CHAPTER 2
POST HARVEST VALUE CHAIN MANAGEMENT – CONCEPTS, THEORIES AND THE AVAILABLE EMPIRICAL PERSPECTIVE

2.1 As agriculture sector of India is getting diversified from food grains centric sector to one with growing importance of horticulture and other sub sectors, the management of post harvest value chain has acquired added significance. Accordingly, the literatures on various dimensions and issues related to the post harvest management of farm products in general and horticultural crops in particular have also expanded. There have also been significant changes and innovations in the management of these processes. Hence, before getting in to the specific objective and research questions of the present study, it is felt necessary to carry out a review of the existing studies on the subject so as to prepare a backdrop for the present study and to identify gaps in the literatures to be filled by the present study. Accordingly, a detail survey of the literatures was carried out which provide the inputs for discussion reported in this chapter.

The chapter consists broadly of two parts. The first one (section 2.2) provides an idea of various concepts used in the present study. The next section (section 2.3) is organised in 7 sub sections. The first two sub sections provide in the country context, the importance of the horticultural sector in agricultural development and various policy initiatives for the development of the sector. Sub section three provides a historical count of the assessment of the post harvest losses and is followed by a detail analysis of the factors responsible for such losses and its impact on agricultural development. The next section examines the marketing aspect of the post harvest system. The importance of value chain analysis to examine the competiveness of any kind of supply chain is explained in sub-section six. The last one explains contract farming as an option of vertical co-ordination in agricultural value chain.
2.2 The Conceptual Background

In the present study, in any discussion of horticultural crops and their post harvest management, the following terms and concepts are frequently surfaced. A detail of the same along with the sense in which they are applied is outlined below.

**Horticultural Products and Horticultural Crops**

The International Society for Horticultural Science (ISHS) provides a wider definition of horticultural products along with the possible confusion of classification in the process of value addition of the product. According to the Society, the horticultural products include all processed or raw products that arise from the horticultural industry. That means the products that go from the horticultural industry to the market either resiping or processed is considered as a horticultural product. But sometimes the classification becomes complex for a product coming from horticulture industry is used as an ingredient of another manufactured item. The citation may be made regarding yogurt with fruit which may come both as a horticultural product, bakery or dairy product. This wider definition is supportive and even necessary for the present study as it involves traceability of the horticultural products right from the producer to the ultimate consumer through the value chain approach.

But to use this definition of a horticultural product, it is necessary to have an idea regarding the definition of the horticultural crops assigned to the horticultural industry. The literatures have mentioned the impossibility to give an exact definition of horticulture along with a definite scope for the same. Sometimes the horticultural plants are used by an animal to produce another crop but the final crop may not be a classification of the horticultural crop. Honey may be considered under this category and is often considered as a horticultural product. Again silkworm feeds mulberry trees to produce raw silk. Although silk is not a horticultural crop but mulberry trees which may be used to produce edible oil comes under the classification of the horticultural crops. However, a substantial enlightenment on the concept, scope and definition of horticulture can be obtained from the writings of various authors in the field.
Etymologically, the word ‘Horticulture’ is modelled after agriculture and comes from the Latin words ‘Hortus’ means garden ‘cultura’ means ‘Cultivation’\(^7\). Therefore, ‘Horticultural Crops’ may be defined as the crops grown in garden/yard. Bailey (1928) the father of horticultural science defines horticulture as the growing of flowers, fruits and vegetables, and of plants for ornament and Fancy. According to Bailey (1928) horticulture is that part of plant agriculture with so called ‘garden crops’ as contrasted with agronomy (field crops, mainly grains and forages) and forestry (forest trees and products)\(^8\). He considered horticulture as the branch of agriculture concerned with intensively cultured plants directly used by man for food, for medicinal purposes, or for aesthetic gratification. On the other hand, Louisiana State University (2011) defines horticulture as the science and art involved in the cultivation, propagation and marketing of ornamental plants, flowers, turf, vegetables, fruits, and nuts\(^9\). According to this definition horticulture is a unique plant science which involves not only science and technology, but also incorporates art and principles of design. Thus, horticulture is the art and science of plant production for both beauty and utility, rather than staple crops, horticulture focuses on value-added, luxury crops. In the context of India, The Working Group on Horticulture, Plantation Crops And Organic Farming for the XI Five Year Plan (2007-12) redefines horticulture as “science of growing and management of fruits, vegetables including tubers, ornamental, medicinal and aromatic crops, spices, plantation crops their processing, value addition and marketing\(^10\)”.

Thus from the above definitions, it may be concluded that horticulture is a branch of plant agriculture and is a both a science and an art. As an art, it incorporates the principles of design (as in landscaping). Horticulture crops deals with intensively cultured and high value crops. It include vegetables, fruits, and nuts which are directly used by man for food, the flowers and

\(^7\) The New Webster’s Dictionary of the English Language, international edition, Lexicon Publications,
\(^9\) Louisiana State University retrieved from http://www.horticulture.lsu.edu/whatis.html.
ornamental plants for aesthetic value or visual enjoyment, and those used for medicinal purposes.

Although a lot of definitions are there to give an appropriate definition of the horticultural crops but the definition of such crops many times influenced by the availability of the crops in the region. The Department of Agriculture, Government of Assam has made the following classification (Table: 2.1) along with the available components under each classification in the state. The major horticultural crops found in the state is classified under the major headings of fruits (including traditional fruits), vegetables, spices, tuber crops, flowers, plantation crops, aromatic plants, nut crops and medicinal plants.

**Table: 2.1 Major Horticultural Crops of Assam**

<table>
<thead>
<tr>
<th><strong>FRUITS</strong></th>
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<tbody>
<tr>
<td>Banana, Jackfruit, Pine apple, Papaya, Assam Lemon, Orange, Litchi, Guava, Mango, Sapota , Carambola, Leteku, Paniyal, Thekera, Rabab Tenga, Au Tenga</td>
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</tbody>
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<tr>
<th><strong>VEGETABLES</strong></th>
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<tbody>
<tr>
<td>Tomato, Ash Gourd, Bitter gourd, Bottle gourd, Brinjal, Broccoli, Cabbage, Capsicum, Carrot, Cauliflower, Chilli, Chow-chow, Cow pea, Cucumber, cucurbits, French Bean, Garlic, Knolkhol, Ladies Finger/ Okra, Lettuce, Musk melon, Pea, Pointed gourd, Pumpkin, Radish, Ridge gourd, Snake gourd, Spinach, Beet, Spine gourd, Sponge gourd, Water melon</td>
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</tbody>
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<tr>
<th><strong>SPICES</strong></th>
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<tbody>
<tr>
<td>Chilli, Coriander, Ginger, Turmeric, Onion, Garlic, Black Papper, Cumin &amp; Black Cumin, Mint, Fennel, Fenugreek, Bay leaf, Curry Leaf, Vanilla</td>
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<table>
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<tr>
<th><strong>TUBER CROPS</strong></th>
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<tr>
<td>Potato, Sweet Potato, Tapioca, Colacasia, Yam, Kath alu</td>
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<table>
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<tr>
<th><strong>FLOWERS</strong></th>
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<tbody>
<tr>
<td>Marigold, Tuberose, Gladioli, Gerbera, Bougainvillea, Mussaenda, Chrysanthemum, Dahlia, Orchids, Antirrhinum, Aster, Balsam, Calendula, Carnation, Petunia, Portulaca, Salvia, Zinnia</td>
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<tr>
<th><strong>MEDICINAL PLANTS</strong></th>
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<tbody>
<tr>
<td>Amlakhi, Silikha, Bhumura, Bael, Nefafu, Brahmi sak, Maha Brhringaraj, Madhusoleng, Sarpagandha, Kalmegh, Neem, Safed Musli, Tulsi</td>
</tr>
</tbody>
</table>
AROMATIC PLANTS
Citronella, Lemongrass, Vetiver, Patchouli

NUT CROPS
Areca nut, Coconut, Cashew nut

PLANTATION CROPS
Betel vine, Tea, Rubber, Coffee, Agar

Source: Department of Agriculture, Government of Assam

From these broad categories of horticultural crops found in Assam, the study considers the first three of the broad categories, namely, fruits, vegetables and spices. The rationale behind the selection is the similarity of economics of cultivation of these crops. Whereas, in case of other categories, like plantation crops, nut crops and so on, the economics of cultivation is different. Plantation based crops require relatively greater initial investment, have a gestation period and gives returns for a long period of time. Besides, the post harvest issues related to the crops are also different from those that arise in case of fruits and vegetables. These crops require a huge initial investment with its return for more than one year unlike the first three categories of horticultural crops.

Post Harvest System
The post harvest system encompasses a sequence of activities and operations that can be divided into two groups- technical activities and economic activities\textsuperscript{11}. The technical activities consist of harvesting, field drying, threshing, cleaning, additional drying, storage and processing. The economics include transportation, marketing, quality control, nutrition, extension, information and communication, administration and management. Spurgeon (1977) has identified the following (Table: 2) twelve stages of the whole post harvest system starts right from the harvesting to the consumer education\textsuperscript{12}.

\textsuperscript{11} Agriculture and Consumer Protection Department, FAO

Table 2.2: Stages of a Whole Post Harvest System

<table>
<thead>
<tr>
<th>Stage</th>
<th>Description</th>
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<tbody>
<tr>
<td>01</td>
<td>HARVESTING (handling)</td>
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<tr>
<td>02</td>
<td>THRESHING</td>
</tr>
<tr>
<td>03</td>
<td>DRYING (transport and distribution)</td>
</tr>
<tr>
<td>04</td>
<td>STORING</td>
</tr>
<tr>
<td>05</td>
<td>PROCESSING</td>
</tr>
<tr>
<td>06</td>
<td>PRIMARY PROCESSING (cleaning, classification, dehulling, pounding, grinding, packaging, soaking, winnowing, drying, sieving, whitening, milling)</td>
</tr>
<tr>
<td>07</td>
<td>SECONDARY PROCESSING (mixing, cooking, frying moulding, cutting, extrusion)</td>
</tr>
<tr>
<td>08</td>
<td>PRODUCT EVALUATION (quality control: standard recipes)</td>
</tr>
<tr>
<td>09</td>
<td>PACKAGING (weighing, labelling, sealing)</td>
</tr>
<tr>
<td>10</td>
<td>MARKETING (publicity, selling, distribution)</td>
</tr>
<tr>
<td>11</td>
<td>USE (recipes elaboration: traditional dishes, new dishes)</td>
</tr>
<tr>
<td>12</td>
<td>CONSUMER PREFERENCES (product evaluation, consumer education)</td>
</tr>
</tbody>
</table>

He also stated that the entire system encompassing the delivery of the crop from time and place of harvest to the time and place of consumption should involve with minimum loss, maximum efficiency and maximum return from all involved in the post harvest system. The identification of the stages along with the efficiency concern throughout the system will help in the evaluation of an appropriate post harvest system for the identified crops in the present study.
**Supply chain and Value Chain**

The concept of agricultural value chain includes the full range of activities and participants involved in moving agricultural products from input suppliers to farmers’ fields, and ultimately, to consumers (Fries, 2007; Mileer and Jones, 2010). By understanding the complete production to consumption system of any agricultural product, it is possible to determine how the marketing and value addition activities take place and who shares how much benefit from such activities.

A supply chain in agriculture, on the other hand, consists of mere steps in which agricultural products just transfer from one place to final place without adding value in the channels of transferring (Feller et al., 2006; Sahoo, 2010). It focuses on integrating supplier and producer processes and its main objective is to improve efficiency and reduce wastages. Thus the main difference between the two is that the supply chain merely traces the product from the production ground to final users whereas the value chain when traces the product also takes in to account the value added at each stage of the chain (FAO, 2005).

The value chain analysis has become an important tool for analysing the competitive strength of supply chain of any commodity. The assessment of the performance and relationship through value chain analysis helps in identifying the constraints in the supply network and also the roles and benefits of different agents in the chain (UNIDO, 2009). Accordingly, such analysis provides adequate insights to increase the efficiency, productivity and competitiveness of the chain actors. There are two kinds of co-ordination, viz. horizontal and vertical within the value chains (FAO, 2010). Horizontal coordination refers to coordination among the agents of the same level in the supply chain. On the other hand, vertical coordination refers to the coordination among different agents at different stages of the supply chain.

An assessment of the performance and relationship among participants through this value chain approach helps in identifying the constraints in the

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way of increased efficiency, productivity and competitiveness and thus taking adequate measures for removing the same. There may be horizontal and vertical coordination within the value chains. Horizontal coordination refers to coordination among agents operating at a particular link of the value chain. Vertical coordination refers to organisation of various activities at consecutive stages of the chain, i.e., from input supply, through growing, harvesting, marketing and so on.

**Figure 2.1 Michael Porter’s Value Chain**

![Figure 2.1 Michael Porter's Value Chain](image)


The concept of value chain was first used by Porter (1979). In Porter's value chains, Inbound Logistics, Operations, Outbound Logistics, Marketing and Sales and Service are categorized as primary activities. Secondary activities include Procurement, Human Resource management, Technological Development and Infrastructure.

Primary activities are those that are related with production, while support activities are those that provide the background necessary for the effectiveness and efficiency, such as human resource management. According to porter, in order to analyse the competitive advantage it is essential to examine the firms as a whole. It may be possible only through analysing the discrete activities a firm performs in designing, producing, marketing, delivering and supporting its product Each of these activities can

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contribute to a firm’s relative cost position and create a basis for differentiation.

The main stage of an agricultural value chain is illustrated in the following diagram. The dashed arrows flow from input supply to all other stages to show that this is a crosscutting function that affects all participants, not just at the farm level. Dashed arrows are also drawn from farm production to processing and distribution to show that some farmers may deliver their crop directly to a factory or, in the case of unprocessed goods, directly to the final market, thereby fulfilling the assembly and delivery function as well.

**Fig. 2.2 Agricultural Value Chain**


In the present study, this value chain analysis will help to map the movement of price and journey of the produce from farmer to the end consumer. This mapping will be useful in identifying and also in understanding the crucial aspects to achieve competitive strengths and core competencies in the marketplace for the selected horticultural crops. Whereas, the examination of the performance will help in identifying the role and benefit shares of different actors and thus improving the strengths of the chain by removing the actors fail to provide an important role.

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16 Available at [https://openknowledge.worldbank.org/bitstream/handle](https://openknowledge.worldbank.org/bitstream/handle)
**Price Spread**

As part of the analysis of the efficacy of the marketing channels, the concept of price spread has been used. Price spread refers to the price difference between the net price received by the farmer and the price paid by the end consumer for the same product (AAU, 2011)\(^{17}\). A higher price spread indicates a greater exploitation of the farmers in terms of a lower share in the total return of the produce and vice versa.

**Value Addition**

Value addition refers to any kind of activity immediately after harvesting which adds value to the produce (FAO, 2007)\(^{18}\). Farmers may take the advantage of value added opportunity through three ways. The first way refers to the activities which makes changes in the form, space and time characteristics. Thus, it basically refers to the activities, like storing, packaging and so on. Secondly, the farmers may take the value added opportunity through vertical and horizontal co-ordination with other farmers or bypassing the stages in the supply chain to ensure close connection with the consumers. Finally, the farmers may perform such activities which change the identity and quality characteristics of the raw produce. Thus, it refers to the activities like processing. In the present study, the concept of value addition is examined in terms of the first way of above explained value added opportunity. This is because nowhere in the study area found third way of value addition activities and the next way of value addition has been examined to some extent while examining the performance of various value chain actors.

**2.3 A Review of Empirical Studies**

*The Post Harvest Management* is a multi disciplinary concept and the issue has received the attention from various disciplines. The economic implication of the concept is also found in many literatures. A review of the research work done relating to the present study has been presented below. The reviews examined are related to the role of the horticultural sector in agricultural


\(^{18}\) Agricultural Value Chain Finance, available at [http://www.fao.org/docrep/017/i08466e/i08466e.pdf](http://www.fao.org/docrep/017/i08466e/i08466e.pdf)
economy along with the policy initiatives in the country for the development of the sector. The historical count of the issue of post harvest losses and its impact and determinants has also been included in this section. The literatures pertaining to the examination of the marketing channels and the examination of their efficacy has also been a part of the reviewed empirical studies. Besides the research works relating to the value addition has also formed a part of this analysis. Finally, it examines the value chain approach along with the contract farming as an option of vertical coordination of value addition.

2.3.1 Horticultural Sector in India – The Driving Force of Agricultural Development

The importance of the horticultural crops was well recognised in India since time immemorial considering the nutritional, medicinal and aesthetic value of these crops. The Vedas and other related text reveal the ancient Indians gave great importance to gardens and parks\textsuperscript{19}. Even a king was considered an ideal king if his abode is provided with spacious gardens full of fruit bearing trees, containing pools and tanks adorned with beautiful lotus blossoms, having plants laden with fragrant flower etc. Kautilya has also included garden and field under ‘Vastu’ and so Vastu Satra or the science of habitation may be taken to stand for laying gardens etc. including horticulture and agriculture.

The importance of the sector is growing day by day and considering its present role in the overall development of the agriculture sector often term the sector as ‘sunrise area’\textsuperscript{20}. The basic feature of the horticulture sector and the nature of the economy is well suited to grow each other and in accelerating economic development. The potentiality of the unique agro climatic condition of the country can be best utilised to produce a wide range of varieties of such high value crops. The horticulture sector is characterised by higher bio mass production per unit area and it suits the present low income agrarian set up of the country to earn more per unit area.


\textsuperscript{20} Horti Vision 2020, available at \url{http://www.agriassam.in/download/hortiVision2020.pdf}
The sector also provides an important role in ensuring nutritional security of the country\textsuperscript{21}. The dietary aspect which is often ignored in rural areas due to the lack of awareness and maintaining a nutritional diet being costly affair can be solved to some extent by expansion in the cultivation of such crops. The sector has the potentiality to improve rural diet with least investment or any extra effort.

The high value horticultural crops sector also plays an important role in employment generation. This is the most profitable venture of all farming activities, as it provides ample employment opportunities and at the same time provides ample scope to raise the income of the farming community (Choudhary et. al 2013). The high man labour ratio compared to cereals at different stages of harvesting provides employment opportunities and thus may reduce the rural unemployment to some extent. The average labour required for growing horticultural crops is about 450-2,500 man days as compared to only 150 – 200 man days for field crops in a year (“Food Processing Industries in India”, Ministry of Food Processing Industries, Govt. of India). Besides the sector posses a wide range of potentiality of value addition and thus raises the direct and indirect employment effects of development of the post harvest value chain of farm output. Direct employment opportunities will arise in the acts of storage, processing, transportation, packaging and marketing. Indirect employment growth can also take place mainly from backward linkages. Development of post harvest value chain may encourage farmers to increase production as more output now can be disposed off without depressing the price. Increased output can come from increased cropping intensity and diversification towards high value crops. There can also be further employment effect at the level of the input suppliers to the farm sector. Besides all these, this high value crop sector has a universal appeal all over the world with the aesthetic outlook.

The diversification towards the horticulture sector is also found to be a profitable shift in many studies (Raju, 2005; Singh et. al, 2007; Jhaet.al,

\textsuperscript{21} Planning Commission Report, Gol, available at \url{http://planningcommission.nic.in/aboutus/committee/wrkgrp/horticulture.pdf}
This high value crops provide a higher price than cereals and the demand for these crops is also increasing domestically as well in the international market. The increasing demand of these high value crops provide higher market price to the farmers than the traditional crops. The changing food habit of the people with the changes in income and more concern about dietary aspect has helped the agents involved in the supply chain of these produce to receive a better price for the produce.

The sector can also be one of the major emerging sources of the foreign exchange earnings (Weinberger and Lumpkin 2007; Mittal, 2007, Nanda et.al, 2008). The export of processed fruits and vegetable crops has been reported a potential area for enhancing the export of value added products. But the status of the processing industry is still unorganised and has been carried out on small units without having modern facilities. In present time, some multinational companies have entered in to the proceed food sector of the country. This may help in the improvement of the required infrastructure and thus may provide more employment opportunities. The increased import demand of this sector provides the opportunity for India to look forward to be a centre of major producer and exporter of this crop segment and thus in overall development of the agricultural sector.

Diversification towards horticultural crops is also a support to the degraded land quality of the country. The issue of arable land depletion, loss of soil fertility and environmental degradation due to excessive human pressure on land justifies diversification towards high value crops as the traditional crops have little advantage in these areas (Chand, 1996; Tout, 1990). Also, due to continuous traditional cereal cropping pattern, multiple nutrient deficiencies have emerged in the fertile lands. So, high-value cash crops, including horticulture, are encouraged in these areas, which have less pressure on land compared with traditional crops (Das, 2006).

Horticulture is also an important segment of Agriculture in the economy of Assam contributing about one-fifth share of the Agriculture and allied sectors (Dutta, 2013; Gogoi, 2013). Rapidly growing demand for horticultural commodities and products especially for processed fruits and vegetables as
well as booming floriculture market is an evidence of the phenomenon that is expected to accelerate horticultural growth in the state. Consequently, horticulture is set to assume a greater role and importance within the agriculture sector and eventually in the state economy.

Being a flood prone state, many studies have reported fluctuations in the productivity of the major crops of the country. There should be an alternative option for the farmers which may minimise the impact of such harvest losses and may provide monetary security to the farmers to some extent. Besides the sector can also provide required assistance to generate gainful employment, promote trade and commence and fighting against malnutrition.

Thus, the above analysis clearly indicates the importance of the horticultural sector from two perspectives. The first one is the availability of the required conducive climate to grow the sector, ability to absorb a huge workforce with comparatively high returns per unit land area and its support to fight nutritional security. The second one is the changing economic situation with the changes in the food habits of the people supports its role for economic development by the way of diversification. The diversification towards this sector offers an attractive option and a major source of pushing up the growth of agricultural sector. But technological upgradation and institutional arrangements are the major thrust areas require special attention for the development of the sector. For a sustainable development of the sector it should be accompanied by the growth of the agro processing industry. Day by day the demand for the processed product is increasing both at the domestic and international level. Therefore the production strategy should target not only meeting the domestic and export demand of fresh products but also of the processed products. There is the need to improve postharvest operations related to handling, storage and marketing of fresh and processed produce. Under such a situation it is imperative to examine the policy initiatives undertaken both for the national and state level for the development of the sector especially for the development the post harvest sector of this high value crop segment.
2.3.2 Policy Initiatives for the Development of the Horticulture Sector in India

In the initial stage of planning process, the main emphasis of the government of India was to attain self sufficiency only in the production of the cereals. Thus, the horticulture sector as an important sub sector for agricultural development was totally ignored (Mittal, 2007). From the Fourth Five Year Plan (1969-74), a separate budgetary allocation was earmarked for the development of the horticulture sector\textsuperscript{22}. But it was only from Seventh Five Year Plan (1985-1990); this high value crop sector has received the attention of the policymakers (Chand, 1996; Singh et. al, 2004). At the initial stage, the government has focussed only on the development of some specific horticultural crops like spices, coconut and potato. Subsequently various policy initiatives have been undertaken to develop the sector in an integrated manner covering all the crops. An increase in the fund flow for the development of the sector is also noticed in the subsequent plan period. The increase in between Fourth to Ninth Five Year plans was 61 times for research and 584 times in respect of the development programmes\textsuperscript{23}.

In all these five year plans, the emphasis was mainly for the enhancement in production, productivity and the availability of the horticultural produce. These efforts of the Government of India has helped the country to emerge as the largest producer of coconut, arecanut, cashew, ginger , turmeric black peeper and tea and the second largest producer of fruits and vegetables. The government has also succeeded in introducing several new commercial crops in the country like kiwi, olive crops and oil palm.

During the Ninth Five year Plan period (1997-2002), a total of 16 sub schemes were initiated for the overall development of this horticulture sector. Majority of the schemes introduced during this plan period mainly emphasised on expansion of the area, production and productivity of the horticultural crops, improve availability of seeds of high yielding, to generate employment opportunities in the rural sector and so on. Citation may be made for the schemes like Integrated Development of Fruits, Integrated Development of Horticulture...  


\textsuperscript{23} Planning Commission Report, Gol.
Medicinal and Aromatic Plants, Integrated Development of Spices, Integrated Development of Cashew & Cocoa, Integrated Development of Coconut, Horticulture Development through Plasticulture Interventions, Development of Beekeeping for Improving Crop Productivity, Integrated Development of Horticulture in Tribal/Hilly Area, Human Resource Development in Horticulture Integrated Development of Tea and Integrated Development of Coffee. As a result of these efforts, during the last decade, the area under horticultural crops has increased by 55%, whereas, the production has increased by 86%\textsuperscript{24}.

While the expansion of area and production has received a good response from the policy makers, the required post harvest operations to cope up with this increased production were found missing. It was only from the Eighth plan onwards the attention was paid for the development of the post harvest infrastructure\textsuperscript{25}. Accordingly, National Horticultural Board was set up to have both technical and financial support for the creation of the post harvest infrastructure for horticultural crops. Besides, various organisations, like Directorate of Marketing and inspection, NCDC, APEDA, Ministry of Food Processing industries have been implementing various policies for the development of the post harvest sector. During the Nine plan period, schemes were initiated for the development of the post harvest management aspect of this high value crop segment. The schemes considering the post harvest management as their basic policy objective are - Integrated development of Vegetables Including Root & Tuber Crops & Mushroom; Integrated Development of Commercial Floriculture, Post Harvest Management, Marketing and Exports.; Technology Mission for the Integrated Development of Horticulture in the NE Region including Sikkim (TMIDH) and Integrated development of Rubber. But these schemes could not provide the required institutional as well as infrastructural set up for the development of the post harvest sector of this high value crop. However, under the Mini Mission–III and IV of Horticulture Mission for North East and Himalayan States (HMNEH) (Renamed TMIDH in 2010-11) attempts have been made to

\textsuperscript{24} India’s Horticulture, \url{http://mospi.nic.in/Mospi_New/upload/SY82015/CH-9-HORTICULTURE}
create adequate infrastructure in terms of the marketing facilities and establishment of processing units. Up to 2010-11, the scheme has succeeded in establishing 1 Wholesale Market, 28 Rural Primary Market and 4 Apni Mandies and under Mini Mission IV, 16 processing units have been established\textsuperscript{26}.

In the state of Assam, the transition phase of the agriculture best suits the Technology Mission for Integrated Development of Horticulture (TMIDH) scheme. This policy initiative along with the others taken at national level has helped this sector to reach a new era of Horticultural revolution. However, the post harvest aspect has not received the required attention and thus proper value addition in these high value crops is found to be missing.

Thus, the above analysis provides an idea about the growing concern of the policy makers for the development of the sector in a balanced manner. But somehow the post harvest aspect could not compete with the advancement achieved by the pre harvest management practices. A sustainable development of the sector requires a balanced coordination between the various pre and post harvest management components. The absence of this linkage results in failure to achieve required level of value addition in the supply chain of the horticultural crops along with a huge post harvest losses up to 20-30% of the total produce\textsuperscript{27}. Under such a situation, it is imperative to examine the status of the post harvest management system and the associated loopholes in the system to suggest a better one for proper value addition in the system.

2.3.3 Post Harvest Management - Historical counts of Post Harvest Losses

Post harvest loss at any stage of the supply chain is an indication of an inefficient post harvest management system. An insight in to the assessment of the post harvest losses will help in articulating the extent and stages of the

\textsuperscript{27} Report of the 12\textsuperscript{th} Five Year Plan Period, Planning Commission, Gov
losses along with the factors responsible for such losses in the supply chain of the produce.

But in any discussion of the estimation of post harvest losses, the confusion arises regarding the different elements to be included in the post harvest system (Grolleaud, 2002). Parifitt et al. (2010) mentioned that post harvest loss is generally used to describe the losses within agricultural systems and the onward supply of produce to markets, whereas, in relation with food supply chain the term is associated with post harvest processing, large retail sectors, post consumer losses that include food wasted from activities and operations at the point at which food is consumed. In this study, three types of confusions have been mentioned about the post harvest loss assessment. The first one is mainly related to the starting and end point of post harvest system. The second one is the basis of loss calculation, should it be as a percentage of amount harvested, or should it be on the basis of theoretical or recorded yield per hectare. The third confusion is related to the consideration of post harvest operations as a part of production cycle, processing or distribution cycle. Besides, due to the differences in the post harvest system, the estimation of post harvest losses differ in different sectors like crop, livestock, forestry and even it differs within the sector. With different importance, the available literatures on post harvest loss estimates along with its key elements are discussed below.

For the first time, the importance of reduction in food waste in general and post harvest losses in particular as a mechanism for ensuring food security was emphasised only after the 1974 first World Food Conference (Parfitt et al., 2010a). Accordingly, United Nations General Assembly passed a resolution committing its members to reduce the post harvest losses by 50% by 1985 (Harris and Lindblad, 1978). The global recognition of reduction in post harvest losses as a solution to world hunger leads to the estimation of post harvest losses for different agricultural commodities in different countries for finding out the factors responsible for post harvest losses and removing the same with the set targets.

A few international studies are found involved in the estimation of post
harvest losses during 1970s and 1980s (Morris, 1978; Kitinoja, 2015, Blond, 1984). Besides the mentioned studies, some other postharvest systems assessments were also done for vegetables in the USA in the 1980s (Brennan and Shewfelt, 1989; Prussia et al., 1986, cited in Kitinoja, 2015). The resulting estimates of such studies of postharvest losses for horticultural crops varied somewhat, and differed by region, crop and season, often without having a detailed explanation of what is being measured, when or how and without analysing the factors affecting such losses. But later on many development authorities, e.g. the UNFAO, the World Bank and USAID have primary quote a general figure of 30 to 50% losses in such studies.

In a study by World Food Logistics Organization for the estimation of post harvest losses for 14 major horticultural cops in 5 countries (Egypt, Ghana, Kenya, India and Indonesia) during 2009 found an average rates of damage between 15-20% (measured via sampling across all 4 countries at the farm, wholesale and retail level) with sorting losses of 12% on the farm, 19.5% at wholesale and 21% at the retail markets. The studies have identified that the factors like storage duration, storage depletion pattern, market access conditions, and higher seasonal price differences have a greater influence on the post harvest losses.

The above studies have collected data on post harvest losses either via interview of the agents involved in the value chain or direct measurements and are reported as either physical or economic loss. The studies itself also state the limitation of the interview method as a method of data collection since the interviews require people to try to remember what happened in the past, sometimes weeks, months or even a season back and are generally less accurate than physical measurements.

In India, the estimation of such post harvest losses is found in a few studies (Gauraha, 1997; Sharma and Singh, 2004; Basavaraja, 2007; Murthy et al., 2007; Gangwar et al., 2007; Gajanan et al., 2008; Sharma et al., 2011). The studies are related to the estimation of post harvest losses of food grains, fruits and vegetables. These studies show that losses vary from season to season, from crop to crop and from region to region. Even for the same crop
the estimate is found to be different in different time periods. But these studies have quoted a general figure for post harvest losses without taking into account of the losses at different stages of the supply chain. But a detail analysis of the estimation of post harvest losses is found in the following studies for different agricultural products.

The estimation of the post harvest losses for food grains reveal the highest share of losses at the storage stage. Basavaraja et al (2007) in his study of the estimation of post harvest losses for rice and cereals found the highest percentage share of losses at the storage level. The study was conducted in the state of Karnataka with multi stage random sampling technique selecting 100 farmers, 20 wholesalers, 20 processors and 20 retailers for the year 2003-04. The estimated loss figure for the study was 5.19 kg per quintal for rice and 4.32 kg per quintal for wheat. The storage losses registered the highest percentage of the total post harvest losses (1.20 kg/q in rice and 0.95 kg/q in wheat). Therefore, the major policy suggestion of the study was the establishment of the small sized cold storage and popularising the zero cool chambers technology developed by Indian Council of Agriculture Research. The highest storage losses for food grains is also fund in a recent publication and is stated to be 2% of the total 6% post harvest losses in the year 2013\textsuperscript{28}. The others studies supported the highest storage loss for food grains are Deshpande and Singh (2001), Nagpal et al., 2012; Sarkar et.al, 2013; and Kannan, 2014). The main reasons of storage losses cited in the literatures are inadequate and traditionally equipped storage facilities, greater risk of insect attacks, lack of knowledge about pre storage management practices, agro climatic condition, quality of the output and so on.

Contrary to the above finding, Jain (1968) in his study of storage losses for food grains reported that the losses at storage level are not significantly high. The estimated losses were only 0.5% to 1.0% (if the period of storage remains below six months) and it may be maximum 2% (the length of storage remains in between 6-12 months) of the total quantity stored. He also found

that the losses in public warehouses are smaller than those in private godowns. On an average, in percentage terms, the losses in the private storages double within the time-period specified above.

The estimation of the post harvest losses for different varieties of fruits, vegetables, spices and other horticultural crops have been conducted in different states of the country. In the study of post harvest losses in Punjab for kinnaw (Citrus fruit) random sampling technique was followed in the largest production region of the state in 2004-05 (Gangwar et.al 2007). After identifying the region, four villages were randomly selected and kinnaw growers were grouped in to three categories on the basis of the size of the orchards. Then data were gathered during the fruit harvesting and marketing seasons through pre structured schedule by personal interview method. Simple averages and percentages were used to calculate the post harvest losses at different stages identified in the kinnaw supply chain. In all these studies, the harvesting technique and distance of the markets are found to affect on the post harvest losses. Long distant market reported a higher post harvest losses for orchard level, transit and wholesale level and retail level. In order to analyse the effect of the harvesting technique on the post harvest losses, both the studies have examined the extent of post harvest losses separately for alternative harvesting techniques. The first method involves just dropping them on the ground and the second one uses clippers, followed by the collection of fruits in crates or bags. The first method of harvesting registered 10.63% of the total post harvest losses whereas; the second one has recorded only 2.51%. The main loss was found at retailer’s level 67.75 (in Delhi market) and 62.5% in Bangalore market. The study has emphasised on the expansion of the processing sector with value added ready to serve products.

In his study by Sharma et al. (2011) in the state of Uttarakhand examined the nature and extent of post harvest losses for twelve major vegetables and recorded the highest post harvest losses for tomato followed by potato, brinjal, chilly, French bean and pea. Multistage cluster sampling was used in the study for the selection of 80 vegetable growers, 40 farmers from the hilly
region and 40 farmers from the bhabhar region. The highest losses were estimated during the selling stage in most of the crops except potato, onion, cauliflower and radish. The maximum loss during selling was registered in tomato. The major policy suggestion of the study for the reduction in post harvest losses was the establishment of producer co-operatives to handle various activities relating to production and marketing of vegetables.

In a study by Murthy et al. (2007) for the estimation of the post harvest losses for the fruit crop banana in Karnataka reported 28.84% of the total production as post harvest losses. Like the previous study here also losses are found to be the maximum at the retail, i.e., 16.66% of the total losses. The highest retail loss is also reported by Gajanan et al. (2008) in his study of post harvest losses for the fruit crop Papaya. With a total post harvest loss of 25.49 % of total production, losses at retail level constitute 11.49% of total losses.

The above cited literatures clearly indicate the existence huge differences in the extent and stages of the post harvest losses between food grains and horticultural crops. The highest losses is found to be at retail level for horticultural crops but for food grains the recorded highest losses is at the storage stage. The difference is also prominent even among the crops of the same category. For the food grain category Dereje (2000) recorded 20% of post harvest losses whereas the figure was 10 to 20 % by FAO (1977) and 11 to 19% by Kasahun (2000). Thus, the homogeneity of loss estimates may be attained only by providing a range estimate rather than an accurate objective estimate.

Very limited studies have been conducted for the estimation of such post harvest losses in Assam. In an estimation of post harvest losses for the crop paddy in the year 1998-99, the state reported a 3.90% at producer’s level for all categories of cultivators and stage wise the highest percentage was found in threshing (1.03%)\(^{29}\). This specific study was conducted nationwide following stratified multi stage random sampling technique. In the first stage, the study selected 20% of the total number of districts from each state and then 15 villages from each district were selected based on total area.

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\(^{29}\) Marketable Surplus and Post Harvest Losses of Paddy in India 2002, Ministry of Agriculture, Gov
cultivated and finally from each village 10 cultivator households were selected classifying in to three categories, viz., small, medium and large. In a study by AERC (2006) for the two major crops of Assam paddy and pulses recorded the highest losses at the harvesting stage (4.24%) followed by storage (1.20%), transportation (0.39%).

In a recent study by Kannan (2014) for the important crops in India recorded the highest post harvest losses in Assam for paddy and wheat. The study was conducted in 10 states of the country covering two cereals (paddy and wheat) and two pulses (tur and soyabean). For the crop paddy, the study covered Golaghat and Sonitpur District with the sample size of 120. For the crop wheat Morigaon and Barpeta were selected with the same sample size. To collect the primary data, a sample survey was conducted in two districts for each reference crop in the selected state for the agricultural year 2011-12 (July to June). In case of wheat, total post harvest loss was computed at 8.5 kg for marginal, 10.7 kg for small, 13.5 kg for medium and 14.2 kg for large farmers in Assam. Total post harvest loss of paddy was the highest in Assam followed by Tamil Nadu and Karnataka. In case of wheat, the post harvest loss was relatively high in Assam with 11.7 per cent followed by Madhya Pradesh (8.6 per cent) and West Bengal (7.2 per cent). The per quintal post harvest losses is found to be increasing with the size of the holdings. The total post harvest losses for paddy were 5.39% for marginal farmers, 6.48% for small farmers, 8.03% for medium farmers and 9.42% for large farmers. Similar is the case for the crop wheat with 11.71% kg/ qtl with the highest post total post harvest loss recorded at transportation (2.95%).

Post harvest losses of horticulture produce varies between 5-39 percent in Assam (Planning Commission, 2012). In case of brinjal, cauliflower, guava, chilly and papaya post-harvest loss is found to be at a lower level, because of lower level of production. On the contrary, in case of mango, onion, tomato and potato, loss is at a very high level due to lack of quality consciousness and this in turn leads to post-harvest losses Post Harvest losses for potato is
found to be up to 2% at harvesting, between 2-3% at village traders and 2% among traders\textsuperscript{30}.

The estimation of such post harvest losses is also found in the study by Bordoloi (2013) for the major food crops paddy and wheat. The figure of such losses for Paddy stood at 1138.74 (15% of total production) quintal out of the actual total production of 7442.18 quintal, which is indeed a greater loss in terms of quantity available and on the income of the farmers. In the same study post harvest losses of wheat was recorded to be at 255.26 quintal out of the actual production of 927.20 quintal, with a loss of 27.53 per cent. To minimise such losses, the study has suggested establishment of post harvest co-operative farms, strengthening other social institutions, like NGOs, establishing a strong linkage with the private sector and finally establishment of food grain banks.

Post harvest loss is one of the major constraints identified in the commercialisation of potential rabi crops in the state (Gogoi et. al., 2011). Although pre harvest factors, like lack of irrigation facilities, small land holdings high cost fertiliser and plant protection chemicals and so on affect the production of the rabi crops in the state, but the post harvest losses discourage the farmers as they have to incur both physical and monetary losses. Among the post harvest operations, storage is responsible for maximum loss of 7.5 per cent; processing and transportation cause 1 per cent and 0.5 per cent losses respectively aggregating 9.5 per cent total loss of production. Development of the status of post harvest technologies is suggested as a measure to overcome such post harvest losses in the studies.

Deka (2005) in his estimation of post harvest losses for six major horticultural crops ( Ginger, Assam Lemon, Banana, Pineapple and Tomato ) of Assam revealed that the post harvest losses of these selected horticultural crops ranges from 9.25% (Pineapple) -25% (Tomato) with a maximum monetary loss of Rs. 128.34 crore. But the losses have been estimated as overall losses without having a detail analysis of the losses in different stages. In


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order to minimise the post harvest losses, the study has emphasised on the adoption of market driven production system, planned truck farming, appropriate post harvest handling through promotion of pack house concept including storage, processing and value addition, creation of adequate transportation infrastructure, introduction of organized marketing system and time to time arrangement of different workshops and seminars in the region. In a study by Dutta et. al (2013) for some important the vegetables of the state , it is found that total post harvest losses was 14.93% , here also retail level recorded the highest figure of losses (8.09%).

The existence of such a huge post harvest losses is really a threat to the economy of the country in terms of the availability of the produce as well as the huge monetary losses. Especially, the horticulture sector should receive the adequate attention in this respect considering the perishable nature as well as the potentiality to add values in the post production process. Besides, these losses many times discourage the farmers to reduce their production and thus it decelerates the entire development process of this potential high value crop section. Reduction of such post harvest losses requires an extensive analysis of the factors causing such a huge drain of the produce from the supply chain mechanism. Therefore, on the basis of the available studies, an account of the factors responsible for such losses at various stages of the supply chain is explained below.

2.3.4 Post Harvest losses- Responsible Factors and Its Impact on Agricultural Development

The above discussion on the assessment of post harvest losses clearly indicates that post harvest losses for a given commodity and region is the sum of total post harvest losses occurring at each of stage of the post harvest system. A typical post harvest chain comprises of a number of stages for the movement of harvested output from field to the final retail market. The loss incurred at each step varies depending upon the organisational and technological status in the supply chain. Therefore, the magnitude may post harvest losses may also vary depending on the stage of economic development of the nation (United Nations, 2011). The literatures reveal that
that in high and middle income nations, significant losses are reported in the early stages of the food supply chain and at the consumer level. In case of developed nations food losses are low in the middle stages of the supply chain due to the existence of more efficient farming system, better transport, better management, storage and processing facilities (Hodges et al. 2011). In contrast, in case of low income countries, food losses are found to be high in the early and middle stages of the food supply chains with proportionately less amounts wasted at the consumer level.

The magnitude of the post harvest losses is determined by the status of the elements of the post harvest system. According to Alemu (2007), the key elements of a post harvest system are harvesting, transport, post harvest drying, threshing, storage, processing (primary), marketing, skill of value chain actors, infrastructural and marketing status and finally the socio cultural factors. The losses at every stage are guided by the status of the components of the stage. For example, losses at farm level are determined by the nature of the harvesting techniques available, storage facilities at the farm level and so on. The following statistical framework will better explain the factors responsible for the post harvest losses at each stage of the supply chain of the produce.

Total post harvest loss = Sum of PHL at each stage of the food supply chain

\[ \text{Total PHL} = \sum S_i = \sum f(X_j) \]..........................(i)

In the above equation, \( S_i \) stands for the loss in each critical stage of food supply chain and \( X_j \) stands for the factors affecting loss at each stage and \( i \) represent all stages from harvesting to sales. The right hand side of the equation (i) represents post-harvest losses at particular stage in the food supply channel and on the left hand side represents all the measurable factors which contribute to these losses.

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losses. Post harvest losses at the different stages represented in a functional form as follows.

Post Harvest Losses (PHL) at harvesting:

\[ \text{PHL}_{\text{HARVESTING}} = f (\text{agro climatic factors, farm and farmer related factors, level of mechanization, and credit availability}) \]

Post Harvest Losses (PHL) at storage:

\[ \text{PHL}_{\text{STORAGE}} = f (\text{agro climatic factors, farm and farmer related factors, length of storage, distance to storage, quality of storage, and credit availability}) \]

Post Harvest Losses (PHL) during processing:

\[ \text{PHL}_{\text{PROCESSING}} = f (\text{agro climatic factors, processing plant related factors, quality of supply chain, use of standards and grading, and credit availability}) \]

Post Harvest Losses (PHL) during packaging:

\[ \text{PHL}_{\text{PACKAGING}} = f (\text{agro climatic factors, firm and operator related factors, quality of packaging, transportation, and credit availability}) \]

Post Harvest Losses (PHL) during sales:

\[ \text{PHL}_{\text{SALE}} = f (\text{agro climatic factors, retail outlet and manager related factors, quality of logistics and inventory control, and credit availability}) \]

This expression states that the nature and extent of the post harvest losses for a particular commodity at different stages is influenced by the components for each stage. However, the infrastructural related factor like availability of storage, processing and packaging along with its level of sophistication, market linkage and market information are common among the identified factors at each stage. Besides these, some other factors like agro climatic condition, farmer related factors may also affect the losses at every stage of the post harvest system.

The agro climatic condition is said to have an influence in every stage of the system. Initially it may deteriorate the quality of the produce during harvesting and which adds the post harvest losses in other stages of the system. The
agro climatic condition also affects the losses at the processing level, especially in case of traditional processing. A bad weather does not allow the traditional processors to dry their produce and required level of value addition which leads to losses during processing.

The farm related factors cover the size of the farm, nature of the commodity produced and so on. Large harvested amount from the big farm may lead to huge post harvest losses in the absence of the developed post harvest system. The farmer related factors cover the socio-economic characteristics, such as age, education, income and so on which have greater bearing in ensuring an efficient post harvest management system. In a study by Basavaraja et al., (2007) found that the age and education of the farmers have a negative relationship with post harvest losses. An aged farmer is found to have little interest in following the sophisticated harvesting techniques and to go for further value addition. The study also found that the educated farmers have tried their best to reduce such losses by exploring new ways of storing, processing and channels of marketing for the produce and this accelerates the profitability of that section of the producer.

The level of mechanisation at each stage of the post harvest system affects the post harvest losses (Nag et al., 2000). The study found significant differences in the quantum of post harvest losses depending on the level of mechanisation followed during harvesting. For the same crop, the post harvest loss was higher in the traditional plucking method than the sophisticated one.

The credit availability may affect the post harvest in the sense that due to some economic obligation, the farmers may not continue his post harvest operations and has to sell it at a lower price. Besides, there is also the risk component of post harvest losses which may lower his profit in near future. The fear of loss even compels them to sell their products to pre harvest contractors. The credit requirement is also supported due to the initial cost of transportation, processing, packaging and so on since his/her return will be only after the sale of the produce.
The existence of post harvest losses at any stage of the supply chain affects negatively on the margin of all the actors involved in the supply chain (Murthy et al.; 2007, Gangwar et al.; 2007, Sudha; 2007, Omar et al.; 2014). In fact, many studies reported negative profitability of the agents with the inclusion of the cost of post harvest losses. Such losses also lower the per capita availability of out-put (Subrahmanyam, 1986). Post harvest losses not only lower the quantity but also the quality of the produce available for consumption. These losses inject a negative impact throughout the entire supply chain of production and thus have a long standing impact in the overall development of the sector. This quantitative loss at the field level reduces quantity available for selling and thus profit margin of the farmers. These losses also have an opportunity cost of production as the farmers could have invested that much of land, labour and capital for other crops. Agriculture being the main source of livelihood, such giving away efforts lowers both the income and desire to go for extensive cultivation. This in long term impacts on the size and commercialisation of cultivation. The post harvest losses other stage of the supply chain lead to an increase in the price of the produce. The market intermediaries have to cover the value of the loss quantity in terms of increased consumer price and sometimes with the compromised quality.

2.3.5 Marketing Channels- Its Efficiency and Determinants

A marketing channel helps in establishing a link between the farmers with the end consumers with or without the involvement of the intermediary agents. The best marketing channel is supposed to be the one which provides the highest profit share to the farmers by minimising the gap between the price paid by the end consumer and the price received by the farmer. The selection of a particular market outlet/ channel is an important determinant of farmers’ margin and thus in the subsequent development of the agriculture sector. Theoretically, a rational farmer will always choose that marketing channel which provides him the highest return for the efforts he/she has incurred for the production process. But many times, the decision of the farmers to choose a particular channel of marketing is guided by the various factors starting from the farm and farmer characteristics to the institutional back up in
the area (Agarwal and Ramaswami, 1992; Ferto and Szabo, 2002; Park, 2011; Jari and Fraser, 2009; Sharma et al., 2009; Xaba and Masuku, 2012 and Girmaa and Abebawb, 2012)

Gnagwar et al. (2007) in his study of estimation of post harvest losses for the kinnow mandrain identified six channels of marketing to sell it in Punjab.

Channel-I: Producer – Pre-harvest contractor – Wholesaler at local fruit mandi – Retailer – Local consumer

Channel-II: Producer – Wholesaler – Local retailer – Local consumer

Channel-III: Producer – Local retailer – Consumer Channel-IV: Producer – Local consumer

Channel-V: Producer – Pre-harvest contractor – Wholesaler at distant market – Distant market retailer – Consumer

Channel-VI: Producer – Wholesaler (distant market) – Retailer (distant market) – Consumer

The study calculated the profitability of the farmers separately for each marketing channel in terms of the price spread. In his estimation, the Channel- II is found to be the most profitable with the highest producer’s share where the farmers sell their produce to local wholesalers. But the study stated that most of the farmers prefer channel- V, where they sell their orchard to the pre harvest contractors. The channel-VI is the least preferred one due to the possibility of huge post harvest losses with the increase in the distant of the market.

A similar kind of study by Murthy et al. (2007) for estimating the efficacy of various channels of marketing of fruit Banana is found in the state of Karnataka. The study has identified the following channels of marketing for channelizing the product.
Channel-1: Farmers -- Pre-harvest contractors -- Wholesalers -- Retailers -- Consumers

Channel-2: Farmers—Wholesalers-- Retailers --Consumers

Channel-3: Farmers—Wholesalers-- Consumers

Channel-4: Farmers -- Farmers’ Co-operative Society (wholesaling and retailing) – Consumers

The most efficient channel of marketing is found to be the channel-IV with a higher profit share of the producers whereas most of the farmers prefer channel- I and Channel-2. Among the identified channels, the total post harvest losses are also found to be lower in channel –IV. But due to higher field level losses (7.82 %) most of the farmers prefer to sell their produce either through channel – I or channel- II. Thus, higher marketing costs in terms of higher post harvest losses form an important determinant of outlet choice decision.

Shyamasundar et al. (1995) in their study identified the four important marketing channels followed in disposal of onion.

Channel 1: Producer - Village level trader - Wholesaler - Retailer - Consumer

Channel 2: Producer - Wholesaler - Retailer – Consumer

Channel 3: Producer - Commission agent - Trader - Trader cum - Retailer - Consumer

Channel 4: Producer - Commission agent - Cart Vendor – Consumer.
The producers got the highest net price per quintal in channel-2 (Rs. 163.57) and lowest in channel-I. The channels involving commission agents leave a little return for the farmers. But high transportation cost with and losses during transportation make the marketing of small quantity of output through this channel an unviable one. Therefore the study has suggested adequate transportation facilities with formation of co-operatives or other social institutions as a solution to minimise losses.

Ladaniya et al. (2003) in their study on marketing pattern of mosambi sweet orange in selected district of Maharashtra found that farmers with small mosambi plantations. This type of decision making by the producers was attributed to lack of will to take risks associated with marketing and lack of financial assistance required during mosambi production process, while growers with large plantations farmers sold mosambi fruits themselves in distance market. Market efficiency was higher when farmers themselves marketed fruit in distance market. It was also opined that, as the market distance and number of intermediaries increased in marketing cost and margins of cost marketing also increased. Further it was noticed that the market efficiency and share of farmers in consumer’s price was decreased.

Hatai and Raju (2010) in their analysis of the supply chain of pineapple in the West Garo Hills of Meghalaya found that majority of the growers were of small (50%) and medium (33%) farm sized categories. Small farmers preferred selling their produce directly to the retailers, while medium farmers sold directly to the consumers. The net price received by the farmer was higher in the long market chain with lower share in consumers’ price.

Besides, the other studies have identified the determinants of outlet choice decision are factors like price, production scale and farm size, household characteristics, behavioral aspects (trust, risk, and experience), and market context (distance, communication condition and purchase condition). The support service provisions like quality of extension services, market information, and association of the farmers with farm based organizations (co-operatives, producers’ company and so on) have also found to affect the farmers outlet choice decision.
The studies have reported differently the impact of different factors in market outlet choice decision. In the study by Ferto and Szabo (2002) for the fruits and vegetable growers in Hungary found that farmer’s age, information costs, bargaining power and monitoring costs affect negatively in choosing wholesale market, whereas, the factors, age and information costs affect positively in the probability of choosing to cooperative marketing channel. In a study by Agarwal and Ramaswami (1992) reported that level of education of the farmer, off farm employment, own means of transpiration and age of the operator had positive effect, whereas, household size was negatively associated with super marketing channel choices. Jari and Fraser (2009) identified that market information, expertise on grades and standards, contractual agreements, social capital, market infrastructure, group participation and tradition significantly influence household marketing behaviour. Xaba and Masuku (2012) in their study also identified that age of the farmer, quantity of the crop produced and level of education were significant predictors of the choice to sell vegetables to NAMBoard market channel instead of selling to other-wholesale market channel. On the other hand, the age of the farmer, distance from production area to market, membership in farmer organization and marketing agreement were significant determinants of the choice to use non-wholesale market channel over other-wholesale market channel. Girmaa and Abebawb (2012) identified that gender and educational status of the household head together with household access to free aid, agricultural extension services, market information, non-farm income, adoption of modern livestock inputs, volume of sales, and time spent to reach the market have statistically significant effect on whether or not a farmer participates in the livestock market and his/her choice of a market channel.

The above mentioned studies have extensively used Multinomial Logit (MNL) model to identify the factors affecting outlet choice decision. This model is basically used to predict the probabilities for different possible outcomes in case of a categorically distributed dependent variable. This model is appropriate tool in the above studies as the studies have concerned with the
choice dependent and it has more than two unordered possible outcomes. Multinomial Probit (MNP) is often cited as an alternative in case of such dependent variable with more than two possible outcomes. But MNP is criticized as susceptible because estimation problems (Dow, 2004). The first one is that MNP is weakly identified in application. This weak identification is difficult to diagnose and this may lead to misleading inferences. Again, MNL is criticised for the assumption of independence of irrelevant alternative (IIA). But, in the same paper, it is mentioned that the assumption of IIA is irrelevant and non restrictive in most its application.

2.3.6 Value Chain Analysis- As an Approach to Assess Prospect for Competitiveness of the Agriculture Sector

The understanding of the cost and returns to farming activity and in the other stages of the supply network helps in identifying the steps required for the improvement in supply chain performance\textsuperscript{32}. By analysing the cost structure of the individual value chain participants, it can identify the types of cost that account for the majority of total value. Accordingly by focussing on the specific area through new investment or other improvements, the profitability, competitiveness and growth of the sector may be enhanced. Many studies have been found analysing value chain as a road map to enhance their competitiveness in various fields, like exports, marketing, and agriculture and so on.

The quantitative value analysis was extensively used in a study by Tchale and Keyser (2010) to improve trade competitiveness for agricultural produce in Malawi. This paper analyses the competitiveness of the country’s key agricultural commodities—tobacco, maize, cotton, and rice—using prices that prevailed in the 2007/08 agricultural season.

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The results indicate that Malawi does not have competitive edge in maize and rice production for export like tobacco and cotton. Key factors that underpin Malawi’s narrow competitiveness include the high cost of inorganic fertilizer and other inputs, low productivity, and the higher trader margins and intermediation costs along the value chains. Furthermore, farm gate prices in Malawi are higher than in other countries, and this undercuts its trade competitiveness.

In his study of “Value chain analysis of Coconut in Orissa”, Kumar et al. (2010) found that no major value addition is done by the intermediaries at any level by changing the form of product. They just collect the product in one stage and sell the same at higher prices. Therefore, there is every possibility of increasing farmers’ income by removing these players adding no value in the chain. In this study, prices and market margins were computed at the different stages of the chain in order to reflect the value addition through various participants of the chain.

The value chain study has also been carried out to examine the supply and demand dimensions of identified Focus Core Groups (FCGs) from the North East Region for some selected horticultural crops\textsuperscript{33}. The main constrains identified in the study is the backward marketing and post harvest infrastructure in the region. It has been observed that the average productivity, production, technology, logistics, post-harvest and marketing infrastructure need to be upgraded for identified FCGs so that the potential of the region can be fully realised.

The above studies have made it clear that examining the organisation of the agriculture along the value chain framework has conceived as one of the strategies to bring more efficiency in the agriculture sector. There has been an increasing emphasis on the development of efficient agricultural value chain and various steps have also been initiated for the same. One vertical coordination option that has emerged both as popular and efficient integration of farmers in to horticultural supply chain is contract farming. In the next

section, innovative institutional arrangements in the form of contract farming as a way to marketing efficiency is examined in the light of the available literatures

### 2.3.7 Contract Farming – As an Option of Vertical Coordination in Agricultural Value Chain

Contract farming can be defined as an agreement between farmers and processing and/or marketing companies for the production and supply of agricultural produce under forward agreements, frequently at predetermined prices (Eaton and Shepherd, 2001). Under this arrangement, the purchasing company provides production support to the farmers in the form supply of inputs, required technical guidance and so on. The main basis of this arrangement is the commitment of the farmers to provide a specific quantity with a predetermined quality of the produce to the supporting company.

This kind of formal agreement has helped the farmers in reducing post harvest losses of their produce and in ensuring an efficient value chain for the produce (Dev et al., 2005; Sahoo, 2010; Anim, 2011). The timely and quality supply of inputs by the supporting company provides a greater scope to the farmers to produce a wide range of products with an improved quality. It adds value to their production and thus may think for a higher income. The quality inputs along with the technical guidance again helps the farmers to produce quality output with a more scope for further value addition.

The contract farming in the farm of assured market also helps the producers to go for further expansion and free themselves from the fear of post harvest losses which otherwise would not have been possible. With the provision of improved infrastructural facilities under this contract the farmers may also think for the production of the profitable crops throughout the year.

Birthal et al. (2005) have examined the effect of the institutional mechanism to integrate small producers of milk, broilers and vegetables in the supply chain. Accordingly, the study covers in three states, viz., Punjab, Delhi and Andhra Pradesh for dairy farming, vegetable and broiler respectively. Three case
studies were carried out for each product in each state and found that this institutional arrangement has helped the farmers to reduce transaction cost and in receiving a better net return. However, a sector wise variation in case of the approach of the supporting farm was found in the study. For example, the study found that in contract broiler farming, the firm pays fixed growing charges thus protecting producers from the price risks, whereas in the case of dairying and vegetable production, the entire price risk is borne by the producers. The study also rejects the criticism against contract farming schemes for their bias against small producers and finds a considerable involvement of smallholders in such schemes. The contract framing has also been found as option of better price realisation for the farmers for the crops like basmati paddy and potato in the state Punjab and also provides justification for expanding it for other horticultural crops, like fruits and vegetables (Sharma, 2016). The successful stories of contract farming have also been there in our state itself, specially for the crop potato and organic joha rice cultivation. 

Contrary to the above study, Dev et al. (2005) have criticised the contract farming for their unwillingness to meet the needs of the growers. The study was conducted in the state of Andhra Pradesh with focus on oil palm and gherkin. The study fully attributed the role played by contract farming in solving the problem of supply of quality raw material. But in some instances these institutional authority was unable or unwilling to meet the need of the growers. No direct linkage between the farmers and processors was found and the entire mechanism is fully controlled by the agent of the industry. The sufferings of the farmers were found in many aspects under such institutional mechanism. To cite a few examples, oil palm processors did not have any collection centres initially and the farmers had to take the fruit bunches all the way to factory on their own. Later, with pressure from the growers, the processors opened number of centres and they bear the transport charges from collection centre to the factory now. Besides, the processors have also

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neglected the smaller farmers. Hence, the study has suggested some form of government intervention to ensure contracts under such an arrangement.

Thus, contract farming as an effective option for vertical coordination in the value chain has both its merits and demerits. The successful stories of PepsiCo and other corporate entities in achieving greater value addition no doubt clear the role played by these corporate agencies in ensuring an efficient value chain. However, this kind institutional arrangement is found to be missing in the state of Assam. The small landholdings of the farmers and the absence of adequate dissemination of information regarding such innovative arrangement may be among the reasons for lacking such an innovative solution in the state.

2.4 Concluding Comment

Horticulture crop segment plays an important role in Indian agricultural development through the basic feature of the sector like high returns, high employment potential, capability to restore land quality, ensure nutritional security and being the growing demanded crop segment. The policy focus for the development of the sector in the country emerged from the Fourth Five year plan onwards and the sector received separate budgetary allocation from the Seventh Five year plan. Initially, the major policy focus was on the enhancement of area, production and productivity of this high value crop segment. The policy focus for the development of post harvest infrastructure started from the Eight Five year plan onwards. While the issue of post harvest losses as a threat to ensure food and nutritional security drew worldwide community attention during 1970s. But the available literatures at national and state level reveals about the initial dealings of this issue. Few in depth study has been found for such estimation and exploration of factors causing such post harvest losses at state level. In fact, the documenting the figure of such losses is also missing from authentic source at state level. The cited literatures reveal that out choice decision for disposing the harvested produce is an important determinant of farmers’ margin. But the literatures find that that various factors affecting the farmers in choosing the most profitable and
efficient marketing outlet for his produce. This requires an examination of the present marketing trend of all the agricultural produce at state level so that an efficient disposition of the produce can be ensured. The literatures also make it clear that value chain analysis has received growing popularity as an approach in examining the status and improving the competitiveness of agricultural sub-sectors. It helps in identifying the constraints and thus in articulating the appropriate measures for the development of the sector. While reviewing contract farming as an option of vertical coordination in agricultural value chain is found to be mixed blessings. But its importance can not be denied as farmers in many instances face an uncertain market and price for their produce. The research agenda of the present study has been set keeping in view the research gaps indicated above.