4675	14	15

Cauliflower	26770	19	89
Brinjal	9435	12	31
Onion	9950	18	58
Tomato	24165	39	160
Chilli	4648	5	5
Potato	142281	24	701
Total Estimated Post-Harvest Wastage			1622

Horticulture Survey of Muzaffarpur

Table No. 11

Geographical (sq.km.)	**Net Sown Area (000hect.)**	**Net Sown Area once (000hect.)**	**Estimated more than horticulture produce**	**No. of Cold Storage land under (000hect.)**
3175.91	257	169	55	10

Table N0.12

Name of Fruits & Vegetables	**Total Estimated Production (in ton)**	**Total Estimated Wastage (in Per cent)**	**Total Estimated Wastage (in lac Rs)**
Mango	178720	32	4150
Banana	245050	19	1980
Litchi	43804	25	2200
Chilly	17770	5	90
Guava	31840	16	160
Cauliflower	39000	19	300
Brinjal	31100	14	99
Onion	31375	25	400
Tomato	39500	40	450
Cabbage	26500	17	90
Potato	91200	14	390
Total Estimated Post-Harvest Wastage			10309

Combined Horticulture data of Six Districts of Bihar

Table No. CA

Geographical (sq.km.)	**Net Sown Area (000hect.)**	**Net Sown Area once (000hect.)**	**Estimated more than horticulture produce**	**No. of Cold Storage land under (000hect.)**
16719.24	1214	900	137.4	26

Table No. CB

Name of Fruits & Vegetables	**Total Estimated Production (in ton)**	**Total Estimated Wastage (in Per cent)**	**Total Estimated Wastage (in lac Rs)**
Mango	508740	39	8639
Banana	273250	18	2125
Litchi	53679	22	2309
Papaya	23901	10	136
Guava	67689	15	322
Cauliflower	119645	18	592
Brinjal	112931	14	247
Chilli	78781	5	676
Onion	116665	25	908
Tomato	82457	39	140
Potato	448691	24	2091
Total Estimated Post-Harvest Wastage			18191

Status of Post – Harvest Handling of Horticulture Produce in Uttar Pradesh

As far as state of the horticulture sector of Uttar Pradesh is concerned, it has many advantages over Bihar in term of infrastructure and access to the big market for its horticulture produce. As far as power condition is concerned, situation is not much different from Bihar. Uttar Pradesh is also facing acute power shortage. This is certainly adversely affecting cold storage like other industrial units. Though, recently some steps have been taken to ensure regular power supply to cold storages, nonetheless ,losses of a portion of total horticulture produce can not be ruled out. According to our estimate, it may vary between 5 to 35 per cent of the total produce. In case of Uttar Pradesh, in addition to the existence of a big market in UP itself, its closeness to Delhi, has given a big boost to its horticulture produce. As a result export of fruits and other horticulture produce have also become feasible.

In spite of so many positive factors, horticulture sector of Uttar Pradesh is still far from realisation of its actual potential. Many incentives are required on behalf of government to induce farmers to think to switch over to horticulture sector on a large scale.

First and foremost impediment is the market. Regional and local markets are small in size and they do not have the capacity to absorb any horticulture produce in large quantity. Gone the days when Indian agriculture sector was facing the problem of undercapacity or under production. Now, Indian agriculture sector is faring well but result is more disastrous than before. It is driving farmers to suicide. Indian horticulture sector is also not an exception of this trend. Almost same thing is happening also in this sector. For instance, take example of bumper production of potato in Uttar Pradesh. This year's estimated 4 – 4.5 million excess production of potato is not contributing to the betterment of farmers, it actually making them economically more disadvantaged. Therefore, without a market, it is naïve to suggest farmers to resort to horticulture produces.

Recently, some training programmes for pre and post harvest management for horticulture produce are being undertaken with the assistance from APEDA, National Horticulture Board and from National Institute of Agricultural Marketing (NIAM). But this has to be taken up at a large scale, only then situation can improve substantially.

Road conditions and communication facilities need a lot of improvement. Common farmer does not know how to reach Paris or Dubai markets? So, market intelligence is a major bottleneck. They can produce good quality fruits and vegetables but where is their market? So, arrangement should be worked out so that market intelligence can be provided to the farmers at their doorsteps.

Everyone is harping on diversification of agriculture but one would like to know that what kinds of incentive are given by the state government or any agency for rapid diversification of agriculture – nothing. Therefore, some frsh incentives are required.

In eastern Uttar Pradesh, sugar cane used to be a main cash crop for the farmer. Since sugar industry is in a very bad shape, most of the farmers want to switch over to another cash crops, possibly in horticulture. But one prime concern of a farmer is the market. Where is the market for horticulture produce? Bumper production of potato is actually playing havoc with the farmers livelihood. Many cases have been noticed when farmers keep their potato in cold storage but they do not come to take it back . Reason is prevailing low price of potato in the market. That price actually does not cover the cost of transportation and cold storage charges. By June 30 per cent of Potato, used to be taken out of the cold storage but this year by last week of June even 5 per cent of Potato has not been taken out of cold storages. Reason is, the price farmers have to pay for per quintal Potato to keep their produce in cold storage is almost equal to its prevailing price in the whole sale market of Potato. As a result, cold storage owners fear for the worst. They are afraid that the farmers will not come back to take back their produce and ultimately they will have to arrange buyers for it.

As far as state of the other horticulture produce is concerned, situation is even worse than this. Cold storage has no meaning for horticulture produce other than Potato because the temperature tthat require for other produce is not available in these cold storages. Even they don't have different kind of chambers for different produce. Therefore, all kinds of produce are kept in the same chambers, that also create problems because various horticulture produce required different temperature but they are given the same temperature. Therefore, neither it is advisable nor desirable for the farmers- given the present state of infrastructure and market conditions-to switch over from other cash crops to the horticulture.

Implementation of proper post-harvest management methods in the horticulture industry is expected to limit losses to less than 5 per cent in these districts. Because, in the case of other horticulturally developed countries like China, Korea and Japan , the level of post-harvest losses is below 5 per cent.

Lack of advanced infrastructure facilities such as sorting and grading of products, transportation and marketing system, cold storage facilities are yielding very low returns as a result farmers are reluctant to make further investment in the industry. And this phenomena is not limited to a particular district or state, it is a national phenomena.

From national viewpoint , even though India enjoys an enviable position in the production of horticultural crops, the productivity level is much lower than other developed countries owing to non-availability of quality plant and seed material. Not only this, there is also little chance of getting technical assistance in the field of fruits and vegetable cultivation in India as there is no strong network between the horticulturally developed countries and India. Presently, low cost processing technologies are not available to Indian farmers, as a result only less than 0.1 per cent of the entire production is being processed. Whereas, the potential demand for processed fruits and vegetables is at 0.5 per cent, with 55 per cent in the export

and 45 per cent in the domestic market . To promote the horticulture industry in the country especially through proper post-harvest strategies in areas such as sorting and grading, packing, transportation, storage, infrastructure development, several initiatives are needed to be taken, and some steps have already been taken. Interest-free loans are being offered to farmers for setting up grading and packing centres, retail outlets, pre-cooling units, purchase of plastic crates and also transport vehicles. The assistance is being given in the form of soft loan with 4 per cent service charges and better repayment schedule at competitive rate of interest.

Survey of Post- Harvest Wastage of Horticulture produce in Uttar Pradesh

Horticulture Survey of Mirjapur

Table No. 13

Geographical (sq.km.)	**Net Sown Area (000hect.)**	**Net Sown Area once (000hect.)**	**Estimated more than horticulture produce**	**No. of Cold Storage land under (000hect.)**
4851.9	209	92	19	10

Table N0.14

Name of Fruits & Vegetables	**Total Estimated Production (in ton)**	**Total Estimated Wastage (in Per cent)**	**Total Estimated Wastage (in lac Rs)**
Mango	32500	24	174
Banana	2450	16	19
Litchi	650	21	15
Papaya	650	12	5
Guava	4767	15	18
Cauliflower	38045	18	55
Brinjal	11115	14	32
Onion	9650	27	165
Tomato	21775	34	48
Chilli	3175	5	6
Potato	67049	19	603
Total Estimated Post-Harvest Wastage			1140

Horticulture Survey of Agra

Table No. 15

Geographical (sq.km.)	Net Sown Area (000hect.)	Net Sown Area once (000hect.)	Estimated more than horticulture produce	No. of Cold Storage land under (000hect.)
4027	288	191	31	67

Table N0.16

Name of Fruits & Vegetables	Total Estimated Production (in ton)	Total Estimated Wastage (in Per cent)	Total Estimated Wastage (in lac Rs)
Mango	49020	24	351
Banana	5250	15	24
Litchi	475	21	16
Papaya	1890	12	18
Guava	3975	15	22
Cauliflower	6745	18	47
Brinjal	4271	16	19
Onion	27845	29	185
Tomato	18165	32	45
Chilli	2376	5	6
Potato	95000	22	605
Total Estimated Post-Harvest Wastage			1338

Horticulture Survey of Deoria

Table No. 17

Geographical (sq.km.)	Net Sown Area (000hect.)	Net Sown Area once (000hect.)	Estimated more than horticulture produce	No. of Cold Storage land under (000hect.)
2527.2	203.6	106.1	29.19	3

Table N0.18

Name of Fruits & Vegetables	Total Estimated Production (in ton)	Total Estimated Wastage (in Per cent)	Total Estimated Wastage (in lac Rs)
Mango	44065	23	380
Banana	4115	16	19
Litchi	868	19	8
Papaya	931	11	5
Guava	7935	17	21
Cauliflower	41735	16	32
Brinjal	14822	16	15
Onion	29120	27	183
Tomato	17745	31	29
Chilli	6975	5	14
Potato	65804	26	3600
Total Estimated Post-Harvest Wastage			4306

Horticulture Survey of Ghaziabad

Table No. 19

Geographical (sq.km.)	Net Sown Area (000hect.)	Net Sown Area once (000hect.)	Estimated more than horticulture produce	No. of Cold Storage land under (000hect.)
1966.9	142	102	29	73

Table N0.20

Name of Fruits & Vegetables	Total Estimated Production (in ton)	Total Estimated Wastage (in Per cent)	Total Estimated Wastage (in lac Rs)
Mango	27650	15	35
Banana	4345	16	27
Litchi	425	11	4
Papaya	3275	11	19
Guava	970	12	5

Cauliflower	9271	17	18
Brinjal	5268	15	14
Onion	5574	21	39
Tomato	3925	33	65
Chilli	1256	5	3
Potato	98000	24	2700
Total Estimated Post-Harvest Wastage			2929

Horticulture Survey of Gorakhpur

Table No. 21

Geographical (sq.km.)	**Net Sown Area (000hect.)**	**Net Sown Area once (000hect.)**	**Estimated more than horticulture produce**	**No. of Cold Storage land under (000hect.)**
3483.8	260.43	127.12	13.95	5

Table N0.22

Name of Fruits & Vegetables	**Total Estimated Production (in ton)**	**Total Estimated Wastage (in Per cent)**	**Total Estimated Wastage (in lac Rs)**
Mango	48250	24	560
Banana	5260	14	31
Litchi	878	17	21
Papaya	425	11	5
Guava	7895	15	17
Cauliflower	23475	16	86
Brinjal	14587	13	31
Onion	24775	26	145
Tomato	22908	37	196
Chilli	7465	5	33
Potato	63900	26	860
Total Estimated Post-Harvest Wastage			1985

Horticulture Survey of Muzaffarnagar

Table No. 23

Geographical (sq.km.)	Net Sown Area (000hect.)	Net Sown Area once (000hect.)	Estimated more than horticulture produce	No. of Cold Storage land under (000hect.)
4008	326	300	46	31

Table N0.24

Name of Fruits & Vegetables	Total Estimated Production (in ton)	Total Estimated Wastage (in Per cent)	Total Estimated Wastage (in lac Rs)
Mango	29650	21	56
Banana	4345	15	21
Litchi	325	14	5
Papaya	1975	11	9
Guava	2970	14	11
Cauliflower	9271	15	26
Brinjal	2468	11	15
Chilli	574	5	6
Onion	3925	16	23
Tomato	29456	34	197
Potato	720000	21	21500
Total Estimated Post-Harvest Wastage			21878

Combined Horticulture data of Six Districts of Uttar Pradesh

Table No. CC

Geographical (sq.km.)	Net Sown Area (000hect.)	Net Sown Area once (000hect.)	Estimated more than horticulture produce	No. of Cold Storage land under (000hect.)
20864.8	1429.03	918.22	168.14	189

Table No. CD

Name of Fruits & Vegetables	Total Estimated Production (in ton)	Total Estimated Wastage (in Per cent)	Total Estimated Wastage (in lac Rs)
Mango	187070	22	1556
Banana	25765	14	141
Litchi	3621	15	69
Papaya	9146	11	61
Guava	28512	14	94
Cauliflower	128542	18	264
Brinjal	52531	12	126
Chilli	97538	5	723
Onion	88443	17	406
Tomato	50703	35	259
Potato	1109753	21	29868
Total Estimated Post-Harvest Wastage			33576

Causes of Post Harvest Losses : Physiological and Biochemical Aspects

The quality of the harvested fruits and vegetables depend on the condition of growth as well as physiological and biochemical changes they undergo after harvest. Fruits and vegetable cells are still alive after harvest and continue their physiological activity.The post harvest quality and storage life of fruits appear to be controlled by the maturity. If the fruits are harvested at a proper stage of maturity the quality of the fruits is excellent. Poor quality and uneven ripening are due to early harvesting and late harvesting which results in extremely poor shelf life.

Respiration plays a very significant role in the post harvest life of the fruits. In most of the fruits, the rate of respiration increases rapidly with ripening. The sudden upsurge in respiration is called the ‘climacteric rise’, which is considered to be the turning point in the life of the fruit. After this the senescence and deterioration of the fruit begin. The fruits such as banana, papaya, mango, guava, jackfruit etc. belong to the category of climacteric fruits. While litchi, pineapple, grapes, pomegranate, lemon, orange, lime, etc. belong to the non-climacteric group. To extend the post harvest life of the fruits its respiration rate should be reduced as far as possible. Thus an understanding of the factors, which influence the rate of respiration, is indispensable to post harvest technologies for manipulating the storage behaviour of fruits.

Mechanical Injury

Owing to their tender texture and high moisture content, fresh fruits and vegetables are very susceptible to mechanical injury. Poor handling, unsuitable containers, improper packaging and transportation can easily cause bruising, cutting, breaking, impact wounding and other forms of injury.

Parasitic Diseases

High post-harvest losses are caused by the invasion of fungi, bacteria, insects and other organisms. Microorganisms attack fresh produce easily and spread quickly, because the produce does not have much of a natural defence mechanism and has plenty of nutrients and moisture to support microbial growth. Post harvest decay control is becoming a more difficult task, because the number of pesticides available is falling rapidly as consumer concern for food safety increases.

Sites of losses

Losses may occur anywhere from the point where the food has been harvested or gathered up to the point of consumption. For the sake of convenience the losses can be broken down into the following sub-headings:

a. Harvest. The separation of the commodity from the plant that produced it. In the case of roots, tubers and bulbs the commodity is lifted out of the soil.

b. Preparation The preliminary separation or extraction of the edible from the non-edible portion, e.g., the peeling of fruits and vegetables.

c. Preservation is the prevention of lose and spoilage of foods. For example, the sun-drying of fruit, the use of refrigeration and the use of funficides to inhibit mold growth in fruits.

d. Processing is the conversion of edible food into another form more acceptable or more convenient to the consumer, for example, the manufacture of fruit juice and the canning of fruits and vegetables.

e. Storage is the holding of foods until consumption. Most storage is common storage (ambient temperature) but there are extensive storage capacities that can hold food under refrigerated or controlled atmosphere conditions.

Transportation. All forms of transportation are used to convey foods from the point of production to the ultimate point of consumption. .

To summarize, transport losses are due to the following:

a. Unsuitable transport containers;

b. Overloading of mixed fruits and vegetables (in some developing countries people and even animals ride on top of the load);

c. Irresponsible driving;

d. Lack of feeder roads loading to highways or collection centres;

e. Rough roads;

f. Heat accumulation or very poor ventilation within the transport vehicles;

g. Virtual absence of refrigerated and insulated trucks;

h. Delays in product procurement after harvesting or at collection centres.

In addition, where machine is used for harvesting losses may be fairly high because the agricultural machinery that is used to harvest the crops leaves some of the commodity in the field and mechanically damages some of it. Considerable quantities of foods a may be discarded at the point of harvest because they are of the wrong size, shape or colour. These are planned losses. But in the case of Bihar and Uttar Pradesh are lower because most of the crop is hand picked. The amount of material rejected is also lower because the expectation of quality and uniformity is lower in the local market.

In developed countries losses are generally small during processing, storage and handling because of the efficiency of the equipment, good quality storage facilities, and close control of critical variables by a highly knowledgeable cadre of managers. In contrast, in India, losses in processing, storage and handling tend to be rather high because of poor facilities and frequently inadequate knowledge of methods to care for the food properly.

The deterioration of a product starts during the harvesting operation. The more carefully a product is handled, the slower the deterioration process during subsequent handling operations. However, the farmers may be unaware or indifferent to the condition of the product after harvest, and harvesting procedures may thus be rather careless. The only constraint is to avoid external injury. Until farmers are convinced that careful handling will increase profits, it will be difficult to persuade them otherwise.

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Grading is a thing that most farmers are loath to do until they are convinced it will bring them added revenues or increases the acceptance of their products. A farmer may separate different

varieties if they are distinguishable, but consumers of both states usually are more price conscious than quality conscious. That is not to say that they are unmindful of the quality, but if good quality products are too highly priced, they are often willing to settle for a poorer quality product.

Post harvest Technologies :

Precooling Good temperature management is the most effective way to reduce post-harvest losses and preserve the quality of fruits and vegetables. Products harvested from hot fields often carry field heat and have high rates of respiration. Rapid removal of field heat by precooling is so effective in quality preservation that this procedure is widely used for highly perishable fruits and vegetables. Currently used precooling methods include room cooling, forced-air cooling, water cooling, vacuum cooling and package icing

Room cooling is a relatively simple method, which needs only a refrigerated room with adequate cooling capacity. The produce is packed in containers, which are loosely stacked in the cooling room, leaving enough space between containers for each one to be exposed to circulating cold air. The rate of cooling is rather slow compared to other methods of cooling, because the heat inside each container needs to be transferred to the surface of the container by means of conduction before being carried away by the refrigerated air. It may take hours or even days to cool a product, depending on what kind of product it is, the size and nature of the container, and the temperature and velocity of the circulating air.

Forced-air cooling is a more rapid way of using air to cool produce. Cold air is forced to flow through the inside of each container, so that it carries away heat directly from the surface of the produce rather than from the surface of the container. The airflow is produced by creating a pressure difference between the two perforated sides of each container. The containers are stacked inside a covered tunnel with an exhaust fan at one end. Highly perishable and high-value products such as grapes, strawberries and raspberries may be cooled in less than an hour using this method.

Hydro cooling is a rapid and less expensive method. Produce is exposed to cold water by means of showering or dipping. The required cooling time is often a matter of minutes. However, not all kinds of products tolerate hydro cooling. Hydro cooled products inevitably have a wet surface, which may encourage decay in some kinds of produce.

Vacuum cooling is the most efficient way to cool leafy vegetables, particularly headed ones such as head lettuce, cabbage and Chinese cabbage. The produce is placed inside a vacuum tube in which air pressure is reduced. When the pressure is lowered to 4.6 mm Hg, water “boils” off at o 0°C from all over the leaf surface. The boiling effect draws heat for vaporization, and hence cools the produce. The cooling time is usually in the order of 20 to 30 minutes. Unfortunately, the equipment needed for vacuum cooling is very expensive, and

may not be a good choice for small-scale farming systems.

Ice bank cooler is a new development in refrigeration with positive ventilation. In this system ice cool air is passed through the boxes containing horticultural produce. This facilitates quicker cooling and large amount of heat is removed in a relatively shorter period. The store maintains a temperature of 0.5 - 0.8oC and relative humidity of 98 percent.

Package icing or top icing is the simplest way of cooling. Adding crushed ice, flake-ice or slurry of ice in containers can cool the produce. However, this method is not suitable for produce, which is very sensitive to ice-cold temperatures. Cooling by ice also inevitably wets both the produce and container, and generates water, which needs to be drained.

Sanitation

Sanitation is of great concern to produce handlers, not only to protect produce against post harvest diseases, but also to protect consumers from food borne illnesses. E.coli 157:H7, *Salmonella, Chryptosporidium, Hepatitis and Cyclospera* are among the disease causing organisms that have been transferred via fresh fruits and vegetables. Use of a disinfectant in wash water can help to prevent both post harvest diseases and food borne illnesses.

Chlorine in the form of a sodium hypochlorite solution or as a dry powdered calcium hypochlorite can be used in hydro-cooling or wash water as a disinfectant. For the majority of vegetables, chlorine in wash water should be maintained in the range of 75-150 pm (parts per million). The antimicrobial form, hypochlorous acid, is mostly available in water with a neutral pH (6.5 to 7.5). Organic growers must use chlorine with caution, as it is classified as a restricted material.

Ozonation is another technology that can be used to sanitize produce. A naturally occurring molecule, ozone is a powerful disinfectant. Fruit and vegetable growers have begun using it in dump tanks as well, where it can be thousands of times more effective than chlorine. Ozone not only kills whatever food borne pathogens might be present, it also destroys microbes responsible for spoilage. A basic system consists of an ozone generator, a monitor to gauge and adjust the levels of ozone being produced and a device to dissolve the ozone gas into the water.

Hydrogen peroxide can also be used as a disinfectant. Concentrations of 0.5% or less are effective for inhibiting development of post harvest decay caused by a number of fungi. Hydrogen peroxide has a low toxicity rating and is generally recognized as having little potential for environmental damage.

Presizing and Storage

For many commodities fruits below a certain size are eliminated manually or mechanically by presizing belt. Undersized fruits are diverted for processing. The sorting process

eliminates cull, overripe, misshapen and otherwise defective fruit and separates produce by colour, maturity and ripeness classes.

Grading

Essentially all fruits and vegetables sold in modern markets are graded and sized into two or more grades according to trade standards. Sophisticated marketing systems require precise grading standards for each kind of product. More primitive markets may not use written grade standards, but the products are sorted and sized to some extent.

Typical grading facilities in large packinghouses include dumpers and conveyors. Produce is graded by human eyes and hands while moving along conveyor belts or rollers. “Electric eyes” are sometimes used to sort produce by colour. In small scale packing operations, one or a few grading tables may be enough. Dumping, conveying and grasping can cause mechanical injury to some products. Equipment should have a smooth, soft surface and dumping and grading operations should be gentle to minimize injuries.

Many products are sized according to their weight. Automated weight sizers of various capacities are used in packinghouses. Round or nearly round fruits are often sized according to their diameter, using automated chain or roller sizers or hand carried ring sizers. An inefficient sizing operation can also cause significant injuries.

Waxing

Food grade waxes are commonly applied to replace some of the natural waxes removed in the washing and cleaning operations to reduce water loss and to improve appearance. It also provides protection against decay organisms. Waxing may be done after grading and fungicides may be added to the wax. Application of wax and post harvest fungicides must be indicated on each container where the refrigerated storage facilities are not available Protective skin coating with wax is one of the methods for increasing the storage life of fresh fruits.

Packaging

Packaging of fresh fruits and vegetables has a great significance in reducing the wastage. Packaging provides protection from physical damage during storage, transportation and marketing. There are variety of packages, packaging materials and inserts available. There are two types of packaging. The first is when produce is packed in containers for transportation and wholesale. The second is when produce is packed into small retail units. Ideal containers for packing fruits and vegetables should have the following attributes. They are easy to handle, they provide good protection from mechanical damage, they have adequate ventilation and they are convenient for merchandising. They should also be inexpensive and easily degradable or recyclable. Many kinds of containers have been used

but the “ideal” is yet to be found. Users often put economic considerations first is selecting containers. Fancy containers such as fiberboard boxes or wooden or plastic crates, are often used for high-value products. Inexpensive containers such as bamboo baskets or nylon net sacs are used for low-priced produce. Methods of packaging can affect the stability of products in the container during shipping, and influence how much the container protects their quality. In fiberboard boxes, for example, delicate and high-priced products are often packed in trays, while other products are simply put in the box in groups.

Prepackaging or consumer packaging generally provides additional protection for the products. It is also convenient for retailers as well as customers, and therefore adds value to produce. However, over-use of non-biodegradable plastic trays and wrapping materials, as often seen in modern supermarkets, which creates an extra burden of waste disposal and damages the environment.

Factors Affecting Storage Life:

Relative Humidity

Transpiration rates (water loss from produce) are determine by the moisture content of the air, which is usually expressed as relative humidity. At high relative humidity, produce maintains salable weight, appearance, nutritional quality and flavour, while wilting, softening and juiciness are reduced. Leafy vegetables with high surface-to-volume ratios; injured produce and immature fruits and vegetables have higher transpiration rates. High temperatures, low relative humidity and high air velocity increase transpiration rates.

Relative humidity needs to be monitored and controlled in storage. Control can be achieved by a variety of methods:

1. Operating a humidifier in the storage area.
2. Regulating air movement and ventilation in relation to storage room load.
3. Maintaining refrigeration coil temperature within the storage room.
4. Using moisture barriers in the insulation of the storage room or transport vehicle.
5. Wetting the storage room floor.
6. Using crushed ice to pack produce for shipment.
7. Sprinkling leafy vegetables, cool-season root vegetables and immature fruits and vegetables with water.

Temperature

Respiration and metabolic rates are directly related to room temperatures within a given range. The higher the rate of respiration, the faster the produce deteriorates. Lower

temperatures reduce respiration rates and the ripening and senescence processes, which prolong the storage life of fruits and vegetables. Low temperatures also slow the growth of pathogenic fungi, which cause spoilage of fruits and vegetables in storage.

Producers should give special care and attention to proper storage conditions for produce with high to extremely high respiration rates, as these crops will deteriorate much more quickly.

It is impossible to make a single recommendation for cool storage of all fruits and vegetables. Climate of the area where the crop originated, the plant part, the season of harvest and crop maturity at harvest are important factors in determining the optimum temperature. A general rule for vegetables is that cool-season crops should be stored at cooler temperatures (0 to 1.7oC) and warm-season crops should be stored at warmer temperatures (7 to 13oC).

Freezing injury

Temperatures that are too low can be just as damaging as those too high. Freezing will occur in all commodities below 0oC. Whether injury occurs depends on the commodity. Some can be repeatedly frozen and thawed without damage, while others are ruined by one freezing.

Injury from freezing temperatures can appear in plant tissues as loss of rigidity, softening and water soaking. Injury can be reduced if the produce is allowed to warm up slowly to optimum storage temperatures and if it is not handled during the thawing period. Injured produce should be marketed immediately, as freezing shortens its storage life.

Chilling injury

Fruits and vegetables that require warmer storage temperatures (4.5 to 13oC) can be damaged if they are subjected to near-freezing temperatures (0oC). Cooler temperatures interfere with normal metabolic processes. Injury symptoms are varied and often do not develop until the produce has been returned to warmer temperatures for several days. Besides physical damage, chilled produce is often more susceptible to disease infection.

Ethylene

Ethylene, a natural hormone produced by some fruits as they ripen, promotes additional ripening of produce exposed to it. The old age saying that one bad apple spoils the whole bushel is true. The damaged or diseased fruits produce high levels of ethylene and stimulate the other apples to ripen too quickly. As the fruits ripen, they become more susceptible to disease. Ethylene “producers” should not be stored with fruits, vegetables, or flowers that are sensitive to it. The result could be loss of quality, reduced shelf life and specific symptoms of injury. Ethylene producers include apples, apricots, avocados, ripening bananas, honeydew melons, papayas, peaches, pears, plums and tomatoes.

Storage Facilities:

Crops that require different storage conditions will need three different storage facilities.

- Cold Storage (temperatures 0 to 2.2oC)
- Cool Storage (temperatures 4.5 to 13oF)
- Warmer storage (temperatures 13 to 15.6oF)

A recording thermometer can be helpful in determining whether storage facilities are maintaining ideal conditions and are not fluctuating. A maximum/minimum thermometer could be substituted. Relative humidity also should be monitored with a hygrometer.

Controlling and monitoring temperature and relative humidity will enable a grower to maintain optimum storage conditions for maximum storage life of the crop and to minimize crop damage from chilling, freezing or high temperature injuries and water loss from the crop.

Air-Cooled Common Storage

This is widely used for storing horticultural products, particularly those that have good keeping quality even without a precise low temperature. However, its use is generally limited to cool seasons in temperate and sub-tropical regions, or high altitude areas where there are low ambient temperatures at night. An ideal storage room is adequately insulated and has a good ventilation control system, which draws cool air inside during night and keeps warm air out during the day.

Refrigerated Storage

Refrigerated storage is a well-established technology widely used for storing horticultural crops all over the world. Its application is limited only by cost and benefit considerations. Essentially, all crops can benefit by being stored at a suitable low temperature, which extends the storage life and preserves quality.

Many horticultural crops have storage life spans ranging from less than one month to several months when refrigerated. Therefore, refrigerated storage can be used continuously only if different crops with different harvesting seasons can share the facility. There are other important reasons why this method is not used in many tropical and sub-tropical countries, where refrigeration is needed most. The initial investment cost is too high and its energy consumption too large for many countries.

Hydrobaric Storage

In this system the horticultural produce is kept in a vacuum-tight and refrigerated container and the air is evacuated by vacuum pump to achieve desired low pressure. The low pressure

retards ripening by decreasing respiration. However this is more expensive method.

Controlled Atmosphere Storage (CA)

The fresh horticultural produce consumes oxygen for respiration and releases carbon dioxide and ethylene. The ethylene further enhances ripening. Reducing oxygen and increasing carbon dioxide can increase the shelf life. In CA storage the levels of CO2, O2 and N2 in the storage room are monitored. CA storage combined with refrigeration reduces respiration and delays yellowing and quality changes. However the tolerance of individual varieties of horticultural crops needs to be considered.

Commercial application of CA storage is limited to only a few crops, apples and pears being the most popular ones. It is not used for other crops because the benefit is too slight to cover the cost. The technologies involved are complicated and sophisticated. The cost of building, facilities, and management for CA storage is considerably higher than for refrigerated storage. Therefore it should not be recommended for any crop without a thorough cost and benefit analysis .

Transportation

Inland transportation of horticultural crops is usually by rail or by truck. Overseas transportation is by sea or by air. A limited amount of high-valued produce is sometimes transported overland by air. The basic requirements for conditions during transportation are proper control of temperature and humidity and adequate ventilation. In addition, the produce should be immobilized by proper packaging and stacking, to avoid excessive movement or vibration. Vibration and impact during transportation may cause severe bruising or other types of mechanical injury.

Refrigerated containers and trailers are more often used for long distance shipping, whether by sea, rail or truck. Shipping by refrigerated trucks is not only convenient, but also effective in preserving the quality of product. However, both the initial investment and the operating costs are very high. Another possibility is insulated or properly ventilated trailer trucks. Precooled products can be transported through well-insulated non-refrigerated trucks for up to several hours without any significant rise in product temperature. There are considerable cost savings without any sacrifice of quality if trucks are only insulated, rather than refrigerated, for short-distance shipping. If the product is not precooled or if the shipping distance is long, a ventilated truck is a better choice than an insulated truck without ventilation and without refrigeration. Ventilation alone does not usually provide a uniform cool temperature, but it may help dissipate excessive field heat and respiration heat, and thus avoid high temperature injury.

Food Processing

The Food Processing Industry sector has tremendous growth prospect in both state Bihar and Uttar Pradesh. If properly pursued it can be a biggest source of employment, growth, export and above all prosperity. Though, both governments have accorded it a high priority, with a number of fiscal relief and incentives, to encourage commercialisation and value addition to agricultural produce as well as to minimise pre/post harvest wastage. But any fiscal incentive or policy priority have no meaning if basic conditions to develope an industry is not fulfiled. These conditions are market, good road and transportation system and last but most important condition is continuous power supply. On average less than one percent of horticulture produce is processed both Bihar and Uttar Pradesh. Most of the processing takes place by the traditional method and for the traditional purpose. For example, raw mangoes are processed for pickles, jam etc. As far as processing of other horticulture products are concerned, barring litchi and potato, they are processed at the very small scale and generally for the same purpose.Muzaffarpur District is horticulturally most advanced district of Bihar, mainly in fruit segment and particularly in Litchi. There are five existing processing factories and two under construction, in this district. Out of five two processing factories are export oriented. Capacity wise there is no processing factories which has capacity to process to the tune of 500 ton fruits per season. Food Processing factories of this district facing same problem as other industries of Bihar face i.e., acute shortage of power and loadshedding. Though production of Vegetables is also high but there is no processing factories related to vegetable processing. Though, some exports are also taking place from these units, there is a tremendous scope to increase it further provided government fulfil above mentioned conditions and also improve law and order situation in the state. As far as capacity utilisation of these industrial units are concerned, since they are based on seasonal horticultore produce therefore, capacity utilisation vary between 45-50 per cent. Reduction in cost is required in order to make it competitive in the export as well as domestic marketss, 100 per cent utilisation is needed.

So far as state of the food processing industry in Uttar Pradesh is concerned, though government is taking various steps to develop it, as mentioned before, without fulfilment of these factors no significant growth is possible. There is a tremendous scope for potato, tomato and mango based processing industries in this state. Though state government is trying to establish agro food parks but, without industry friendly environment its success cannot be assured.

Conclusion

1. There is no proper link between demand and supply of horticulture produce. In both states, production is taking place irrespective of its demand in the market. As a resullt, price-crash has become a usual phenomena. Therefore, mismatch between production and supply should be abolished.

2. State and central government should make urgent efforts to export surplus produce and provide managerial, technical and financial assistance to farmers or farmers' cooperatives.

3. Whole orientation of farmers in both states are towards production. Their negligent attitude towards post harvest losses, lack of quality consciousness and absence of food processing units and unavailability of modern cold storage are responsible of huge post harvest losses.

4. Existing cold storage of both states have been built primarily for preservation of potato only. Therefore, other horticulture products can not be kept there. Therefore, modern cold storages should be built and old one should be upgraded, so that other products also can be kept there and it will also increase profitability of the cold storage owners.

5. Small sized cold storages should be built and it should be located possibly near agriculture field . This will reduce transportation cost and as a result more farmers will be encouraged to use this facility.

6. Post harvest loss of horticulture produce vary between 5-40 per cent of total production.In case of brinjal, cauliflower, guava, chilly and papaya post harvest loss was found lower. Main reason behind this phenomenon was lower level of production. On the contrary in case of mango, onion, tomato and potato, loss was too high.

7. On the one hand, lack of quality consciousness on the part of horticulture producers increase post harvest losses, on the other hand because of the lack of the hygienic awareness among lower class consumers, saves many produce from complete wastage. Because they purchase them on a relatively low price. Thus, though it reduces quantitative loss of horticulture produce, it is hazardous for human health.

8. Both state governments should improve infrastructure, particularly power supply, only and only then,development of food processing industries can take off. If these basic facilities are not provided , any fiscal or other incentives will not bring desired result.

9. Total post harvest estimated loss of horticulture produce is to the tune of Rs.33576 lacs in six districts of Uttar Pradesh and in Bihar approximate post harvest loss of the same is Rs.18191.

Recommendations:

1. Since domestic technical capability to prevent post-harvest loss of horticulture produce is limited, therefore, there should be strong network between farmers and researchers of the horticulturally advanced countries so that Indian farmers can also take advantage of there technical advancement. This interaction should take place at the national level and it should further percolate to the district and village level. For this purpose, a Horticulture Information Centre (HIC) should be established in every district where horticulture production is substantially high. Teachers and scientists from nearby agriculture universities, should frequently visit this centre to inform and interact with the farmers, so that they become aware of cost effective method to prevent post harvest losses. In addition, as a short term measure – because there is a huge knowledge gap between farmers and researchers - an awareness campaign should be taken up by the respective state governments in collusion of national horticulture board, so that farmers of the remote rural areas may become aware of the post harvest loss prevention technologies.

2. In the long run, Farmer Field School (FFS) approach on the lines of Indonesia should be adopted and be promoted to fill up knowledge gap between researchers and actual practitioners (farmers). This approach was pioneered and first promoted by the Food and Agriculture Organization (FAO) as a practical way of diffusing knowledge intensive integrated pest management (IPM) concepts . The FFS training programme could utilize articipatory methods to help farmers develop their analytical skills, critical thinking, and creativity, and help them learn to make better decisions . In this approach the trainer is more of a facilitator, rather than an instructor. The FFS concept does not require that all farmers attend FFS training. Rather, only a select number of farmers within a village or local farmers' group are trained in these informal schools, which entail weekly meetings in a season-long training course. However, in order to disseminate new knowledge more rapidly within the community, selected farmers receive additional training to become farmer-trainers, and are expected to organize field-school replications within the community, with some support from public sources. Furthermore, all FFS trainees should share their knowledge and experiences with other farmers. This approach is in practice in many east asian countries and would benefit India very much.

3. Presently most of the cold storage are setup fitted to preserve only potato from decaying. These cold storage can't give an effective protection to other horticulture produce. Therefore,government should give financial incentives to establish multi-chamber/ multi- product cold storage and for the existing cold storage adequate finance should be made available at concessional rate of interest so that they can be

upgraded converted for multi product storage.

4. Since the horticulture producers are heavily dependant on the domestic market, many times overproduction lead to low price and that ultimately results in a loss to the farmers.

   Therefore, to avoid overproduction of selected varieties in a particular district or region, development of a mixed cropping pattern is needed as well as the linkage of production with processing and organized marketing is also needed in order to eliminate flooding of the local market and falling prices during peak seasons. Horticulture experts may advise farmers on this aspect to avoid such situation.

5. The above mentioned HICs should also provide information about the domestic markets as well as opportunities in the export market. They should also provide information about the type and quality of the produce in demand in the international market. To have access the international market on a large scale and to explore full potential of would market, new initiative in packaging and marketing are required. In addition, to foray into the international market, farmers will have to discard use of prohibited pesticides and for this purpose, informations about the ISO standards prevailing in the western countries should be available to farmers.

6. There is an all round realization at every level that quality production of International standard is the watchword for survival now. Consequently, the processor, small or big, have to take steps to improve quality right from the selection of the raw material and that of the ingredients. Side by side steps would also be required to upgrade hygienic and sanitary conditions of the workers, plant and machinery so as to ensure quality of the finished product. There should be greater emphasis to invest in research and development and product innovation so as to remain competitive in world market.

   In addition, It is suggested that APEDA which has its offices/representatives in many countries may also look after exports of fresh fruits and vegetables and processed products. This would really give the needed encouragement to the horticulture sector of U.P. and Bihar.

7. To boost horticulture export from both states, direct international flights will act as a positive step in this direction. Lucknow and Patna airport should be upgraded and cold storage facilities should also be opened near these airports.

8. Government may consider to give financial assistance to purchase refrigerated vehicles or procure it on a concessional rate. This will ensure quality of the exportable produce. The State Government should prepare an action plan for this purpose and estimate requirements of funds.

9. To begin with, both State Governments should limit their efforts to 3-4 horticulture produce where loss as are too high. In case of Uttar Pradesh it could be Mango, Potato and Tomato and in case of Bihar it could be Mango, Litchi, Banana and Cauliflower. Initially processing industries should be promoted for these produce.

To increase value additions, small sized processing units should be installed and promoted. This will save post harvest losses on one hand and increase profitability of farmers, on the other hand. Processing of fruits and canning of vegetables can multiply their value 50 to 500 times and open up the prospect of huge international market. At present only a fraction of total fruits and vegetables produced in the country are being processed.

In Uttar Pradrsh, to install a unit that can process 36 ton potato per year, it may require investment of 1.5 - 2 lacs rupees . For 1500000 ton potato, that is almost one third of total surplus potato of Uttar Pradesh ,an investment worth 700 crore rupees is required. Equally to process one lac ton raw mango and two lac ton ripen mango, an investment to the tune of 185 crore would be required. Thus total required investment would be the order of 885 crore rupees from this investment , approximately 200000 people could get employment round the from year. This will give boost to the other sectors of the region as well.

Almost the same can be replicated also in Bihar with little modifications. In Bihar, focus of the processing industries should be on mango, tomato, guava and litchi. Initially, investment worth 500 crore rupees would be required to process surplus horticulture produce. This can generate employment for approximately 125000 people for the whole year.

10. Since infrastructure is in a very bad shape in both states and it can't be improved in a short span of time, on the line of export processing zone, horticulture processing zones should be established. One horticulture processing zone may be established in Western

Uttar Pradesh possibly near Agra and another one should be established in Eastern Uttar Pradesh probably near Varanasi.

In Bihar, one horticulture processing zone may be established Near Supaul in north Bihar and another one near Muzaffarpur, in central Bihar. State Government should prepare detailed project reports and estimate requirement of funds. Nationalised commercial banks should come forward to provide loans to the small entrepreneurs on prime lending rate initially a part of this loan should be subsidised by the state governments.

Since power availability of a very bad shape, therefore, until power situation

improves, at least 40 per cent of the net price of the power generating set, should be subsidised.

11. But last and most important precondition of growth of industry in both states in general and in Bihar particular, is law and order situation. In absence of congenial business environment no subsidies and incentives can work. Therefore, law and order situation should be improved on priority basis.

Annexure

Questionnaire for the farmers

1. Name of the Farmer :
2. Age of the Farmer :
3. Number of dependants :
4. Where does he live, village or city
5. Total land holding of that particular farmer
6. Main crops produced by him including horticulture produce:
7. What per cent of total land holding is generally used for the horticulture purpose by that farmer?
8. Why does he want to produce fruits and vegetables, only for self-consumption or to sell in the market?
9. If they grow fruits and vegetables, what percentage of total produce they sell into the market?
10. When they sell it? immediately after production or after sometime. If after sometime then when and why?
11. If they sell it after some time then in-between where they keep their produce?
12. If they keep it in his own godown or home, what is the percentage of total wastage?
13. Is there any cold storage or food processing facilities in that locality?
14. If yes, then how many cold storage exist there?
15. Do farmers keep their produce in a nearby cold storage, if yes, then why? and if no, again why?
16. If they are engaged in a production of horticulture produce, how many people they employ per acre and for how many days?
17. Are farmers satisfied with the quality of service, cold storage owners provide?

Questionnaire for Cold storage owners/managers

17 What is the total capacity of that cold storage?
18. What is the percentage of capacity utilisation?
19. In which month, there is a more demand for it and when less?
20. If it is under utilised then, why?
21. How they charge for the service they provide?
22. Is there a scope for another cold storage?
23. If yes, then why it has not been built?
24. What are the main obstacles, each cold storage of that locality has to face?
25. How these obstacles can be removed?
26. What is the role government can and should play, so that new cold storages can be built

and the old one could get much needed support?

27. What is the general power condition and the availability of other infrastructure Facilities?
28. How many people are employed in each cold storage directly and how many indirectly?
29. What is the amount of salary, different categories of employees receive?
30. What is the cost of building of a cold storage?
31 How many people get employment, out of this construction?
32. What are the main horticulture produce, which are generally kept in cold storage?
33. What is the status of farmers who use this facilities?
34. Generally, how many kilometers a farmer has to travel with their produce to keep that in cold storage?
35. What is the total quantity of wastage due to non availability of cold storage?

Questionnaire for the factory owners/managers

36. How many food processing facilities exist there?
37. What is the capacity of these facilities?
38. What is processed in these facilities, fruits or vegetables ?
39. Where they are sold, in local market or in other cities or it is exported ?
40. What is the total volume of export?
41. How many people are employed in these facilities?
42. Total annual turnover of these companies?
43. Are they running into loss or profit?
44. What is the percentage of loss or profit, as the case may be?
45. What is the total amount of investment made by each companies?
46. Which fruits or vegetables are processed?
47. If export is not taking place, why?
48. What kind of assistance needed to promote export?

Questionnaire for the Officials / Horticulture Officer of that District

49. What is the total area of this district?
50. How many acres/hectares of total land is used for agricultural purpose?. Out of which, how much is irrigated?
51. What are the main horticulture produce of that district?
52. What is the estimated quantity of various horticulture produce of this district ?
53. If there is any cold storage / food processing facilities, how they are functioning?
54. If there is no such facilities, why?
55. What is the quantity of exact wastage of horticulture produce due to non-availability of cold storage/ food processing facilities?

56. What steps are needed to improve the situation?
57. How many people of this district are involved directly or indirectly , in the activities related to horticulture?