SUPPLY CHAIN MANAGEMENT OF APPLE – A STUDY IN ARUNACHAL PRADESH

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MBA 929

DEPARTMENT OF AGRICULTURAL MARKETING

CO-OPERATION & BUSINESS MANAGEMENT

UNIVERSITY OF AGRICULTURAL SCIENCES

G.K.V.K. CAMPUS, BANGALORE-560 065

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Thesis submitted to the

University of Agricultural Sciences, Bangalore

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in

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BANGALORE **AUGUST, 2011**

Affectionately
Dedicated To
My Beloved Father,
Late Shri Appa Dodum

DEPARTMENT OF AGRICULTURAL MARKETING
CO-OPERATION & BUSINESS MANAGEMENT
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CERTIFICATE

This is to certify that the project report entitled **"Supply chain management of Apple- A study in Arunachal Pradesh"** submitted by **Mr. Tadi Dodum, ID No. MBA 929** in partial fulfillment of the requirements for award of degree of ***Master of Business Administration (MBA) in Agribusiness Management*** to the University of Agricultural Sciences, Bangalore is a record of *bona-fide* research work carried out by her during the period of her study in this university, under my guidance and supervision and the project report has not previously formed the basis of the award of any degree, diploma, associate ship, fellowship or similar titles.

Bangalore
July, 2011

(P. V. Rame Gowda)
Major Advisor

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August , 2011 ***(Tadi Dodum)***

SUPPLY CHAIN MANAGEMENT OF APPLE – A STUDY IN ARUNACHAL PRADESH

TADI DODUM

ABSTRACT

India is the 7th largest producer of Apple in the world. The total production and area under apple cultivation in India is 1.993 Million Tonnes and 279800 ha respectively (Indian Horticulture Database, 2010). However, the post-harvest looses in apple is very huge. India produces about 8 per cent of the world's fruit, but looses 25 to 40 per cent of the fruits produced due to lack of post harvesting infrastructure such as cold chains, transportation, and storage and processing facilities. The objectives of the study were to assess the method of consolidation of Apple and its movement to the market yard, to examine the infrastructure facilities in the supply chain of apple and to estimate the losses in the supply chain. The required data were collected from 60 apple growers, 10 wholesalers and 15 retailers. Only 8.30 per cent of the farmers sell their produce only to customers, 1.70 per cent sell only to retailers and 28.30 per cent sell only to wholesalers directly. The consolidation of the apple in the village was mainly done by the wholesalers. The only facilities that were provided to the apple growers were saplings, packing material and fencing facility. The post-harvest loss at the farmer's level was found to be 11.07 per cent and the value lost was 12.20 per cent of the total produce. The loss at wholesaler's level was 2.93 per cent in volume and 2.98 per cent in value. The handling losses at retailer's level were 6.74 per cent of the quantity handled and 6.84 per cent loss in value.

Signature of the student Major advisor

(P.V. RAME GOWDA)

ಸೇಬಿನ ಪೂರೈಕೆ ಸರಣಿ ನಿರ್ವಹಣೆ– ಅರುಣಾಚಲ ಪ್ರದೇಶದಲ್ಲಿನ ಅಧ್ಯಯನ

ತದಿ ದೊದುಮ್

ಸಾರಂಶ

ಭಾರತವು ವಿಶ್ವದಲ್ಲಿ ಏಳನೇ ಅತಿ ದೊಡ್ಡ ಸೇಬು ಬೆಳೆಯುವ ದೇಶವಾಗಿದೆ. ಭಾರತದಲ್ಲಿ ಸೇಬು ಬೆಳೆಯುವ ಸಾಗುವಳಿ ಪ್ರದೇಶ ಮತ್ತು ಉತ್ಪಾದನೆ ಕ್ರಮವಾಗಿ 2,79,800 ಹೆಕ್ಟೇರ್ ಮತ್ತು 1,933 ಮಿಲಿಯನ ಟನ್ ಆಗಿದೆ. (ಭಾರತೀಯ ತೋಟಗಾರಿಕ ಡಾಟ್ ಬೇಸ್ 2010), ಆದಗ್ಯೂ ಭಾರತದಲ್ಲಿ ಕೊಯ್ಲಿನ ನಂತರ ನಷ್ಟ ತುಂಬ ಅಧಿಕವಾಗಿದೆ. ಒಟ್ಟಾರೆ ಭಾರತದ ಹಣ್ಣು ಮತ್ತು ತರಕಾರಿ ಉತ್ಪಾದನೆಯನ್ನು ವೀಕ್ಷಿಸಿದರೆ, ಭಾರತವು ಪ್ರಪಂಚದ 8% ರಷ್ಟು ಹಣ್ಣು ಮತ್ತು 15% ರಷ್ಟು ತರಕಾರಿಯನ್ನು ಬೆಳೆಯುತ್ತದೆ, ಆದರೆ ಸೂಕ್ತ ಕೊಯ್ಲಿನ ನಂತರ ಬೇಕಾಗಿರುವ ಸೌಲಭ್ಯಗಳು. ಕೊರತೆಯಿಂದ ಶೇಕಡ 25 ರಿಂದ 40% ರಷ್ಟು ನಷ್ಟ ಆಗುತ್ತಿದೆ. ಈ ವಿಷಯಕ್ಕೆ ಸಂಬಂಧಿಸಿದಂತೆ ಸೇಬಿನ ಕೇಂದ್ರೀಕರಣ, ಕೃಷಿ ಉತ್ಪಾದನೆ ಮಾರುಕಟ್ಟೆಗೆ ಅದರ ಸಾಗಣಿಕೆ, ಸಾಗಣಿಕೆಯಲ್ಲಿರುವ ಮೂಲಭೂತ ಸೌಕರ್ಯ ಮತ್ತು ಸಾಗಣಿಕೆಯಲ್ಲಿ ಆಗುವ ಸೇಬಿನ ನಷ್ಟವನ್ನು ಅಧ್ಯಯನ ಮಾಡಲಾಯಿತು. ಈ ಅಧ್ಯಯನಕ್ಕೆ ಬೇಕಾಗಿರುವ ಮಾಹಿತಿಯನ್ನು 60 ಸೇಬಿನ ಬೆಳೆಗಾರರು, 10 ಸಗಟು ವ್ಯಾಪಾರಿಗಳು ಮತ್ತು 15 ಚಿಲ್ಲರೆ ವ್ಯಾಪಾರಿಗಳಿಂದ ಕಲೆ ಹಾಕಲಾಯಿತು. ಈ ಅಧ್ಯಾಯನದಿಂದ ಕೇವಲ ಶೇಕಡ 8.30 ರಷ್ಟು ರೈತರು ತಮ್ಮ ಬೆಳೆಯನ್ನು ಗ್ರಾಹಕರಿಗೆ, ಶೇಕಡ 1.70 ರಷ್ಟು ರೈತರು ಚಿಲ್ಲರೆ ವ್ಯಾಪಾರಿಗಳಿಗೆ ಮತ್ತು ಶೇಕಡ 28.30 ರಷ್ಟು ರೈತರು ಸಗಟು ವ್ಯಾಪಾರಿಗಳಿಗೆ ನೇರವಾಗಿ ತಮ್ಮ ಸೇಬಿನ ಬೆಳೆಯನ್ನು ಮಾರುತ್ತಾರೆ ಎಂದು ತಿಳಿದು ಬಂದಿತು. ಹಳ್ಳಿಗಳಲ್ಲಿ ಸೇಬಿನ ಕೇಂದ್ರಿಕರಣವನ್ನು ಮುಖ್ಯವಾಗಿ ಸಗಟು ವ್ಯಾಪಾರಿಗಳು ಮಾಡುತ್ತಾರೆ ಎಂದು ತಿಳಿದು ಬಂದಿತು. ಅರುಣಾಚಲ ಪ್ರದೇಶ ರಾಜ್ಯದಲ್ಲಿ ಸರಕಾರವು ಸೇಬು ಬೆಳೆಯುವ ರೈತರಿಗೆ ಕೊಡುತ್ತಿರುವ ಸೌಕರ್ಯಗಳೆಂದರೆ ಎಳೆ ಸಸಿಗಳ ವಿತರಣೆ , ಪ್ಯಾಕಿಂಗ್ ಸೌಲಭ್ಯ ಮತ್ತು ತಂತಿ ಬೇಲಿಯ ಸೌಕರ್ಯವಾಗಿದೆ. ರೈತರ ಬಳಿಯಲ್ಲಿ ಸೇಬಿನ ನಷ್ಟವು ಶೇಕಡ 11.07 ರಷ್ಟು ಆಗಿದೆ ಮತ್ತು ಅದರ ಬೆಲೆಯು ಒಟ್ಟಾರೆ ಸೇಬಿನ ಉತ್ಪಾದನೆಯಲ್ಲಿ ಶೇಕಡ 12.20 ರಷ್ಟು ಆಗಿದೆ. ಸಗಟು ವ್ಯಾಪಾರಿಗಳ ಬಳಿಯಲ್ಲಿ ನಷ್ಟದ ಪ್ರಮಾಣದಲ್ಲಿ ಶೇಕಡ 2.93 ರಷ್ಟು ಮತ್ತು ಬೆಲೆಯಲ್ಲಿ ಶೇಕಡ 2.98 ರಷ್ಟು ಆಗಿದೆ. ಚಿಲ್ಲರೆ ವ್ಯಾಪಾರಿಗಳ ಮಟ್ಟದಲ್ಲಿ ಶೇ. 6.74 ರಷ್ಟು ಹಣ್ಣುಗಳು ಹಾಳಾಗಿದ್ದು ಅದರ ಮಾಲ್ಯ ಶೇ.6.84 ರಷ್ಟು ಆಗಿರುತ್ತದೆ.

ವಿದ್ಯಾರ್ಥಿಯ ಸಹಿ ಪ್ರಧಾನ ಸಲಹೆಗಾರರು

(ಪಿ.ವಿ. ರಾಮೇಗೌಡ)

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Introduction

CHAPTER I

INTRODUCTION

Apple is a fleshy fruit of the tree of the species *Malus domestica* in the rose family Rosaceae. The trees of the Malus family require a long period of dormancy, a well drained soil, years of careful pruning and pest management. The apple tree usually grows to about 5-12 m in height, and is one of the most cultivated fruit trees in the world. Apple ripe in autumn, and generally are 5-9 cm in diameter. The tree is believed to have originated from Asia, and now more than 7,500 varieties of apples are available worldwide. Storage of apples is an important aspect and care should be taken to store them in a cool and dry place, wrapped in a poly bag.

Apple was introduced into India by the British in the Kullu Valley of Himachal Pradesh in the year 1865, while the coloured 'Delicious' cultivars of apple were introduced to Shimla hills of the same State in 1917. The apple cultivar 'Ambri' is considered to be indigenous to Kashmir and had been grown long before Western introductions. Apple trees will tolerate a variety of soils, but do well on loamy soils. It requires full sunlight, good air flow and soil that drains well. The target pH on new plantings is between 5.5 and 6.5 and grows in 1,500-2,700m above MSL with 1,000-1,500 hours of chilling temperature.

India is the 7th largest producer of Apple in the world (Food and Agriculture Organisation, 2010). The total production and area under apple cultivation in India is 1.993 Million Tonnes and 279800 hectares respectively (Indian Horticulture Database, 2010). However, the post-harvest looses in apple is very huge. In fact, if we look at country-wide picture, India produces about 8 per cent of the world's fruit and about 15 per cent of the world's production of vegetables but looses 25 to 40 per cent of the fruits produced due to lack of post harvesting infrastructure such as cold chains, transportation, and storage and processing facilities. In India, the average annual consumption of fresh apple is estimated at about 19 kg per household of the affluent class, 17.1 kg, 13.6 kg and 10.8 kg respectively for the upper, core and lower middle class households.

About 99 percent of India's apple area falls under the North Western Hills region, covering six districts of J&K (Srinagar, Budgam, Pulwama, Anantanag, Baramullah, Kupwara), six districts of H.P. (Shimla, Kullu, Sirmour, Mandi, Chamba, Kinnaur) and eight districts of Uttarakhand (Almora, Nainital, Pithauragarh, Tehri, Pauri, Chamoli, Uttarkashi, Dehradun). In the North-eastern Hills region, good quality apple is grown in the West Kameng district of Arunachal Pradesh.

Apple is one of the most widely grown fruit crops in Arunachal Pradesh. Almost all the apples grown in India come from its three mountainous states i.e. Himachal Pradesh, J&K and Uttarakhand but lately Arunachal Pradesh have entered the Apple market in India. Arunachal Pradesh produced 9800 MT from an area of 10,800 ha in the year 2009-2010 (National Horticulture Board, 2010). Though lower in production, Arunachal apples are of high quality and have the capacity to capture the markets of eastern India and also South-east Asian nations like Bangladesh and Myanmar. The supply chain of apples in Arunachal Pradesh is laden with inefficiencies across the entire chain leading to poor price realization of growers on one hand and exorbitant prices paid by consumers on the other.

West Kameng district of Arunachal Pradesh produces highest amount of Apple in the State (Anonymous, 2010). Apple was introduced in the district during 1960s. But since inception of Horticulture Technology Mission Scheme, the people of the district started to cultivate apple on commercial basis especially in the areas viz. Dirang, Zimthung, Morching, Chillipam, Wangho, Shergaon and Jigaon.

Supply Chain Management is a set of synchronized decisions and activities utilized to efficiently integrate suppliers, manufacturers/ farmers, warehouses, transporters, retailers, and customers so that the right product or service is distributed at the right quantities, to the right location, and at the right time, in order to minimize system-wide costs while satisfying customer service level requirements. The objective of Supply Chain Management (SCM) is to achieve sustainable competitive advantage.

Supply Chain Management (SCM) is the process of planning, implementing, and controlling the operations of the supply chain with the purpose to satisfy customer requirements as efficiently as possible. Supply chain management spans all movement and storage of raw materials, work-in-process inventory and finished goods from point-of-origin to point-of-consumption.

In this context, logistics and supply chain management have become the crucial areas of management and of national focus. This area becomes even more important in the sector of agribusiness because most of the agricultural products are perishable and have a very short shelf life.

The concept of Agriculture supply chain refers to the activities of procurement, order fulfillment, product design and development, distribution, delivery and customer service executed by two or more separate organizations in the agribusiness industry. Agriculture supply chain consists of small and medium enterprises, such as farmers and raw material producers, suppliers of agricultural inputs, processors of agricultural outputs, farmers co-operatives, brokers, suppliers, distributors, wholesalers and retailers, that either tend to operate independently or in co-operation, mainly in the last stages of supply chain.

There are many factors involved in Supply chain management. Flow is the foremost element, the foundation for all aspects of the process. There are three main types of flow, such as the product flow, the information flow and the finance flow. The product flow includes the movement of goods from a supplier to a customer, as well as any customer returns or service needs. The information flow involves transmitting orders and updating the status of delivery. The financial flow consists of credit terms, payment schedules etc., to ensure prompt, efficient and accurate monetary transactions within these categories, various other elements falls, which includes the sourcing of raw material, coordinating, manufacturing and assembly of products, maintaining accurate warehousing and inventory accounts, researching supply and demand, and much more. The challenge for us in Supply chain management is to maintain all three flows and in an efficient manner, resulting in optimal results.

In West Kameng district of Arunachal Pradesh, the apple growers still follow the age old cultivation practices and have no idea of consumer needs and preferences, market prices, various government schemes, scientific agronomical practices especially Agri-inputs, sources of timely and adequate credit availability and market linkages. The cold storage facilities are virtually non-existent and almost 95% of the apples plucked and transported reach the first intermediate storage point after long hours of travelling in bumpy roads, which poise significant damage to the fruit. The facilities available for packing, storage and transportation don’t even have the bare minimum standard in spite of the region being touted as the “fruit basket of the state” and apple in particular. Collection and consolidation of Apple to bring it to market yard is done by individual farmer himself / herself on most occasions, limiting the presence of commission agent in the apple supply chain in the district.

Keeping the above aspects in consideration, the study was carried out with the following objectives:

1. To assess the method of consolidation of Apple and its movement to the market yard.
2. To examine the infrastructure facilities in the Supply chain of Apple.
3. To estimate the losses in the Supply chain.

Presentation of the study

The study has been presented in six chapters as indicated below. chapter-I deals with the nature, importance and specific objectives of the study; Chapter-II describes the comprehensive review of the relevant research work done in the past related to the present study; Chapter-III outlines the features of the study area, nature and source of data, sampling procedure and analytical tools and techniques employed in the study; Chapter-IV is devoted to present the main findings of the study through tables; Chapter-V discusses the results of the study; Chapter-VI provides the summary of the of the whole study and also suggests the policy implication based on findings of the study. At the end, important references have been listed relating to the present study.

Limitations of the study

Since the data were collected during the month of April 2011 for the preceding season, i.e., 2010 by survey method, the gap in time may have had minor lacunae in the data collected. The study is limited to supply chain of West Kameng apple only. Even though, the estimates were provided by recall memory on account of the non-maintenance of the records with regard to quantity sold by farmer, quantity procured by intermediaries, quantity purchased by the consumers and quantity unsold by the intermediaries, the data are mainly on the average of the quantities of the produce. But, sincere efforts have been made to elicit accurate and reliable information as far as possible by cross questioning. However, the degree of discrepancy if any would be negligible as the estimates presented are in averages and aggregate averages. The markets for study are limited to three areas, Bomdila and Itanagar in Arunachal Pradesh and Tezpur in Assam. These are the three main markets for the Arunachal apples.

Review of Literature

CHAPTER II

REVIEW OF LITERATURE

The review of past studies help us in framing objectives, developing research design, variable selection, interpreting the results and in drawing meaningful conclusions. In accordance with the objectives of the study, a brief review of literature is presented here under the following headings.

2.1 Method of consolidation and movement of the produce to market yards.

2.2 Infrastructure facilities in supply chain.

2.3 Losses in the supply chain.

2.1 Consolidation and movement to market yards

Sidhu and Kahlon (1967) studied the marketing of apples in Kullu valley and found that 62.3 percent of the orchard owners sold their fruits on contract basis (pre-harvest contract), 34 percent at the market and 3.7 percent directly to the consumers. The main reasons for leasing out orchards were small and scattered holdings, lack of transportation facilities and absence of local wholesale markets in Kullu Valley. They suggested that the sales directly to consumers after grading increased the profits of the growers. They also indicated that priority should be given to road development programmes to facilitate product transfer to the markets.

Kahlon and Singh (1968) studied the market structure of Pome and stone fruits in Kullu and Parabathy valleys. The major marketing channels found were:

1. Producer- Pre-harvest contractor- Commission agent/ wholesaler-Retailer-Consumer

2. Producer-Village merchant-Commission agent or Wholesaler-Itinerant merchant- Retailer-Consumer.
3. Producer- Forwarding Commission agent- Commission agent or Wholesaler-Retailer- Consumer.
4. Producer- Consumer.
5. Producer-Cooperative marketing society-Commission agent or Wholesaler-Retailer- Consumer.

It was found that the sale through pre-harvest contractor was the most popular method of sale being used by 43.73 percent of the sample growers.

Thakur and Johl (1969) studied marketing of apples in Himachal Pradesh and reported that sales through commission agents was the most commonly used system(37.0 percent) followed by the contract system(30.0 percent). The study also indicated that the growers' share seldom exceeded 53 percent of the retail price. They also stated that the middlemen obtained handsome profits because of the inadequate knowledge of the grower about markets and marketing channels, absence of cold storage facilities, lack of transportation and other facilities.

Mehta and Gupta (1970) studied the marketing of apples through cooperatives in Kullu Valley and found that the growers could get a net share of 43 and 40 percent in the consumer's rupee in the primary and terminal markets respectively when the produce was sold through cooperatives as compared to a net share of 41 and 39 percent when apples were marketed through commission agents.

Raghubanshi (1971) studied marketing of hill capsicum in Saproon valley of Himachal Pradesh and found that there were five marketing channels. He indicated that 56.6 percent of the produce was marketed through the village dealer, 39.8 percent through retailer and 0.5 percent directly to consumers. He also found that the producers got the lowest share of 54.29 percent of the consumer's rupee when sold directly to primary wholesaler, 67.19 percent when sold to secondary wholesaler and 74.74 percent when sold to retailers.

Singh and Raghubanshi (1977) studied the marketing of apples in Himachal Pradesh. The following marketing channels were found to be existing for apples:

1. Outright sale at assembling market.
2. Sale directly to consumer and other agency at the orchard itself.
3. Through a forwarding agent to a commission agent in a wholesale market.
4. Through a forwarding agent to HPMC (Himachal Pradesh Marketing and Processing Corporation), which acts as a commission agent in the wholesale market.
5. Through a producer's cooperative to a wholesale market.
6. Directly to a commission agent.
7. To a wholesaler through a commission agent.
8. Directly to retailer.
9. To a processing unit.

Sai Kumar Krishnan (1979) found that the Wholesaler/ Commission agent at Bangalore received, on an average, a net profit of Rs.7.60 and Rs.4.29 per box of Delicious and Maharaja Apples sold through him. The rate of commission fee charged was 8 percent. The wholesaler at Mysore received a net profit of Rs.4.33 and Rs. 3.15 per box of Delicious and Maharaja respectively. The net profits received by the Wholesalers at tumkur and Mandya were Rs. 3.61 and Rs. 3.27 per box of Delicious and maharaja respectively. The Apples, which were marketed in Karnataka, reached the consumer by two Channels. They were:

a. Commission agent at Delhi - Wholesaler/Commission agent in Karnataka – Retailer –Consumer.
b. Commission agent at Delhi - Wholesaler/Commission agent in Karnataka – Cart- Vendor –Consumer.

Singh and Sharma (1983) studied the management of milk procurement from three villages by cooperative, private and public sectors in Karnool district of Andhra Pradesh. They found that monthly variation in milk prices was almost constant in case of cooperatives, whereas in private sector it was high, during three months of the study period that is April to June. While the public sector prices varied quarterly.

Andrew (1994) in his study building effective partnership in the meat supply chain which was conducted in U.K. Many of the features of the livestock partnerships reported in this study are specific to the UK, the degree of retailer dominance. However there are three important features of livestock partnership in the UK which we feel apply to most sectors of the food industry in most developed countries.

a. The paradox of power as the power of food retailers increases along with their interest in own label products, so they become increasingly dependent on fewer and fewer larger suppliers who can deliver safe products of consistently high quality on a large scale at competitive prices and who have the potential (and desire) to innovate and add value to the commodity oriented categories.

b. The learning supply chain competition between firms within firms within supply chains is being replaced by competition between supply chains themselves, as retailers seek to establish competitive advantage by creating closer links with their upstream trading partners.

c. Those people operating at the start of the supply chain – the producers of raw materials need to accept the fact that the financial benefits which come from partnerships will invariably be distributed in relation to distribution of value added. Successful partnership should deliver cost savings and higher value but it is essential that all members of the partnership are actively engaged in finding ways to achieve them.

Hence, in seeking to exploit the opportunities which partnerships provide, considerable care needs to be given to the treatment of costs and prices.

Julie *et al.* (1994) in the study of supply chain management in cereal grains; a case study from the U.S. milling wheat industry, it focuses on supply chain management in the grain industry by investigating the effects of wheat quality on marketing arrangements between producers, grain handling companies and processors, wheat quality is defined by many different characteristics, broadly categorized into physical and intrinsic quality attributes. The complexity of wheat quality places limitations on the effectiveness of industry grading schemes in assuring end use quality. In the US wheat grading factors mostly reflect physical characteristics. Moreover, the US wheat industry does little to regulate the intrinsic quality of new cultivars. Consequently, there is functional quality uncertainty in the U.S. wheat market, encouraging some individual processors to segregate wheat based on their own quality specifications. The costs and benefits of wheat segregation are illustrated with a case study of wheat procurement taken from the U.S. flour industry. Pendleton flour mills Inc. operates a stringent testing program to segregate wheat supplies with specific intrinsic quality attributes from the U.S. wheat market. The paper concludes that the inadequacy of the US grading system in guaranteeing functional quality provides some processors with an incentive to manage the supply chain for milling wheat.

Fearne and Hughes (1999) in their study on Success factors in the fresh produce supply chain: insights from the UK, found that power of retailer increases along with their interest on own label products. So they become increasingly dependent on fewer larger suppliers who can deliver safe products on a large scale at a competitive price. He suggested that farmers and growers should directly link with other sector of the marketing chain in order to supply the right and consistent quantity and quality of different products. The producer of raw material need to accept the fact that the financial benefit, which comes from partnership will invariably distributed in relation to value added.

Ricks, *et el.*(1999) in his study revealed that the appropriate combination of vertical coordination arrangements like contracts, informal agreement and joint venture can improve supply chain performance by providing adequate supplies to the shippers from packers and growers, aiding standardization and packaging of fruit products and risk sharing between the shippers, packers and growers.

Burma *et al.* (2000) in studying the development of a sustainable Agri supply chain which requires commitment of the various stakeholders like growers, traders and supermarkets. An important condition or even prerequisite for commitment is mutual understanding and benefit. The aim of this study was to understand the interest and matching behaviour of the various stakeholders in the supply chain for vegetables in Thailand and to recommend appropriate strategies for chain development, taking the respective interests into account. The stakeholders considered in the vegetables supply chain are the general management of the super market organization, the management of the distribution centre, the buyers of the super market organization, the vegetable suppliers, the vegetable growers and the input suppliers of the vegetable growers. The various stakeholders perceive weaknesses and threats in the misuse of pesticide, the delusion of good quality vegetables, the irregular supply of vegetables, the obscurity of cost of production and handling, the strong price fluctuations for vegetables and the strong competition in the market for inputs. These weaknesses and threats can be surmounted by certification growers' association and production system innovation along with cost monitoring.

Narayana Reddy (2004) in his study reported that most (61%) of the retailers get their requirements from wholesalers, 15 per cent from the large and other retailers. Over 17 per cent of the selected retailers get their goods from more than one source, but a small percentage of retailers get some of their requirements from producers. From the side of the terms of supply 67 per cent of retailers get their requirements by paying cash. Only 13 per cent of the retailers get their requirements on credit and 19 per cent get credit partly from the suppliers. Apart from this, the study also shows that the organized retailers/hyper malls and super marketers get wholesales' margin plus concession as they buy in bulk and are also the producers.

2.2 Infrastructure facilities in supply chain

Sidhu and Kahlon (1967) studied the marketing of apples in Kullu valley and found that main reasons for leasing out orchards were small and scattered holdings, lack of transportation facilities and absence of local wholesale markets in Kullu Valley. They suggested that the sales directly to consumers after grading increased the profits of the growers. They also indicated that priority should be given to road development programmes to facilitate product transfer to the markets.

Biradar (1996) studied the marketing costs, margins and price spread of selected agricultural commodities in Kolhapur district of Maharashtra during 1990-92. He identified the supply chains with commodity wise with mainly involvement of cooperative, wholesaler and millers making difference with village merchant and commission agent. The study concluded that cooperative societies can play a greater role in processing, storing and transporting etc. for reducing cost of marketing especially the commission has to be reduced by encouraging the farmers to sell their produce without the commission agents. The marketing efficiency can be increased by employing the certain measures like reducing the costs of marketing and margins through cooperative societies, widening the range of activities, increasing the volume of business, creating awareness of regulated markets among the farmers, to recruit qualified, trained and experienced market personnel, delinking middlemen and linking cooperative societies in the market, introducing innovative methods of marketing practices through managerial control. Especially the cost of marketing can be reduced by about 3 per cent if the farmers are encouraged to sell their produce without the help of the commission agents.

Chung *et al.* (1998) study revealed the factors influencing the furniture retailers purchasing decisions in Taiwan. Important factors of the furniture producers in choosing distribution channels were production capacity, salesmanship, type and grade of the products, transportation and storage. Many distribution channels were available to the producers. The retailers were under pressure to reconsider their management style and marketing strategy in order to obtain more profit.

The most important business concerns to the retailers were the product quality and the number of locations selling the same furniture. The salesman in the furniture business agreed that education and training were very important, with 96.70 per cent of the retailers believing that service was the most important requirement for salesman. The factors influencing the retailer's decision to purchase furniture were product quality (100per cent), style of finishing (100per cent), special functions (90per cent), assembly functions (90per cent), cheap price (90per cent) and the reputation of suppliers (90per cent).

Lars-Fek (1998) conducted the study of understanding the modern cold chain in Sweden he concluded that frozen food consumption is estimated at 40 million tonnes a year and is a necessity for millions of families and institutional consumers in both developed and developing countries. It is no exaggeration to say that our food distribution systems are dependent on refrigeration.

Udaya (2002) studied the marketing management of pesticides in Karnataka. The result of the study shows that the price of preferred products was significant at 0.1 per cent influencing the dealer's loyalty to the large extent. The malpractices prevailing at the dealers point also significantly influenced the farmer. Credit availability, discount / gift/ incentive, quality and availability of preferred brands were significant at 5 per cent level influencing the dealer loyalty. The multiple determinations were found to be 0.57 explaining the variation of 57 per cent in dealers loyalty of farmers to the variables included in the function.

Babu Lal Meena, D.C. Pant, and J.D. Sharma (2004) studied that about 69 percent of the produce was transported by tractor trolleys. To carry guava produce from field to the market, Producer sellers used only bamboo baskets. Channel-1 (Producer – Pre-harvest contractor –

Commission agent – Retailer – Consumer) is the most important channel, by which maximum quantity (53.19 percent) was reached to consumer.

2.3 Losses in the supply chain

Ramaswamy (1966) examined the transit losses in fruits and vegetables and reported that the percentage of wastages in transit of apples arriving in important consuming markets to the total annual arrivals was 10 percent in Calcutta, 12 percent in Bombay, 4.1 percent in Delhi and 13.2 percent in Madras. He attributed the causes for wastages to factors like unsuitability of containers and carriers used, imperfect packing, delay in movement and lack of adequate and proper storage facilities.

Singh and Mehta (1969) studied the losses due to defective packing in Apples and reported that as many as seven apples in a box of 10 kg were unsalable because of cuts and bruises caused by careless box construction. The losses amounted to 5.83 percent of the volume of 10 kg box.

Thakur and Johl (1969) studied the average cost of transportation and losses due to spoilage during transit incurred by Himachal Pradesh apple growers in principal wholesale markets. The transportation costs per box were Rs. 1.70 to Shimla, Rs. 3.40 to Delhi, Rs. 5.70 to Calcutta and Rs. 6.75 to Madras. The percentage of losses during transit was lowest in Shimla market (2 percent) followed by 5.5 percent in Delhi market and was highest in Calcutta and Madras (10 percent).

Thakur (1971) studied the transit losses of apples in five important markets, viz., Shimla, Delhi, Calcutta, Madras and Bombay. The percentage of losses per box during transit was the lowest in the case of Shimla market (1.5 percent) and it was 2 percent in all other markets examined.

Thakur (1973) studied the transportation costs for apples from Mahasu and Kullu districts of Himachal Pradesh to five markets. The transportation cost per box of apples was Rs. 2.55 to Shimla, Rs. 4.90 to Delhi, Rs. 7.50 to Calcutta, Rs. 8.50 to Madras and Rs. 8.00 to Bombay.

Rajesh K. Rana, and *et el.*, (2002) studied that crate packing considerably lower the Post-harvest losses of Kinnow fruit at Commission agent level, which was estimated upto 61 percent of the total losses due to the use of baskets and/or Palli (Jute fabric) as packing material. Rotten fruits have been estimated to cause Post-harvest losses to the level of 8.8 percent of the produce at the orchard level in Punjab and 6.9 percent in Haryana on weight basis.

Sreenivasan, M. D. and *et el.*, (2006) found out that proper placement of fruits during storage and ripening helped to reduce the losses to the extent of 23 percent. Post-harvest losses increased nearly 50 percent in the form of loose berries and injury to the berries. Acceptance of the good quality produce at the time of procurement, careful loadings, better transportation and lower number of handling and the good practices adopted in banana, which not only reduced the losses, but also fetched higher net price to the farmers. No proper packaging for banana and mangoes were seen.

Methodology

CHAPTER-III

METHODOLOGY

In this chapter, a brief description of the study area, sampling framework, method of analysis employed are presented. The present study was carried out to examine the supply chain of Arunachal Pradesh apples in terms of its consolidation, movement to market yards, facilities available and the losses in the levels of the supply chain. Hence the methods and procedure followed in conducting this research is furnished under the following heads.

3.1 Description of the study area

3.2 Nature and source of data

3.3 Sampling procedure

3.4 Analytical tools and techniques employed

3.1 Description of the study area

An assessment of any developmental activity can be made only with a detailed understanding of the physical and natural characteristics and socio-economic status of the region. Hence an attempt has been made to describe the physical, natural and socio-economic features of West Kameng district of Arunachal Pradesh, where this study was conducted to analyse various aspects of supply chain management of Apple.

3.1.1 Geography:

West Kameng district of Arunachal Pradesh is lying approximately between 26.45^0 N and 28.61^0 North latitude and 91.80^0 to 92.40^0 East longitudes. The district is surrounded by Tibet in China in the North, Bhutan in the West, Tawang and East Kameng District in the North West and East respectively. The southern boundary adjoins Sonitpur district of Assam. The District accounts 8.86 % of the total area of the state. The district is having geographical area of 7422 Sq.km with a population of 74,595 as per census 2001. The district is endowed with favourable agro-climatic condition ranging from sub-tropical to temperate, attributed to variation in altitude ranging from 60m in foot hill areas to 5000m in alpine zones of high hills and Sela areas from mean sea level. The district is having an annual rainfall between 1000 mm to 2000mm

3.1.2 History:

The name of the District derived from the Kameng River. Till 1914 the district was a part of Darrang District of Assam. By a Government of India notification of 1914, the area covered by the district became a part of the "Western section" of the North East frontier Tract, to which the entry of the British subject was regulated by an "Inner line". In 1919 the tract was renamed as "Balipara Frontier Tract" having its HQ at Charduar of Assam. In 1946, the district area was curved out of "Balipara Frontier Tract" with the name of "Sela Sub Agency" and its HQ continues to be at Charduar. In 1954 Sela sub Agency was renamed as the Kameng Frontier Division and its HQ was later transferred to Bomdila. Like other parts of NEFA it was also under the ministry of External affairs and over all In-charge of the district was a Political officer and administrative charge of NEFA from the ministry of External Affairs and Kameng frontier division was renamed as Kameng district and the political officer was renamed as a Deputy Commissioner. On first June 1980 Kameng district was bifurcated into East and West Kameng District. East Kameng was formed covering the area of the then Seppa-sub-division. Finally on 6th October: 1984, Tawang Sub-division was bifurcated from the West Kameng District.

3.1.3 Physiography:

The topography of the district is mostly mountainous. A greater part falls within the higher mountain consisting mass tangled peaks and valleys.

In West Kameng there are three principal mountain range, viz., Sela range, Bomdila range and foot hills range. The Sela Range consists of series of mountains ranged in the form of big line from Tibet in the North, Bhutan in the West and thus forming a tough terrain to pass through it. The altitude of Sela range varies from 14,000 to 15,000 ft and that of Sela Pass 13714 feet high. The Bomdila range having an average height of 9000 feet is separated by a 4500 feet high valley of river Dirang-Chu. On this range, the district HQ Bomdila lies at an altitude varying from 8100 to 9000 feet above Mean Sea Level (MSL). South of the Bomdila range lies the foot hills range having hills of quite low altitude and the area is mostly plains. The area of foot hills range is full of tropical forest with trees of great economic values. The Kameng river flows through the district and leave the district at Bhalukpong. It ultimately joins the Brahmaputra in Assam. Bichom and Dirang-Chu are the main tributaries of the river Kameng.

3.1.4 Climate:

The district is situated in temperate zone and remote from the sea. Although the district lies close to the tropic, it furnishes every gradation of climate. Thus the climate is hot and humid up to 4000 feet in southern area. Temperate climate prevails up to 7000 feet and cold beyond it. Humidity is generally high throughout the year, the winter months being less humid.

3.1.5 Local inhabitants:

There are five major tribes in West Kameng namely Monpas, Mijis, Akas, Sherdukpens and Khawas.

Diverse agro-climatic conditions, varied soil type and abundance of rainfall offer immense scope for Horticulture Development. In spite of these favourable conditions, the horticulture development was not accelerated before 2001. But after the introduction of Technology Mission Scheme, the horticultural activities gained its momentum. Now Horticulture is an important sector of economic activity in the district. In the middle and broad valleys off-seasonal vegetable crops viz. Tomato, Cabbage, Chilli, Broccoli, Cauliflower and fruit crops viz. Kiwi, Orange etc are grown commercially. Apple, Walnut, Kiwi etc are grown in higher altitudes. Horticultural activities occupy a significant place in the development of the district and its rural economy as a whole.

Selection of the study area:

West Kameng district was selected for the study since the area has the tremendous potential to become one of the major apple producing areas in the country, but lack of infrastructure facilities and area being far flung to major markets has put apprehension among apple growers regarding expansion of area under apple. Arunachal Pradesh is seeing major transition from a laid back traditional society to a modern society of late with government emphasising on connectivity to all the villages through PMGSY (Pradhan Mantri Gram Sadak Yojna) scheme and West Kameng district, regarded as the defence area under Ministry of defence, Govt. of India, has the advantage of being the areas given foremost importance in this regard. Taking this as a profound opportunity for the apple growers in the district, the area has been selected to examine the supply chain of apples to better the condition of supply chain management.

For the study of wholesalers in the supply chain of apple, 2 markets were selected, namely, Itanagar market in Arunachal Pradesh and Tezpur market in Assam. For the retailers, 3 markets were selected, viz., Bomdila and Itanagar market in Arunachal Pradesh and Tezpur market in Assam. Bomdila is the head-quarter of the West Kameng district and Itanagar is the capital of Arunachal Pradesh, both of them are the major apple market in Arunachal Pradesh. Tezpur market was selected as it is the gateway to the district of West Kameng and it is the first major market of apple as one enters into Assam from Arunachal Pradesh.

3.2 Nature and source of data

3.2.1 Primary data

The Primary data were obtained by a pre-tested structured schedule of questions from the farmers (producers) and intermediaries that are involved in the movement of apple till it reaches the consumers, viz., Wholesalers and retailers. In supply chain of Arunachal apples, existence of commission agents and their roles are virtually not present, which is why the data for commission agent was not collected and even the District Horticulture Department do not have any mentioning of the commission agents in their database. Pre-harvest contractor is also not present in the chain of apple supply as opposed to Himachal Pradesh, where the apples are mostly sold through pre-harvest contractor (Sidhu and Kahlon, 1967).

3.2.2 Secondary data

The secondary data were obtained from sources like internet from authentic websites (retrieving dates mentioned, Agricultural and general marketing journals, Department of Horticulture (Govt. of Arunachal Pradesh), Department of Horticulture of West Kameng District, NERAMAC (North-Eastern Regional Agricultural Marketing Corporation Limited) and various horticulture sub-divisions in the West Kameng district.

3.3 Sampling procedure

The sixty farmers for study were selected from ten different villages of the West Kameng district. Five wholesalers each from Tezpur and Itanagar markets were selected and 5 retailers each from Bomdila and Itanagar markets in Arunachal Pradesh and Tezpur in Assam were selected, which is the major market for the traders of West Kameng district in Assam due to its close proximity to the district. The sample respondents were selected by Simple random sampling. The respondents were contacted individually and the objectives of the study were clearly explained to them to ensure their cooperation and accuracy in their responses.

Period of study

The reference year of the study was 2010-11 and the collection of data was carried out during the period of April 2011.

3.4 Analytical tools and techniques employed

The methods of statistical analysis employed in the present study are elaborated under the following headings:

1. Measures of Central tendency

2. Percentage analysis

Definitions of terms and concepts used in the study

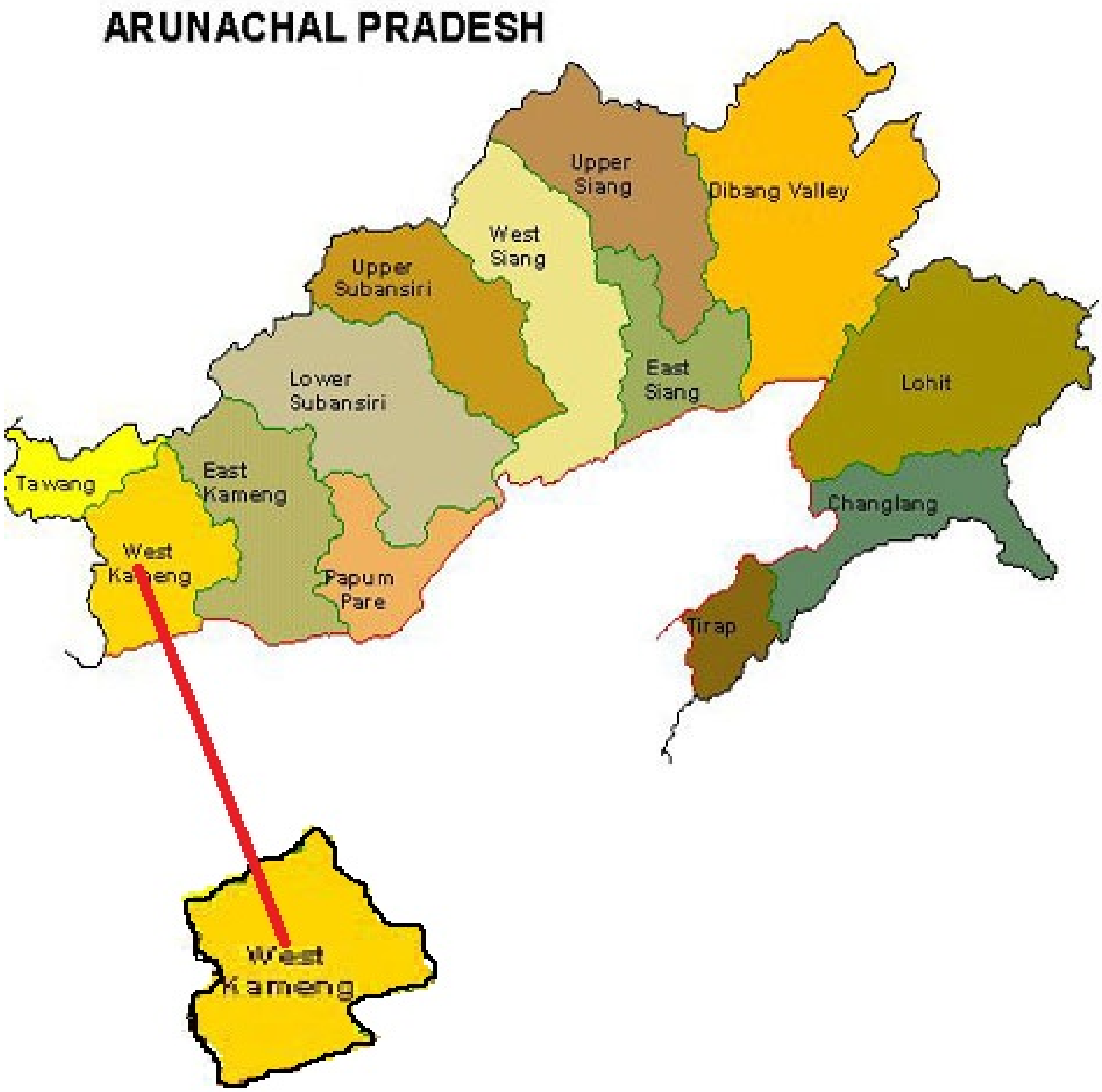
Supply Chain Management (SCM): Supply Chain Management is the process of planning, implementing, and controlling the operations of the supply chain with the purpose to satisfy customer requirements as efficiently as possible.

Intermediaries: Intermediaries are those individual who performs various marketing functions involved in purchase and sale of goods and move goods from producers to consumer.

Wholesaler: The duties of wholesaler in buying and selling of the commodities in bulk at wholesale market. He sells the apple to the retailers.

MAP OF ARUNACHAL PRADESH AND

WEST KAMENG DISTRICT



Results

CHAPTER-IV
RESULTS

Keeping in view the specific objectives, the results of the analysis carried out for fulfilling the objectives of the study are presented under the following headings:

4.1 Apple growers and various intermediaries of West Kameng district in the supply chain and their average production, purchase and sale.

4.2 Consolidation of apple by different intermediaries and its movement to market yard.

4.3 Infrastructure facilities in the Supply chain of Apple.

4.4 Losses in the Supply chain.

4.1 Apple growers and various intermediaries of West Kameng district in the supply chain and their average production, purchase and sale

In order to have a better understanding about the different roles played by the intermediaries in the supply chain of apple in West Kameng district of Arunachal Pradesh, information is provided in Table 4.1 to Table 4.6. The tables also give information about wholesalers in Itanagar and Tezpur market of Arunachal Pradesh and Assam respectively, and retailers of Bomdila and Itanagar market in Arunachal Pradesh and retailers of Tezpur market in Assam.

4.1.1 Villages selected and total respondents for the study in West Kameng District

The villages selected for the study and number of respondents (apple growers) is furnished in Table 4.1. The table shows that 15 respondents each from Shergaon and Dirang, 5 each from Jigaon, Rupa and Chillipam and 3 each from Mukuthing, Thongree, Membachuk, Brokoplang and Lumbaktang were selected, totalling upto 60 respondent farmers.

4.1.2 Average production and sale of apples in West Kameng district (2010)

It can be seen from the Table 4.2 that average number of apple trees held by a single apple grower is 1716. The table also revealed that the average production for the season is 10,086.6 kg per farmer, average quantity sold is 8970.5 kg per farmer and average price at which the apple is sold to different intermediaries is Rs. 33.00 per kg of apple. It can be also noted from the table that on an average the income generated from the sale of apple for the season is Rs. 2,59,905 per farmer. The apple season in Arunachal Pradesh starts from the month of July and ends during October. The peak months are August and September.

4.1.3 Wholesalers of different markets in the supply chain of apple in Itanagar and Tezpur markets (2010)

The wholesalers of Itanagar and Tezpur markets are described in Table 4.3. The table tries to throw some information regarding the Wholesalers of two apple markets; Itanagar in Arunachal Pradesh and Tezpur in Assam and also it show the average of the two markets combined together. In this table, it can be seen that in Itanagar market the average age of wholesalers is 42.6 years and average number of years into the business is 11.6 years. It can be seen that 100 per cent of the Itanagar wholesalers do not make outright purchase from farm gate and transport the produce on their own. Average amount of apple purchased by the Itanagar wholesalers is 60,000 kg per wholesaler (60 tonnes) for the whole season and average quantity sold is 57,530 kg per wholesaler. Average price at which it is purchased from the producers and sold to the customers are Rs. 27 per kg and Rs. 35 per kg respectively in the

Table 4.1 : Villages selected and total respondents for study in West Kameng District

Sl.No.	Villages selected	No. of respondents
1	Shergaon	15
2	Dirang	15
3	Jigaon	5
4	Rupa	5
5	Chillipam	5
6	Mukuthing	3
7	Thongree	3
8	Membachuk	3
9	Brokoplang	3
10	Lumbaktang	3
	Total	60

Table 4.2 : Average production and sale of apples in West Kameng district (2010)

Sl. No.	Particulars	Value
1	Average number of apple trees	1716 trees per farmer
2	Average production (2010)	10, 086.67 kg per farmer
3	Average quantity sold (2010)	8970.50 kg per farmer
4	Average price at which the farmers sold the apple	Rs. 33.00 per kg
5	Average income from the apple sold	Rs. 2,59,905 per farmer
6	Season of apple in West Kameng district	July-October

Itanagar market. Average income per wholesaler is Rs. 20, 13,550 in Itanagar market.

In Tezpur market of Assam, the average age of the wholesalers is 48.20 years and average years in business is 23.40 years. All the wholesalers in Tezpur market said that they make farm gate purchase of apple from farmers and also transport them to the market yard. Average amount of apple purchased from the farmers and average sale made for the season is 1, 64,000 kg per wholesaler (164 tonnes) and 1, 59,896 kg per wholesaler (159.90 tonnes) in Tezpur market. Average price at which it is purchased from the producers and sold to the customers are Rs. 28 per kg and Rs. 38 per kg respectively in the Tezpur market. Average amount of money invested to buy the apple for a season and income generated from the sale of apple are Rs. 45, 00,000 per wholesaler and Rs. 60, 76,048 per wholesaler respectively.

Combining all the wholesalers of Itanagar and Tezpur market, the average age and number of years in business is 45.40 years and 17.50 years, respectively. It can be observed from the table that an equal number of wholesalers/traders are purchasing apples at the farm gate and out of the farm gate. Only the Tezpur wholesalers arrange transport for apple. Average quantity of apple purchased and sold is 1, 12,000 kg per wholesaler and 1, 08,000 kg per wholesaler, respectively, when combined. In both the markets, on an average, purchase and sale are made at rate of Rs.27.50 and Rs. 36.50 per kg respectively.

4.1.4 Type of ownership of the business of the wholesalers

Ownership of the business is presented in Table 4.4. It can be seen from the table that in Itanagar market 60 per cent of the wholesalers have individual ownership of the business, 0 per cent partnership type and 40 per cent have family run business. In Tezpur market, 40 per cent

Table 4.3 : Wholesalers of different markets in the supply chain of apple in Itanagar and Tezpur markets (2010)

Sl. No.	Particulars	Itanagar Market	Tezpur market	Total/ Average
1	Number of respondents	5	5	10
2	Average age of the respondents	42.60	48.20	45.40
3	Number of years in business	11.60	23.40	17.50
4	Farm-gate purchase and transportation by traders	No (100%)	Yes (100%)	Yes (50%)
5	Average quantity purchased (kg per wholesaler)	60,000	1,64,000	1,12,000
6	Average price at which purchased (Rs. per kg)	27.00	28.00	27.50
7	Average amount incurred in purchase of apple for a season (Rs. per wholesaler)	15,80,000	45,00,000	30,40,000
8	Average quantity sold (kg per wholesaler)	57,530	1,59,896	1,08,713
9	Average price at which sold (Rs. per kg)	35.00	38.00	36.50
10	Average income (Rs. per wholesaler)	20,13,550	60,76,048	40,44,799

of the wholesalers have individual control over the business, 40 per cent have partnership business and 20 per cent have family run enterprises.

4.1.5 Type of investment made in business by the wholesalers

Types of investment by wholesalers are shown in Table 4.5. It was found from the table that in Itanagar market 100 per cent of the respondents manage their business with their own funds and 0 per cent with borrowed money with interest and out of which 80 per cent also said they have borrowed money without interests from relatives and friends to run the business. In Tezpur market, 100 per cent of the wholesalers use their own capital for business and 60 per cent used borrowed funds too. In Tezpur market out of all the respondents, 60 per cent used borrowed funds on interests from banks as well.

4.1.6 Retailers of apple supply chain in different markets

Retailers of apple markets of Bomdila, Itanagar and Tezpur are presented in Table 4.6. It could be seen from the table that average number of years into apple business for retailers is 16.20 years with 2-3 staff employed on an average. The retailing premises are rented and average monthly rent was Rs. 2546.67 per month. Average quantity of apple purchased and sold for a season (2010) is 4180 kg per retailer and 3898.33 kg per retailer respectively. The retailers purchase the apple and sell the produce to customers at the rate of Rs. 32.67 per kg and Rs. 45.00 per kg, respectively. The amount invested to buy apple by a retailer in a season is Rs. 1, 36,560.60 and the total amount earned from the sale is Rs. 1, 75,424.85 per retailer.

In the table, it can also be seen that when taken in account the three markets of Bomdila, Itanagar and Tezpur, there is significant differences between the markets. In Bomdila market, average years of retailers into business is 6.20 years, staff employed is zero other than

Table 4.4 : Type of ownership of the business of the wholesalers

(in percentage)

Markets	Individual	Partnership	Family run
Itanagar	60	0	40
Tezpur	40	40	20

Table 4.5 : Type of investment made in business by the wholesalers

(In percentage)

Markets	Owned funds	Borrowed funds	Borrowed funds with interests
Itanagar	100	80	0
Tezpur	100	60	60

Table 4.6 : Retailers of apple supply chain in different markets

Sl. No.	Particulars	Bomdila market	Itanagar market	Tezpur market	Total/ Average
1	Number of respondents	5	5	5	15
2	Average number of years in business	6.20	18.80	23.60	16.20
3	Number of staff employed	0	2	3	2-3
4	Rented/ owned retail shop	Rental	Rental	Rental	Rental
5	Average rental charge (Rs. per month)	500	2200	4940	2546.67
6	Average quantity of apple purchased (kg per retailer)	1240	3800	7500	4180
7	Average price at which purchased (Rs. per kg)	25	35	38	32.67
8	Average amount for purchase (Rs. per retailer)	31,000	1,33,000	2,85,000	1,36,560.60
9	Average quantity of apple sold (kg per retailer)	1185	3570	6940	3898.33
10	Average price at which the apple was sold (Rs. per kg)	40.00	50.00	45.00	45.00
11	Average income realized (Rs. per retailer)	47,400	1,78,500	3,12,300	1,75,424.85

himself/herself. They handle the business on their own paying rental of Rs. 500 on a monthly basis. In this market, the average quantity of apple purchased and sale made is 1240 kg per retailer and 1185 kg per retailer, respectively. Average price at which it is purchased and sold to is Rs. 25 per kg and Rs.40 per kg by the retailers in Bomdila market. Average amount invested by the Bomdila retailers is Rs. 31,000 per retailer and the income gotten is Rs. 47,400 per retailer in a season. In the table, it is shown that in Itanagar market, average number of years into business of the retailers is 18.80 years, employing 2 staffs on an average and paying monthly rental charge of Rs.2200. In this market, average amount of apple purchased and sold in quantity terms is 3800 kg per retailer and 3570 kg per retailer in a season. The average price at which the apple is purchased and sold is Rs. 35 per kg and Rs. 50 per kg respectively. Average amount of money used for purchase and income earned is Rs. 1, 33,000 and Rs. 1, 78, 500 per retailer in a season respectively.

The table also gives information about the retailers of Tezpur market. In Tezpur market, the average years of retailers into apple business is 23.60 years, employing at least 3 staffs on an average and paying average monthly rent of Rs. 4940. The Tezpur retailers on an average purchase 7500 kg of apple per retailer in a season. Average amount of apple sold by them is 6940 kg per retailer. Average price at which the apple is purchased and sold by the Tezpur retailers is Rs. 38 per kg and Rs. 45 per kg. The average amount invested by a retailer to buy the apple is Rs. 2, 85,000 in a season and on an average a retailer earns Rs. 3, 12,300 per season.

4.2 Consolidation of apple by different intermediaries and its movement to market yard

4.2.1 Number of farmers selling its produce to different intermediaries in the supply chain of apple

The apple farmers selling its produce to different intermediaries in the supply chain is shown in Table 4.7. In the table, it is seen that only 8.30 per cent (5 respondents out of 60) sell their produce only to consumers, 1.70 per cent (only 1 respondent from a total of 50) sell only to retailers and 28.30 per cent (17 farmers) sell only to wholesalers directly.

Out of all the farmers, the percentage of apple growers selling their produce to retailers and wholesalers directly is 13.30 per cent (8 respondents), 23.30 per cent (14 respondents) out of the total farmers said that they sell their produce directly to consumers and wholesalers and 8.3 per cent(5 respondents) sell their apple to consumers and retailers as well. Out of all the apple growers recorded, 16.70 per cent of them (10 respondents) nodded to selling their produce to consumers, retailers and also to wholesalers directly.

Interestingly, the table also highlights a very important fact of apple supply chain in Arunachal Pradesh. There is zero per cent presence of Commission agent and the concept of Pre-harvest contracting in apple production and supply is virtually nonexistent. Zero per cent of all the farmers said they do not sell the produce to Commission agents.

Table 4.7 : Number of farmers selling its produce to different intermediaries in the supply chain of apple

Sl. No.	Apple farmers sell the produce to	Numbers of farmers	Percentage (%)
1	Only Consumers	5	8.30
2	Only Retailers	1	1.70
3	Only Wholesalers	17	28.30
4	Retailers and Wholesalers	8	13.30
5	Consumers and Wholesalers	14	23.30
6	Consumers and Retailers	5	8.30
7	Consumers , Retailers and Wholesalers	10	16.70
	Total	**60**	**100**

From the table, three supply chain channels for the apple produced in West Kameng district can be traced. They are:

1. Farmer-Consumers

2. Farmer-Retailer-Consumers

3. Farmer-Wholesaler-Retailer-Consumers

4.2.2 Place of sale of the produce

Place of sale of apple in different locations is indicated in Table 4.8. The results presented in the table revealed that the number of farmers selling their produce inside the village is 16, which is 26.67 per cent of the total farmers. Farm gate selling farmers account for 60 per cent of the total farmers (36 respondents out of total 60) and the farmers directly taking their produce to market place and selling is 14 in numbers, i.e., 23.3 per cent of the total farmers. It may be noted here that a farmer selling within the village may also sell their apple in farm gate and market place.

4.2.3 Agreement to sell the produce to agencies by the farmers

It could be clearly observed from Table 4.9 that the total number of farmers in agreement to sell the apple to a particular agency is only 2, which is only 3.30 per cent of the total farmers and 58 respondents did not have any such agreement, which is 96.7 per cent of the total farmers.

4.2.4 Mode of packing

The mode of packing and the quantity packed are given in Table 4.10. It indicated that all the farmers (100 per cent) used gunny bags and Plastic crates for packing the apple for transportation to market yard. Quantity packed using gunny bags is 40 per cent of the total produce and 36.20 percent of the apples are packed in plastic crates. The percentage of farmers just putting the produce into heap without packing amounts to 76 percent and the quantity heaped is 23.80 per cent.

4.2.5 Mode of transportation

The mode of transportation of apple from farm level to market place is shown in Table 4.11. The table showed that the three mode of transportation prevalent in Arunachal Pradesh for transporting the apples are by Manual (carrying the apples plucked from the orchard in bamboo baskets to market yard), Trucks/lorry and Bolero pick-up. Out of the total farmers recorded, 47 per cent use manual means, 75 per cent out of the total farmers said they also use truck and 70 per cent of the total farmers use Bolero-pickup as well as a means to transport their produce in addition to other modes of transport.

Percentage of produce transported out of the total produce of farmers by means of manual, truck/lorry and bolero pick-up are 12 per cent, 56 per cent and 32 per cent, respectively.

4.3 Infrastructure facilities in the Supply chain of Apple.

4.3.1 Facilities availed by the farmers from the government in the supply chain of apple in Arunachal Pradesh

In order to know the facilities availed by the farmers from the government is shown in Table 4.12. The table revealed that the number of apple farmers availing the facilities rendered by the government. It could be seen from the table that 100 per cent of the farmers are given technical guidance by the horticulture department of the district. They are advised with respect to the time of planting and varieties to be planted.

Table 4.8 : Place of sale of the produce

Sl. No.	Particulars	Number of farmers	Percentage to the total
1	Within the village	16	26.67
2	Farm gate	36	60
3	Wholesale market	14	23.33

Table 4.9 : Agreement to sell the produce to agencies by the farmers

Sl. No.	Items	Number of farmers	Percentage to the total
1	Yes	2	3.30 per cent
2	No	58	96.70 per cent

Table 4.10 : Mode of packing

Sl. No.	Mode of packing	Percentage of farmers using the packing materials	Quantity packed (percentage to the total produce)
1	Gunny bags	100	40
2	Plastic crates	100	36.20
3	Without packing (in heap)	76	23.80

Table 4.11 : Mode of transportation

Sl. No.	Mode of transportation	Percentage of farmers using the means	Quantity transported (%)
1	Manual (in bamboo basket)	47	12
2	Truck/ Lorry	75	56
3	Bolero pik-up	70	32

Credit facility was not extended to the farmers. Similarly in the storage services, 100 per cent of the farmers said they have no cold storage facility, which is an important aspect in storage of apple for longevity of the produce.

In case of service, transport facility was not provided by the government and zero per cent of the farmers said that there is no transport facility from the government front. Interestingly, 100 per cent of transport facility was borne by the farmers themselves.

The grading service facility was also not provided to the farmers. In case of assembling services, no assembling services were provided by the government. In packing services, 70 per cent of the farmers availed the packing services provided by the government in the form of plastic crates.

Each farmer was provided with 50 plastic crates to put apple into them after harvesting and transport them to the market.

Government provided apple saplings to the farmers as subsidy and 100 per cent of the farmers availed the subsidy. Fencing materials are provided to the farmers by the government as subsidy, but only 33.3 per cent (20 respondents) said that they had availed the facility of fencing.

None of the intermediaries, both Wholesalers and retailers, rendered any kind of credit facilities, transportation facility, cold storage facility and materials for production like, seedlings, fertilizers, irrigation facility, etc. The only help is through advisory roles played by wholesalers in the form of time of planting, varieties to be planted, etc.

Table 4.12 : Facilities availed by the farmers from the government in the supply chain of apple in Arunachal Pradesh

Sl. No.	Facilities	Number of Farmers	Percentage (%)
1	Technical guidance	60	100
2	Packing service	42	70
3	Saplings	60	100
4	Fencing facility	20	33.3

4.3.2 Area expanded in farmer's orchard under Technology Mission programme by the West Kameng Horticulture Department from 2001-02 till 2009-10

The area expanded in farmer's apple orchards under Technology Mission Programme by the Department of Horticulture of West Kameng district is shown in Table 4.13. From the table, it could be inferred that the area expanded and production of apple under the programme had increased with each succeeding year. The area expanded increased from 20 ha to 290 ha from 2001-02 to 2009-09. The production propelled from 200 mt in the year 2001-02 to 4093 mt in the year 2009-10. The farmers were provided with free saplings in the area expanded.

4.3.3 Infrastructure facilities at farmer's level

The infrastructure facilities that apple grower of West Kameng district posses are highlighted in Table 4.14. It could be observed from the table that 100 per cent respondent farmers have harvesting facility in the form of labour, baskets, etc.

The storage facilities in the form of shed in the orchard itself were constructed by 46.67 per cent of the farmers, 45 percent stored at home and 8.33 per cent of the farmers do not have storage facility at all.

The percentage of farmers having owned transportation is 28.33 per cent and 71.67 percent used hired mode of transportation.

4.3.4 Infrastructure facilities at wholesaler's level

The infrastructure facilities at wholesaler's level are presented in the Table 4.15. It can be seen that 80 percent of the wholesalers hire vehicles for procuring the apples and only 20 per cent have owned transportation facility. The facility of cold storage is seen in none of the

Table 4.13 : Area expanded in farmer's orchard under Technology Mission programme by the West Kameng Horticulture Department from 2001-02 till 2009-10

Year	Unit Allotted (1 unit=100 apple trees)	Area covered (Ha)	Cumulative (Area covered in hectare)	Production (Mt)
2001-02	53	20	20	200
2002-03	330	139	159	1312
2003-04	335	87	246	1921
2004-05	300	102	368	2533
2005-06	260	182	550	3443
2006-07	250	130	680	4093
2007-08	300	165	845	4093
2008-09	500	270	1115	4093
2009-10	550	290	1205	4093

Source*: Database, 2010, Department of Horticulture, West Kameng District, Government of Arunachal Pradesh.*

Table 4.14 : Infrastructure facilities at farmer's level

Sl. No.	Infrastructure facilities	Number of farmers	Percentage
1	Harvesting facility	60	100
2	Storage facility		
	i. On farm store shed	28	46.67
	ii. Storage at home	27	45.00
	iii. No store house	5	8.33
3	Transportation facility		
	i. Owned	17	28.33
	ii. Hired	43	71.67
4	Labour		
	i. Hired	49	81.67
	ii. Permanent	11	18.33
5	Weighing machine (Digital/Manual)	42	70
6	Refrigerated van	0	0
7	Grading machine	3	5
8	Packing	100	100

markets and 80 per cent of the farmers store the apples in storage room without any regulated temperature requisite for apples. All the wholesalers have packing facility. For grading the apples, only 10 percent of the wholesaler posses digital grader and 90 per cent grade the apples manually (by labours). In both the markets, wholesalers used have weighing machine (digital/manual).

4.3.5 Infrastructure facilities at retailer's level

The facilities at retailer's level are furnished in Table 4.16. The table revealed that in all the three markets of Bomdila, Itanagar and Tezpur, 80 percent of the retailers used hired vehicles for transporting the apples, rest have owned vehicles. Cold storage in the form of refrigerators is used by 20 per cent of the farmers mainly in the Tezpur market to store the apples. Equal numbers of retailers store the apples in store rooms and in the shops itself.

The packing facility is seen only in Itanagar and Tezpur market (66.67 per cent). All the retailers grade the apples manually in all the three markets. The percentage of retailers weighing the apples in digital machine is 40 per cent and 60 per cent of the retailers weigh manually.

4.4 Losses in the supply chain of apple in Arunachal Pradesh

4.4.1 Apple losses at farmer's level in West Kameng district

The total losses at farmer's level are quantified in Table 4.17. The table showed that at farmer's level, the loss in volume is 11.07 per cent from the total production and in value terms it is 12.20 per cent of the total value of the produce that was harvested.

Table 4.15 : Infrastructure facilities at the wholesaler's level

Sl. No.	Infrastructure facilities	Itanagar market (%)	Tezpur market (%)	Total (%)
1	Transportation facilities			
	i. Hired	100	60	80
	ii. Owned	0	40	20
2	Storage facility			
	i. Cold storage	0	0	0
	ii. Store room	60	100	80
3	Packing	100	100	100
4	Grading machine			
	i. Digital	0	20	10
	ii. Manual	100	80	90
5	Weighing machine (Digital/Manual)	100	100	100

Table 4.16 : Infrastructure facilities at retailer's level

Sl. No.	Infrastructure facilities	Bomdila market (%)	Itanagar market (%)	Tezpur market (%)	Total (%)
1	Transportation				
	i. Hired	100	80	60	80
	ii. Owned	0	20	40	20
2	Storage				
	i. Cold storage (refrigerator)	0	10	40	20
	ii. Store room	0	80	40	40
	iii. Store in shop	100	10	20	40
3	Packing	0	100	100	66.67
4	Grading machine				
	i. Digital	0	0	0	0
	ii. Manual	100	100	100	100
5	Weighing machine				
	i. Digital	0	40	80	40
	ii. Manual	100	60	20	60

Table 4.17 : Apple losses at farmer's level in West Kameng district (2010)

Sl. No.	Particulars	Percentage
1	Percentage loss at farmers' level in quantity terms	11.07
2	Percentage loss at farmers' level in value terms	12.20

4.4.2 Losses of apple at wholesaler's level

Losses of apple at wholesaler's level are given in Table 4.18. The table indicated that percentage loss is 2.93 per cent in volume and 2.98 per cent in value terms at the wholesaler's level.

4.4.3. Average losses of apples at wholesaler's level

The average losses of apples at wholesaler's level were indicated in Table 4.19. It indicated that the average loss a wholesaler incurs is 3287 kg of apples per season and the value amounts to Rs.90, 550 per wholesaler.

4.4.4 Losses at wholesaler's level during different activities

The losses at wholesaler's level during different activities were shown in Table 4.20. It was known that out of all the losses incurred at the wholesaler's level, the highest loss is seen during sales and distribution (2.23 %). During transportation, 0.50 per cent of the apples are lost and 2.23 per cent is lost during cleaning and grading.

The losses in value during different activities are 0.50 per cent during transportation, 0.42 per cent during cleaning and grading and 2.03 per cent during sales and distribution.

4.4.5 Percentage share of losses of apples at wholesaler's level in Itanagar and Tezpur markets

Percentage share of losses of apples at wholesaler's level in Itanagar and Tezpur markets is shown in Table 4.21. It revealed that the share of total losses was incurred mostly by Tezpur market (62.43% of the total loss) and the share of loss in Itanagar market is 37.57 per cent of the total loss.

Table 4.18 : Losses of apple at Wholesaler's level

Sl. No.	Particulars	Percentage
1	Loss in Quantity	2.93
2	Loss in Value	2.98

Table 4.19 : Average losses of apple at the Wholesaler's level

Sl. No.	Particulars	Value
1	Average loss in volume (Kg per wholesaler)	3287
2	Average loss in value (Rs. per wholesaler)	90,550

Table 4.20 : Losses at wholesaler's level during different activities

Sl. No.	Activity	Losses in quantity (%)	Losses in value (%)
1	During transportation	0.50	0.53
2	During cleaning and grading	0.41	0.42
3	During sales and distribution	2.23	2.03

Table 4.21 : Percentage share of losses of Itanagar and Tezpur market at wholesaler's level

Sl. No.	Markets	Percentage loss in quantity to the total loss	Percentage loss in value to the total loss
1	Itanagar	37.57	35.37
2	Tezpur	62.43	64.63

4.4.6 Losses of apple at Retailer's level in the markets of Bomdila, Itanagar and Tezpur

The losses of apples at retailer's level are furnished in Table 4.22. The table revealed that around 6.74 per cent of the total apples purchased from wholesalers are lost and the value lost is 6.84 per cent of the total value purchased. Average loss is 281.67 kg per retailer and the average loss in value is Rs. 10,235 per retailer in an apple season.

4.4.7 Average losses of apple in different markets at retailer's level

Average losses of retailers in the markets of Bomdila and Itanagar in Arunachal Pradesh and Tezpur in Assam are assessed in Table 4.23. The table found that the average losses in Bomdila, Itanagar and Tezpur markets are 55 kg per retailer, 230 kg per retailer and 560 kg per retailer respectively. The average losses in value are Rs. 1375 per retailer, Rs. 8050 per retailer and Rs. 21,280 per retailer in Bomdila, Itanagar and Tezpur markets respectively.

4.4.8 Percentage share of losses of the three markets at the retailer's level in the supply chain of apple

The percentage share of total losses incurred by the different markets at the retailer's level of supply chain is seen in Table 4.24. It was found that the Bomdila market accounts for 6.51 per cent of the total aggregate losses at retailer's level, Itanagar market incurs 27.22 per cent share of the total losses and Tezpur market accounts for the highest share in the total loss at the retailer's level, i.e., 66.27 per cent of the total loss.

Table 4.22 : Losses of apple at Retailer's level in the markets of Bomdila, Itanagar and Tezpur (2010)

Sl. No.	Particulars	Value
1	Percentage loss in quantity at retailer's level	6.74
2	Percentage loss in value at retailer's level	6.84
3	Average loss in quantity (kg per retailer)	281.67
4	Average loss in value (Rs. per retailer)	10,235

Table 4.23 : Average losses of apple in different markets at retailer's level

Sl. No.	Markets	Average loss in quantity (Kg per retailer)	Average loss in value (Rs. per retailer)
1	Bomdila	55	1375
2	Itanagar	230	8050
3	Tezpur	56	21,280

Table 4.24 : Percentage share of losses of the three markets at the retailer's level in the supply chain of apple

Sl. No.	Markets	Percentage to the total loss
1	Bomdila	6.51
2	Itanagar	27.22
3	Tezpur	66.27

Discussion

CHAPTER-V

DISCUSSION

The results of the investigation presented in the previous chapter are discussed in this chapter under the following headings.

5.1 Apple growers and various intermediaries of West Kameng district in the supply chain and their average production, purchase and sale.

5.2 Consolidation of apple by different intermediaries and its movement to market yard.

5.3 Infrastructure facilities in the Supply chain of Apple.

5.4 Losses in the Supply chain.

5.1 Apple growers and various intermediaries of West Kameng district in the supply chain and their average production, purchase and sale.

5.1.1 Villages selected and total respondents for study in West Kameng District

The villages selected for the study and number of respondents (apple growers) is furnished in Table 4.1. The table shows that 15 respondents each from Shergaon and Dirang, 5 each from Jigaon, Rupa and Chillipam and 3 each from Mukuthing, Thongree, Membachuk, Brokoplang and Lumbaktang were selected total upto 60 respondent farmers. as large number of apple growers are in these villages. Shergaon is the traditional apple growing area in the West Kameng district.

5.1.2 Average production and sale of apples in West Kameng district

It can be seen from the result in the previous chapter that average number of apple trees held by a single apple grower was 1716. Average production for the season was 10,086.67 kg per farmer, which is quite low. This can be due to the practice of organic farming by almost all the farmers in the region and non availability of protection materials when needed. Average quantity sold was 8970.50 kg per farmer as some of the apples are lost during transportation and also due to damage and pest and diseases. Average price at which the apple was sold to different intermediaries is Rs. 33.00 per kg of apple, which is very high by national standard. It is due to the high cost of apple production in the region and farmers themselves use their own hard earned money for the apple production and supply. Though the farmers get high price for their produce, the income is low due to low production and productivity and lower number of apple trees held by the farmers.

5.1.3 Wholesalers of different markets in the supply chain of apple in Itanagar and Tezpur markets

It has been observed that there was difference between the age and years of business of wholesalers in Itanagar and Tezpur markets from the study. The age of the wholesalers in the Tezpur market are older than in Itanagar market as the Tezpur wholesalers have been in business for a long time, most of whom have taken over the business from their parents. The wholesalers of Itanagar are mostly from Assam, Bihar and West Bengal, who have just been in the place around some years back and started their business in the market. The Itanagar wholesalers do not make outright purchase of the apples from producers and transport on their own due to the distance involved, whereas the wholesalers from Tezpur go to the producers in their villages and purchase the produce and also transport the produce on their own as they have been into trade with the people of West Kameng from a long time and the flow of carrier vehicles from Tezpur to West Kameng is frequent. The wholesalers themselves consolidate the apple from the farmers and bring them to market yard.

There was huge difference between the apple consolidated by the Tezpur wholesalers and the Itanagar wholesalers due to the demand and the population difference between the two places. Tezpur market has got higher demand and population wise, it is much larger, which is why the wholesalers of Tezpur market buy apple in much higher quantity than Itanagar wholesalers.

The study revealed that the average price at which the Wholesalers of Itanagar and Tezpur buy the apple from farmers are Rs. 27.00 and Rs. 28.00 per kg respectively, which do not have major difference. The average prices at which the Tezpur and Itanagar wholesalers sell their produce are Rs. 35.00 and Rs. 38.00 per kg respectively. The 3 rupees difference can be attributed to the cost of transportation incurred in consolidating and transporting the produce by the Tezpur wholesalers. The study also have shown that the average income of a wholesaler in Tezpur market was higher than in Itanagar market , which could be because of the difference in quantity purchased, demand and higher realisation per unit of apple sold.

5.1.4 Type of ownership of the business of the wholesalers

It can be seen that in Itanagar market 60 per cent of the wholesalers had individual ownership to the business, 0 per cent partnership type and 40 per cent have family run business. It is because the people involved in this business are mainly outsiders, who rely mostly on individual themselves or does business along with family members. In Tezpur market, 40 per cent of the wholesalers have individual control over the business, 40 per cent have partnership business and 20 per cent have family run enterprises. It may be due to size of market, where all kinds of business flourishes.

5.1.5 Type of investment made in business by the wholesalers

From the study it was found that the wholesalers of Itanagar market rely on owned and borrowed funds (without interests) only. They never take loans from bank to run the business. This could be because of the low volume of business in this market, which do not need high amount of funds. In contrast, wholesalers of Tezpur market use all the possible capital available to them as they are much organised and have a long term mindset to keep the business running.

5.1.6 Retailers of apple supply chain in different markets

The retailers observed from the study of apple supply chain are mainly from three markets, i.e., Bomdila and Itanagar in Arunachal Pradesh and Tezpur in Assam. It was observed that in combining all the retailers together from the three markets, the average years of a retailer into business is 16.20 years. This may be because the apple and its popularity in Arunachal Pradesh on a commercial basis are very recent. The average quantity purchased is 4180 kg per retailer in a season and average quantity sold is 3898.33 kg per retailer. This may be due to lower demand in the season. Average purchase price and sale price recorded from the study are Rs. 32.67 per kg and Rs. 45.00 per kg respectively. The difference may be due to the reason given by the retailers to customer of transportation cost. In reality, the retailers do not transport the produce at all. The total value generated from a total investment of Rs. 1, 36,560.60 per retailer for the purchase of apple is about Rs. 1, 75, 424.85 per retailer. The loss at retailer's level is quite high, which may be the reason of lower income.

In Bomdila market, the average year of retailers into business was only 6.20 years as the market of Bomdila is a new one. It was also seen that the average quantity purchased by a retailer for the whole was season is merely 1240 kg per retailer due to small market size and also the space for keeping the produce was small. Being the head-quarter of the West Kameng district, the retailers directly get the produce from the farmers itself, which is assembled in the market by the farmers themselves. This way the retailers of Bomdila purchase the apple at the rate of Rs. 25.00 per kg and sell at the rate of Rs. 40.00 per kg on an average. The study also revealed that the investment made by Bomdila retailers was Rs. 31,000 per retailer and income gained was Rs. 47,400 per retailer. This can be attributed to lower quantity sold and high wastage of produce due to non availability of proper storage.

It was seen that the retailers of Itanagar market on an average sell about 3570 kg of apples per retailer out of 3800 kg procured from the wholesalers and farmers, comparatively which is quite better than the Bomdila market. It can be due to less wastage of the produce in this market. The produce was purchased and sold at the rate of Rs. 35.00 per kg and Rs. 50.00 per kg, respectively. The average income from the sale is Rs. 1, 78, 500 per retailer per season from an investment of Rs. 1, 33,000, which is quite better than the Bomdila market. It may be because of higher quantity sold and lesser wastage.

It was also seen from the results obtained that the retailers of the Tezpur market in Assam make average purchase of 7500 kg of apple per retailer in a season with a sale of 6940 kg per retailer. The average purchase and sale price are Rs. 38.00 per kg and Rs. 45.00 per kg, respectively. The sale price is lower than both the other two markets when compared with purchase price. It may be due to presence of large number of retailers in Tezpur market, which compete with each other for better price, due to which even the income is quite lower comparatively.

5.2 Consolidation of apple by different intermediaries and its movement to market yard

5.2.1 Number of farmers selling its produce to different intermediaries in the supply chain

It was found from the results obtained in the previous chapter that apples in the West Kameng district were consolidated by various intermediaries to move it to market yard. Out of the total farmers, the percentage of farmers selling their produce exclusively to consumers directly is only 8.30 per cent. These may be the farmers who have very less production, lower number of trees or farmers who have young orchards, which have low production in initial years of fruitation. Merely 1.70 per cent sold their whole apple production only to retailers as this group of farmers has vehicles to transport the apple to Bomdila market due to its close proximity. It was also observed that the exclusive sale made only to wholesalers directly was the highest among all the method of consolidation of apple, accounting to 28.30 per cent. This could be because the wholesalers from Tezpur market come with their vehicles to buy from farmers.

It was seen from the study that 13.30 per cent farmers sold their apples to retailers and wholesalers as well, 23.30 percent to both consumers and wholesalers and 8.30 per cent sold to consumers and retailers as well. The reason for most of the farmers selling to different intermediaries may be because they get good remuneration from the multiple sales.

There was zero presence of commission agent as the market of apple in Arunachal Pradesh has not evolved in a big way like the apple markets of Jammu and Kashmir and Himachal Pradesh. The concept of Pre-harvest contractor is nonexistent due to the absence of agro-based companies.

From the study, three supply chain channels for the apple produced in West Kameng district was traced. They were:

1. Farmer-Consumers
2. Farmer-Retailer-Consumers
3. Farmer-Wholesaler-Retailer-Consumers

5.2.2 Place of sale of the produce

The study revealed that the place of consolidation of apple or the procurement of apple in bulk was mostly done on farm gate, then within the village and least by taking the produce to markets by the farmers. This may be because most of the farmers do not have transportation facility and always is on the hope that the wholesalers will bring his/her owned vehicles to consolidate the apples.

5.2.3 Agreement to sell the produce to agencies by the farmers

It was known from the results found that only 3.30 percent of the farmers had agreement with some agency to sell the produce. It may be due to absence of marketing agencies in the region or only few players present, which are not that popular.

5.2.4 Mode of packing

All the farmers use two materials in packing the produce for transport to market yards as was found from the results. The materials were gunny bag and Plastic crates. The plastic crate was made available to farmers by the government. Each farmer was supplied with 50 plastic crates as part of facility rendered by the government. Gunny bags were used due to its availability. Few farmers heaped the apples in truck without packing due to lack of packing materials available in the village.

5.2.5 Mode of transportation

From the results obtained in chapter-IV, it was found that the most used mode of transportation is truck/lorry (75% of the total) other than manual and bolero pick-up. Bolero pick-up (70 % of the total) are available in large numbers in the district of West Kameng and due to its popularity in the mountainous road to travel faster, it is gaining fast acceptance among farmers and wholesalers. By manual means only 47 per cent of the total farmers carry their produce. Produce transported by manual, truck/lorry and bolero pick-up were 12 per cent, 56 per cent and 32 per cent, respectively.

5.3 Infrastructure facilities in the Supply chain of Apple.

5.3.1 Facilities in the supply chain of apple in Arunachal Pradesh

The study has shown that the facilities rendered by the government is not enough and whatever facilities that were available from the government was not even bare minimum. It was found that 100 percent of the farmers agreed to not having credit facility, cold storage facility, transport facility, grading and assembling facility. The reason probably would be the lack of government's initiative and ignorance. The region being the most potential in apple production in the state, the government still have not taken it seriously.

The only facilities that were provided to the apple growers were saplings provided by the government (100 % farmers availed), packing facility (100 % farmers availed) and fencing facility (70 % farmers availed). Each farmer was issued 50 plastic crates for packing. Each farmers was given fencing material for a unit of trees in the orchard (1 unit=100 trees of apple).

It was found that there were no facilities from the wholesaler's side or retailer's front as they were not involved with farmers in any way, be it in production or procurement. Advisory roles were played by the wholesalers as they gave suggestion as part of the formalities only.

5.3.2 Area expanded in farmer's orchard under Technology Mission programme by the West Kameng Horticulture Department from 2001-02 till 2009-10

It could be observed that the area expansion under Technology Mission Programme was successful in increasing the area and production as well since its inception in 2001 in the district. The farmers were provided with free saplings in the area expanded under the programme and new trees were placed with high yielding capacity.

5.3.3 Infrastructure facilities at farmer's level

It was observed from the table that the farmers had harvesting facility, but the storage facility was not adequate with only 46.67 of the farmers having storage structure at farm. There is a huge gap. This may be due to majority of the farmers not having adequate capital to set up on farm storage facility.

Only 28.33 per cent farmers had owned vehicles and rest depended on hired ones. High cost of vehicles and lack of capital among farmers can be attributed to this.

There is a gap of 30 per cent, who do not have weighing facility due to being extremely poor. Refrigerated vans and grading machines costs are very high due to which it was found that none of the farmers possessed any refrigerated vans and only 3 percent had apple grader.

5.3.4 Infrastructure facilities at wholesaler's level

It is clearly evident from the results that presented in the table that only 20 percent owned vehicles, 80 per cent of farmers store the apples in store rooms without regulated temperature, zero per cent had any cold storage facility and only 10 percent possessed digital graders. This could be due to ignorance of the wholesalers or high cost of machines.

5.3.5 Infrastructure facilities at retailer's level

It was evident from the study that 80 per cent of the retailers used hired vehicles, 20 per cent of the retailers had refrigerators for storing the apples and rest used either store rooms or in shop itself, 66.67 per cent retailers had packing facility, 100 percent graded the apples manually and 40 per cent used digital weighing machines.

5.4 Losses in the supply chain of apple in Arunachal Pradesh

5.4.1 Apple losses at farmer's level in West Kameng district

The study revealed that the loss in volume was found to be 11.07 per cent of the total production and 12.20 per cent of the total value of the produce. The losses were mainly due to non availability of storage facility, lack of post-harvest management, and transportation.

5.4.2 Losses of apples at wholesaler's level

It was quantified from the study that the percentage loss at wholesaler's level was 2.93 per cent in volume and 2.98 per cent in value terms. Compared to farmers, it was found, that the loss is lesser at wholesaler's level as wholesalers had better facilities in procuring, transporting and selling the apples.

5.4.3 Average losses of apples at wholesaler's level

It was indicated from the tables that the average loss a wholesaler incurs was 3287 kg of apples per season and the value amounts to Rs.90, 550 per wholesaler. This can be attributed to bad transportation as the area is mostly mountainous and the conditions of the roads are bad.

5.4.4 Losses at wholesaler's level during different activities

The study revealed that the losses at wholesaler's level during different activities were 2.23 percent during sales and distribution, 0.50 per cent during transportation and 2.23 per cent was lost during cleaning and grading. The highest lost during sales in distribution may be due to lack of proper storage facility and the perishable nature of apple.

5.4.5 Percentage share of losses of apples at wholesaler's level in Itanagar and Tezpur markets

In combining the total losses at wholesaler's level in both Itanagar and Tezpur markets, the study revealed that the Tezpur market incurred the higher percentage of loss, which was 62.43 per cent of the total loss in quantity and 64.63 per cent of the total value lost, whereas Itanagar market only accounts for 37.57 per cent and 35.37 per cent in volume and value terms in both the markets, respectively. This may be due to higher amount of apple purchased during a season by the Tezpur wholesalers.

5.4.6 Losses of apple at Retailer's level in the markets of Bomdila, Itanagar and Tezpur

The study estimated that the losses of apples at retailer's level were around 6.74 per cent of the total apples purchased from wholesalers and the value lost was 6.84 per cent of the total value purchased. Average loss was known at 281.67 kg per retailer and the average loss in value was Rs. 10,235 per retailer in an apple season. The lost can be attributed to the lack of cold storage at retailer's outlets.

5.4.7 Average losses of apple in different markets at retailer's level

The highest average loss recorded in the study at Tezpur market at different activities is highest during sales and distribution (2340 kg per wholesaler). The loss can be attributed to perishable nature of the apple and with time the fruit gets damaged.

5.4.8 Percentage share of losses of the three markets at the retailer's level in the supply chain of apple

It was reported that, 0ut of the total losses at retailer's level in all the 3 markets, Tezpur market accounts for the highest loss (66.27 per cent of the total losses in all the three markets) as both the other two markets have lower volume of business and the produce reach the market earlier with fresher lot.

Summary

CHAPTER-VI

SUMMARY

India is the 7th largest producer of Apple in the world (Food and Agriculture Organisation, 2010). The total production and area under apple cultivation in India is 1.993 Million Tonnes and 2, 79,800 hectares respectively (Indian Horticulture Database, 2010) but there are huge post-harvest looses. In fact, if we look at country-wide picture, India produces about 8 per cent of the world's fruit and about 15 per cent of the world's production of vegetables but looses 25 to 40 per cent of the fruits produced due to lack of post harvesting infrastructure such as cold chains, transportation, and storage and processing facilities.

About 99 percent of India's apple area falls under the North Western Hills region, covering six districts of J&K (Srinagar, Budgam, Pulwama, Anantanag, Baramullah, Kupwara), six districts of H.P. (Shimla, Kullu, Sirmour, Mandi, Chamba, Kinnaur) and eight districts of Uttarakhand (Almora, Nainital, Pithauragarh, Tehri, Pauri, Chamoli, Uttarkashi, Dehradun). In the North-eastern Hills region, good quality apple is grown in the West Kameng district of Arunachal Pradesh.

Apple is one of the most widely grown fruit crops grown in Arunachal Pradesh. Almost all the apples grown in India come from its three mountainous states i.e. Himachal Pradesh, J&K and Uttarakhand but lately Arunachal Pradesh have entered the Apple market in India. Arunachal Pradesh produced 9800 MT from an area of 10,800 ha in the year 2009-2010 (National Horticulture Board, 2010). Arunachal apples are of high quality and have the capacity to capture the markets of eastern India and also South-east Asian nations like Bangladesh and Myanmar. The supply chain of apples in Arunachal Pradesh is laden with inefficiencies across the entire chain leading to poor price realization of growers on one hand and exorbitant prices paid by consumers on the other.

West Kameng district of Arunachal Pradesh produces highest amount of Apple in the State (Anonymous, 2010). Since inception of Horticulture Technology Mission Scheme, the people of the district started to cultivate apple on commercial basis especially in the areas viz. Dirang, Zimthung, Morching, Chillipam, Wangho, Shergaon and Jigaon.

The concept of Agriculture supply chain refers to the activities of procurement, order fulfilment, product design and development, distribution, delivery and customer service executed by two or more separate organizations in the agribusiness industry. Agriculture supply chain consists of small and medium enterprises, such as farmers and raw material producers, suppliers of agricultural inputs, processors of agricultural outputs, farmers co-operatives, brokers, suppliers, distributors, wholesalers and retailers, that either tend to operate independently or in co-operation, mainly in the last stages of supply chain.

Objectives of the study

Keeping the above aspects in consideration, the study was carried out with the following objectives

1. To assess the method of consolidation of Apple and its movement to the market yard.
2. To examine the infrastructure facilities in the Supply chain of Apple.
3. To estimate the losses in the Supply chain.

Methodology

West Kameng district was selected for the study since the area has the tremendous potential to become one of the major apple producing areas in the country, but it lacks infrastructure facilities and area being far flung to major markets has put apprehension among apple growers regarding expansion of area under apple. Arunachal Pradesh is seeing major transition from a laid back traditional society to a modern society of late with government emphasising on connectivity to all the villages through PMGSY (Pradhan Mantri Gram Sadak Yojna) scheme. Taking this as a profound opportunity for the apple growers in the district, the area has been selected for the study, which will help in strengthening the supply chain of apple.

For the study of wholesalers in the supply chain of apple, 3 markets were selected, namely, Bomdila and Itanagar markets in Arunachal Pradesh and Tezpur markets in Assam. Bomdila is the head-quarter of the West Kameng district and Itanagar is the capital of Arunachal Pradesh, both of them are the major apple market in Arunachal Pradesh. Tezpur market was selected as it is the gateway to the district of West Kameng and it is the first major market of apple as one enters into Assam from Arunachal Pradesh.

Primary data were obtained through a pre-tested structured schedule of questions from the farmers (producers) and intermediaries. The secondary data were obtained from sources like internet from authentic websites (retrieving dates mentioned, agricultural and general marketing journals, Department of Horticulture (Govt. of Arunachal Pradesh), Department of Horticulture of West Kameng District and various horticulture sub-divisions in the West Kameng district.

The primary data was collected from 60 farmers from different villages of the West Kameng district and also from 5 wholesalers each from Tezpur and Itanagar markets and 5 retailers each from Bomdila and Itanagar markets in Arunachal Pradesh and Tezpur in Assam.

Tabular analysis was used as a tool to analyse the data in respect of all the objectives, in general. Simple statistical measures like averages, ratios and percentages were used to compare, contrast or interpret the results.

The present study was conducted for the apple season of 2010 (July- October) and the collection of data was carried out during the month of April, 2011.

Major findings of study

1. The study revealed that on an average, a farmer possessed 1716 trees in his/her apple orchard with an average production of 10,086.6 kg and sold 8970 kg out of the total production.
2. The wholesalers of Itanagar market had not made any direct purchase from the farm gate, whereas the Tezpur wholesalers made outright farm gate purchase and transported the produce on their own as the flow of vehicles to producing area were frequent from Tezpur and the Wholesalers of Tezpur market had a long relationship with the apple growers in terms of trade.
3. Average quantity of apple purchased and sold for a season (2010) were 4180 kg per retailer and 3898.33 kg per retailer respectively in all the three markets of Bomdila, Itanagar and Tezpur.
4. The average price at which the apple was sold by farmers to different intermediaries, by wholesalers (combining both the markets of Itanagar and Tezpur) and retailers (combining all the 3 markets of

Bomdila, Itanagar and Tezpur) were Rs.33.00 per kg of apple, Rs.36.50 per kg and Rs.45.00 per kg, respectively.

5. The average price at which the apple was purchased by wholesalers (combining both the markets of Itanagar and Tezpur) and retailers (combining all the 3 markets of Bomdila, Itanagar and Tezpur) were Rs. 27.5 per kg and Rs. 32.67 per kg, respectively

6. It was seen that only 8.30 per cent (5 respondents out of 60) sell their produce only to consumers, 1.70 per cent (only 1 respondent from a total of 50) sell only to retailers and 28.30 per cent (17 farmers) sell only to wholesalers directly. The consolidation of the apple was mainly done by the wholesalers from the villages.

7. It was seen from the study that 13.30 per cent farmers sold their apples to retailers and wholesalers as well, 23.30 percent to both consumers and wholesalers and 8.30 per cent sold to consumers and retailers as well. The reason for most of the farmers selling to different intermediaries may be to optimise the returns through multiple sales.

8. There was zero presence of commission agent as the market of apple in Arunachal Pradesh has not evolved in a big way like the apple markets of Jammu and Kashmir and Himachal Pradesh. The concept of Pre-harvest contractor is nonexistent due to the absence of agro-based companies.

9. From the study, three supply chain channels for the apple produced in West Kameng district was traced. They were:

   I. Farmer-Consumers

   II. Farmer-Retailer-Consumers

   III. Farmer-Wholesaler-Retailer-Consumers

10. The study revealed that the place of consolidation of apple or the procurement of apple in bulk was mostly done on farm gate, then

within the village and least by taking the produce to markets by the farmers. This may be because most of the farmers do not have transportation facility.

11. It was clear from the results that only 3.30 percent of the farmers had agreement with some agency to sell the produce. It may be due to absence of marketing agencies in the region or only few players present, which are not that popular.
12. The materials used for packing were mainly gunny bags and Plastic crates. The plastic crates were made available to farmers by the government. Each farmer was supplied with 50 plastic crates as part of facility rendered by the government. Gunny bags were used due to its availability.
13. It was found that the most used mode of transportation was truck/lorry (75%) other than manual and bolero pick-up. The largest quantity of the produce transported was by truck (56 % of the total produce). It may be due to the larger space available in truck/lorry.
14. The only facilities that were provided to the apple growers were saplings (100 % farmers availed), packing facility (70 % farmers availed) and fencing facility (33.33% farmers availed). Each farmer was issued 50 plastic crates for packing. Each farmer was given fencing material for a unit of trees in the orchard (1 unit=100 trees of apple). It was found that 100 percent of the farmers agreed to not having credit facility, cold storage facility, transport facility, grading and assembling facility.
15. The study revealed that the average loss or the wastage occurring at the farmer's level was 1116.17 kg per farmer and Rs. 31,709.17 per farmer. The loss in volume was found to be 11.07 per cent of the total production and 12.20 per cent of the total value of the produce.

The losses were mainly due to non availability of storage facility, lack of post-harvest management, and transportation.

16. The area expansion programme under Technology mission was successful in increasing the land in farmer's orchard from 20 ha to 290 ha over a span of ten years as part of the facility rendered by the government.

17. The study showed that 46.67 per cent of the farmers have storage sheds at farm, 28.33 percent have owned vehicles, and 30 per cent do not have weighing machines and only 3 per cent farmers have apple grading machines.

18. There is hardly any cold storage at wholesaler's level. The results showed that only 20 per cent have owned vehicles, 80 per cent of the farmers store apples in store rooms without regulated temperature and only 10 per cent have digital graders.

19. The study showed that 80 per cent of the retailers used hired vehicles, 20 per cent had refrigerators, 66.67 per cent retailers had packing facility, 100 per cent graded manually and 40 per cent retailers had digital weighing machines.

20. The loss at the farmer's level was found to be 11.07 per cent and the value lost was 12.20 per cent of the total produce.

21. The loss at wholesaler's level was 2.93 per cent in volume and 2.98 per cent in value. During different activities the losses were found to be 2.23 per cent during sales and distribution, 2.23 per cent during cleaning and grading and 0.50 per cent during transportation.

22. In combining the total losses at wholesaler's level in both Itanagar and Tezpur markets, the Tezpur market incurred higher percentage of loss, which was 62.43 per cent of the total loss in quantity and 64.63 per cent of the total value lost, whereas Itanagar market only

accounts for 37.57 per cent and 35.37 per cent in volume and value terms in both the markets, respectively.

23. Around 6.74 per cent of the total apples purchased were lost and the value was 6.84 per cent of the total value purchased at the retailer's level. Average loss was 281.67 kg per retailer and the average loss in value was Rs. 10,235 per retailer in an apple season.

24. The highest average loss recorded in the study at Tezpur market at different activities was highest during sales and distribution (2340 kg per wholesaler). The loss can be attributed to perishable nature of the apple and with time the fruit gets damaged. Tezpur market accounted for 66.27 per cent of the total loss at retailer's level.

Policy implications

1. Restructuring and modernization of the supply chain of apple in Arunachal Pradesh in terms of credit supply, market linkages, cold storage structures, etc.
2. Strengthening Market Intelligence delivery system on Private Public Partnership mode relating to financial resources, logistical needs and other facilities involved in supply chain of apple.
3. Establishing processing units near the producing areas will minimise the loss of apple in Arunachal Pradesh tremendously.

References

CHAPTER-VII

REFERENCES

ANDREW FEARNE, 1994, Building effective partnership in the meat supply chain: Lessons from the UK, *Can. J. Agric. Econ.*, **46**: 491-518.

ANONYMOUS, 2010, Department of Horticulture, West Kameng district, Government of Arunachal Pradesh.

BABU LAL MEENA, D.C. PANT, AND J.D. SHARMA, 2004, Practices and Channels of Guava in Udaipur District of Rajasthan, Indian Journal of Agricultural Marketing, **19**(3)68-80.

BIRADAR, R. D., 1996, Margins and price spread of selected Agricultural commodities in Kolhapur District, Maharashtra, *Agricultural Marketing,* **38** (4): 21-28.

BUURMA, E. S. AND BOSELIE, D.M., 2000, Stakeholder perception analysis for Agri- Supply Chain development. *Acta. Hort.*, **536**: 625-633.

CHUNG, PARRYLHSIUNG, L.U. AND CHUNHSEN., 1998, Domestic marketing channels of furniture in Taiwan. *Quarterly Journal of The Experimental Forest of National, Taiwan University*. **12** (4): 251-267.

FEARNE, A. AND HUGHES, D., (1999), "Success factors in the fresh produce supply chain: insights from the UK". *Int. J. Supply Chain Management*, **4** (3):120-129.

JULIE KENETT., MURRAY FULTON., HARVEY BROOKES AND PAULINE MOLDER., 1994, Supply chain management in cereal grains: A case study from the US milling wheat industry. *Can. J. Agric. Econ.*, **46** : 549-558.

KAHLON, A.S. AND SINGH, B., 1968, "*Orientation of Pome and Stone fruits Market structure to the expanding Volume of fruit production in Kullu and Parabathy Valleys*", Department of Economics and Sociology, Punjab Agricultural University, Ludhiana, Punjab.

KAHLON, A.S. AND SINGH, K., 1968, Marketing of grapes in Punjab:, *Agricultural Marketing*, **10**(4): 2-4.

LARS FEK., 1998, Understanding modern cold chain. *Food Packers*, **52** (1): 59-62.

MEHTA, P. AND GUPTA, J.R., 1970, Co-operative marketing of apples in Kullu Valley, *Agricultural Marketing*, **13**(2): 1-9.

NARAYANA REDDY, P., 2004, Efficiency benefits pass on to consumers: New development in retail market environment in India, *Indian Journal. Marketing*, **34:** 23-25.

NATIONAL HORTICULTURE DATABASE, 2010, Ministry of Agriculture, Government of India, **2**: 29-35

RAGHUBANSHI, C.S., 1971, Marketing of Hill Capsicum in Saproon Valley, Himachal Pradesh, *Agricultural Marketing*, **13**(4): 6-10.

RAJESH K. RANA, AND ET EL., 2002, Estimation of Post-harvest losses in Kinnow Marketing in India, Indian Journal of Agricultural Marketing, **19**(3)92-102.

RANDEV , A.K., 2002, Marketing of Apple in Shimla District of Himachal Pradesh, *Indian Journal of Agricultural Marketing, September-December, 2005.,* **19** (3) 11-19.

RICKS DONALD., TIMOTHY WOODS., AND JAMES STERN., 1999, “Supply Chain Management Improving Vertical Coordination in Fruit Industries”. *Food Distribution Resources*, **30** (3): 44-53.

SAI KUMAR KRISHNAN, 1979, An Analysis of Problems in Marketing Apples in selected towns of Karnataka, Department of Agricultural Sciences, University of Agricultural Sciences, Bangalore.

SIDHU, H.S. AND KAHLON, A.S., 1967, Marketing of Apples in Kullu Valley, *Agricultural Marketing*, **10**(2): 5-7.

SINGH, B. AND MEHTA, P., 1969, Effective Marketing of Apples, *Agricultural Marketing*, **12** (2): 8-10.

SINGH, C. B. AND SHARMA, S. P., 1983, Management of milk procurement at the village by co-operative, private and public sector organisation - A case study. *Agricultural Marketing*, **25** (4): 11-17.

SINGH, H. AND RAGHUBANSHI, C.S., 1977, Marketing of Apples, *Indian Journal of Marketing*, **7**(7): 11-16.

SREENIVAS MURTHY, D., GAJANANA, T.M., SUDHA, M. AND DAKSHINAMOORTHY, V., 2006, Marketing Losses and their impact on marketing margins: A case study of banana in Karnataka. *Agricultural Economic Resources Review*, **20** (1): 49-60.

THAKUR, D.S. AND JOHL, S.S., 1969, Channels, functions, prices, margins and costs of marketing of apples in Himachal Pradesh, *Journal of Research*, **6**(2): 496-498.

THAKUR, D.S., 1971, Marketing of Apples (*Malus pumila*) in Mahasu district of Himachal Pradesh, *Indian Journal of Agricultural Sciences*, **41**(7): 619-626.

THAKUR, D.S., 1973, Pricing efficiency of Indian Apple market, *Indian Journal of Agricultural Economics*, ***28***(1): 105-114.

UDAYA, P., 2002, Marketing management of pesticide in Raichur district. *M.Sc. Thesis,* University of Agricultural Sciences, Dharwad (India).